

FINAL DRAFT

Taxi Drivers and Road Safety

*A report to the
Federal Office of Road Safety*

by

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EXECUTIVE SUMMARY

This report examines aspects of taxi driver road safety in three parts: first, a study of N.S.W. data concerning taxi accidents from 1993-1995; second, a survey of Sydney metropolitan taxi drivers regarding job-related variables, attitudes, fatigue, personality and driving behaviour, together with accident details; and third, qualitative responses from taxi drivers about their working conditions and experience of the profession.

In part one, based on N.S.W. Roads and Traffic Authority accident data, overall trends in Sydney metropolitan taxi accidents are discussed, with results including analysis of accidents by severity, age, time of day, day of week, and month of the year. The major findings indicate that taxi accidents do not differ markedly in severity from an appropriate general public comparison group, but that taxi accidents differ from the public in terms of both age and time measures. Taxi accident rates are most elevated at the end of weekend night shifts, suggesting a “black time” (Folkard, 1996) that results from the combined effects of long shift hours with the natural low point in the human circadian rhythm. Concerning types of accidents, collisions with pedestrians are over-represented among taxi drivers, particularly accidents that result in fatalities and serious injury.

In part two, based on a survey of 165 Sydney taxi drivers, detailed analysis of the factors associated with accidents is presented. In addition, basic data concerning issues such as work patterns, attitudes, fatigue and personality are provided.

The major findings indicate that anger and risk-taking are important predictors of taxi driver accidents, with increased anger expression and increased risk-taking being related to a greater likelihood of involvement in accidents. Average length of shifts and vehicle type were also significant predictors of accident involvement. (Comment: Where does driving style fit in - isn't it a significant predictor of crash rates?) Once these four variables are taken into account, many other factors normally assumed to be responsible for taxi accidents, such as age, time holding a car or taxi license, kilometres travelled, employment type, shift type, etc. were not significant predictors of accidents. While risk-taking was a significant predictor of accidents, optimism concerning one's driving abilities was found to be unrelated to both risk-taking and accidents. Taxi drivers with sleeping problems were found to be much more likely to have fallen asleep at the wheel than other drivers, although overall rates of this occurrence are low. Aggression and sensation seeking were both found to be related to risk-taking, although economic pressures are suggested as an additional factor in taxi driver risk-taking. Finally, taxi drivers work long hours

per week (58 hours average total work), but do not seem to earn high levels of income.

In part three, based on feedback from surveyed taxi drivers and others, information concerning the nature of the job, together with discussion of problems within the taxi industry are presented.

On the whole, taxi drivers are profoundly negative about their working conditions and the structure of their industry. Particular problems include lack of driver safety, low earnings and lack of community respect. While these problems are specific to the experiences of Sydney taxi drivers, they illustrate systemic problems within the taxi industry that may be common elsewhere. A paragraph or two on what the research suggests in terms of countermeasures and improvements within the taxi industry might go well here.

The most important theoretical development of this study is the finding concerning risk-taking and optimism about driving. Previous theories have assumed that individuals with an optimistic view of their driving abilities are likely to take more risks while driving due to over-confidence and perceived invulnerability. This increased risk-taking ironically leads to increased accident rates due to over-estimation of driving skill. The current study found that while “optimism bias” is common among taxi drivers, it is unrelated to actual risk-taking while driving, and is also unrelated to accident rate. However, risk-taking itself (caused, in part, by aggression, sensation seeking and need for income) is a significant predictor of accident involvement. Consideration is given to ways of reducing anger and risk-taking among taxi drivers, and speculation concerning the differential effects of optimism bias on both experienced (taxi drivers) and inexperienced (young) drivers is presented.

Introduction

While recent years have seen a growing body of road safety research from the perspectives of both engineering and psychology, little research concerning taxi drivers has been reported. Taxi drivers are an important group for road safety research, both because of their role in modern transport systems, and due to controls inherent in the nature of the job which are not normally available in general road safety research. Unlike studies of the public, research on taxi drivers can make use of the fixed shift patterns, standard vehicle types, specific areas of driving and so on to limit the confounding factors in analysis of predictors of accidents. The current project utilised these controls to study taxi driver road safety.

CHAPTER 1: INTRODUCTION AND BACKGROUND

1. GENERAL INTRODUCTION TO PSYCHOLOGICAL APPROACHES TO ROAD SAFETY

Road trauma is one of the major causes of death within modern society. It is also a source of enormous financial loss when all aspects of road trauma are considered, such as insurance, treatment of injury, loss of productive capacity, investigation by police, loss of productivity due to traffic delays, etc. While road safety research is a growing field, there is still much work to be done in understanding the causes of motor vehicle accidents, and in developing possible preventative measures that would avoid or minimise accidents.

Effective solutions to road trauma require the input from the fields of both engineering and psychology. However, there are many difficulties presented to any researcher who wishes to examine psychological issues in road safety, and these include: lack of control for driver exposure, lack of control for driver experience, difficulties in observing actual driving behaviour, and the problems associated with recording and analysing accident and violation rates. All of these factors combine to create major methodological problems for basic research into the psychological dimension of road safety.

However, a greater understanding of psychological issues in road safety is critical if we are to develop a comprehensive understanding of the causal factors leading to motor vehicle accidents, and hence develop preventative measures. Engineering solutions to road safety issues (such as, for example, the “Intelligent Cruise Control System” proposed by Chira-Chavala & Yoo, 1994) are not sufficient on their own due to the complex relationship between engineering solutions and psychological factors (Underwood, Jiang, & Howarth, 1993). This problem is worth illustrating with the following two brief examples: first, the introduction of greater vehicular safety features (eg, air bags, anti-locking breaks, crumple zones, etc) may actually lead to increased accident rates, due to the fact that some drivers assume that the greater safety features of the car allow them to take more risks on the road (Wilde, 1982). Second, attempts to create physiological devices that alert drivers to effects of excessive fatigue (Mittler, 1996), such as those being developed for truck drivers, may actually become counter productive, if, as a result of having such devices, drivers continue driving when they are subjectively experiencing excessive fatigue (Brown, 1994), but have not yet been alerted by the (reasonably error-prone) fatigue device on which they are relying. In each of these two examples, the problem is that a psychological reaction to an engineered safety solution may ultimately result in greater risk-taking than previously, and hence increased, rather than decreased, accident rate. A more general theory of this kind relating risk-taking to broad

trends in driver behaviour, known as “risk homeostasis”, has been developed in detail by Wilde (1982, 1985). (Comment:- I believe the jury is still out on risk homeostasis)

Thus, research into the psychological aspects of driving behaviour is essential to an overall approach to road safety issues. However, the problems of conducting such research are not easily addressed. Controlling for the effects of experience and exposure within studies of the general population is extremely difficult (Brown, 1982), and the analysis of actual driving behaviour and accidents is also fraught with problems. One way of attempting to compensate for these problems is to limit the scope of research to groups of road users that allow for more careful study of psychological factors. An example of this approach that has been successful is the study of long distance truck driving (Hamelin, 1987). As a result of job-related “in-built” controls of exposure, and the opportunity for more careful recording of other data, such as experience and crash rates, it has been possible to gain a more detailed and accurate picture of road safety issues within this group than is usually possible in general studies.

Another group that presents similar driving-related controls, but within a very different context, is taxi drivers. The usefulness of general findings concerning the role of psychological factors in road safety from studies of long distance truck drivers are limited by the facts that the vehicles used are radically different to the average motor vehicle, and that the type of driving is also different to that of the average metropolitan motorist. However, taxi drivers, as a group, share more in common with the average motorist than truck drivers in terms of the type of vehicle driven and the location and nature of driving. For this reason, the careful study of taxi drivers may be of considerable value to general road safety research.

2. ROAD SAFETY AND THE STUDY OF TAXI DRIVERS

Research into taxi drivers is not just valuable because of its possible usefulness to general road safety research, it is also valuable in its own right. Taxi drivers play a crucial role in the social and economic function of modern society. Their contribution to the day-to-day operation of the business world and tourism are of considerable significance, as is their general social function as a means of transport for those who are unable to use other modes of public or private transport. In terms of general road safety, the use of taxis is a key alternative to drink driving, and hence taxis provide a service of potentially great indirect benefit to overall road safety.

Unfortunately, taxi drivers themselves have been the subjects of little published research, and despite their worldwide significance within modern society, there is little literature available. Where they have been the subjects of research, the majority of studies have exhibited little systematic interest in the

issues that taxi drivers face in their day-to-day working conditions, but rather have used taxi drivers as subjects for the study of particular issues of interest to the researchers. Examples of this can be seen in research into physiological factors in driving (Corfitsen, 1993; Lisper, Laurel & Stening, 1972), reaction time studies (Babarik, 1968), driving simulator studies (Edwards, Hahn & Flieshman, 1977), and personality studies (Strelau, 1975; Tillman & Hobbs, 1949). This is not to be unduly critical of these researchers' work, as these studies of taxi drivers contribute to our overall knowledge, but it is important to point out the need for more comprehensive research of taxi drivers as a unique group of road users. This research needs to examine a broad range of factors, such as job-related variables, risk-taking and optimism bias, fatigue, and personality.

There are a few studies of taxi drivers that are worthy of more substantial discussion at this point. Edwards, Hahn & Flieshman (1977) examined the relationship between actual driving and driving simulator performance for taxi drivers, but found few connections between these measures. Koh, Ong and Phoon (1986) conducted a study of taxi drivers based mainly on physiological measures, but were unable to find any much evidence of differences between accident-prone (three or more accidents) and non accident-prone (no accidents) based on a 15 month study period. It is disappointing that this study was unable to find any firm indicators of accident-proneness for taxi drivers, but this may be due to the relatively minimal contribution of basic physiological processes in accident causation. A study which examined more complex processes in an ecologically valid way, such as complex reaction time task in a form relevant to taxi driving abilities, or, for example, a study of the effects of fatigue on peripheral vision, may have produced significant relationships (although each of these suggestions are speculation by the current authors, based on anecdotal evidence).

A third important study is that recently published by Burns and Wilde (1995), in which the researchers made use of behavioural measures of actual driving by taxi drivers (through covert recording during a predetermined trip), followed by subsequent questionnaires that included the Sensation Seeking Scale Form V of Zucherman (1994). Their findings indicate that sensation seeking is related to risky driving behaviours such as driving at excessive speeds and careless lane changing, and also to violation rates, but not to accident rates. They also found no relationship between observed driving behaviours and accident rates. While there are several possible reasons for the lack of relationships with accidents rate, problems in accident recording and a small sample size may have obscured an otherwise weak effect. For this reason, it was decided to re-examine sensation seeking in the current project to further explore its importance in taxi driver road safety.

In summary, the existing literature, while sparse, does provide some interesting possible "leads" for researchers interested in this group of road users. In 1993 we conducted a small but revealing study on Sydney taxi drivers which

formed the basis of the current study and which produced several interesting findings of its own. Hereafter this study is referred to as the “1993 study”.

3. DALZIEL AND JOB’S RESEARCH ON TAXI DRIVERS PRIOR TO THE CURRENT PROJECT

In 1993 a study into a broad range of factors associated with taxi driving and crash rates was conducted, based on a group of 42 drivers from a small regional taxi cooperative within the Sydney metropolitan region (Dalziel & Job, 1994, 1996, 1997). The ideas used in the design of this study evolved from reflections on 5 years of part-time work as a taxi driver by one of the current authors (JD). This study not only examined factors of psychological interest (such as optimism bias), but included questions on a variety of job-related variables, such as vehicle type, preferred work patterns, use of breaks, etc.

In the first of the subsequent papers on this study (Dalziel & Job, 1994), it was found that optimism bias was present for a variety of road-related events, and that taxi drivers as a group believe that they have superior driving abilities to the average motorist. It was also found that the relationship between optimism bias and accident involvement was more complex than previously considered, and that optimism bias may not actually be a cause of accidents, but rather a separate process.

In Dalziel and Job (1996), an examination of the role of fatigue related variables in the work of taxi drivers was presented, based on the 1993 data. This study has subsequently been revised and recently published (Dalziel & Job, 1997). This paper provided basic data on the working conditions of taxi drivers, including the long hours of work completed by most drivers each week (average of 60 hours per week of total work, ie taxi driving plus other work where relevant). It also noted that while optimism bias was present regarding the “ability to drive safely when very tired”, drivers exhibited significantly less optimism concerning this statement than other “skill based” driving abilities, such the “ability to drive safely at high speed”. While this is an interesting finding, the reasons for it were unclear.

Thus, the work presented to date has some interesting findings regarding psychological factors and road safety in taxi drivers, and suggests the possibly “profitable” nature of further research of this kind. However, the small sample size and lack of other research elsewhere in either Australia or internationally argues for the need for ongoing research into this area. In addition, the feedback and experience gained from this initial study suggested many improvements that could be developed in a future broader study, and it was on this basis that the current study was funded by the Federal Office of Road Safety.

This report has been divided into three main sections: first, the “big picture” - an overview of all taxi driver accidents recorded by the N.S.W. Roads

and Traffic Authority accident database during recent years; second, the “in-depth” analysis of taxi driver road safety - the results of the survey of individual drivers; and third, the “personal thoughts of taxi drivers” - a discussion of qualitative data collected during this project. It is the second section which represents the bulk of this report, and is the development of the previous work discussed above.

4. AIMS OF THIS RESEARCH

This research has six specific aims, which are based on those presented in the original grant application, and include an additional aim of studying the role of general personality traits in taxi driver road safety (5). This additional aim arose due to the findings of Burns and Wilde (1995) regarding the role of sensation seeking in taxi driver behaviour, and due to anecdotal evidence regarding driver behaviour that suggested the value of including a measure of aggression (such as Buss & Perry, 1992). The six aims are listed below.

- (1) To examine the relationship between attitudes and accident rates, specifically, to test the hypothesis that risk taking and optimism bias are related to increased accident rates.
- (2) To examine the relationship between fatigue-related variables and accident rates, specifically to test the hypothesis that increased time on the road and decreased periods of rest are related to increased accident rate.
- (3) To examine the relationship between driving behaviour and accident rate, specifically, to examine differences between accident versus non-accident drivers in terms of attitudes, experience and exposure variables.
- (4) To examine the effects of a variety of job-related variables (e.g. distance covered, number of breaks, type of car, etc.) on accident rate.
- (5) To examine the relationship between general personality traits and accident rate, specifically, to test the hypothesis that increased levels of both sensation seeking and aggression are related to increased accident rate.
- (6) To explore systematic patterns within attitude, experience, personality and job-related variables, specifically, to examine interactions between the above variables that impinge on road safety.

Part 1: “The Big Picture” - Accidents in N.S.W.

The following section presents some broad trends in taxi driver accidents, based on analysis of data held by the Roads and Traffic Authority of New South Wales. While the scope of this analysis is limited by the small number of comparison variables available within the R.T.A. records, its breadth is considerable, as it includes all accidents involving either injury or the towing of at least one vehicle during 1993, 1994 and 1995 for N.S.W. In an attempt to provide appropriate comparisons, the taxi driver accident data have been limited to only those accidents that occurred within the Sydney metropolitan region (the focus of the current study), and for comparison of these accidents with the general public, only general public accidents that occurred within this region, and involved vehicles of a similar type to taxis have been used.

CHAPTER 2: ROADS AND TRAFFIC AUTHORITY TAXI ACCIDENT DATA

1. INTRODUCTION

Within New South Wales, the Roads and Traffic Authority (R.T.A.) maintains a comprehensive accident database which records fatal, serious and minor injury accidents, as well as any accidents involving the towing of at least one car. Statistical information regarding motor vehicle accidents is published yearly, and provides an excellent starting point for an understanding of some of the major patterns in the occurrence of accidents.

As this database records all vehicular accidents within the state, it includes all accidents involving a taxi vehicle. Fortunately, as taxis have different car license plates to all other cars (of the form "T 0000" with ascending numbers, rather than "AAA 000" with ascending letters and numbers, as used with other vehicles), it is possible to examine the accidents involvement of just taxi vehicles by examining only those accidents involving a vehicle with a "T" license plate. If a researcher were to obtain data from the R.T.A. accident database for only "T" plate accidents within the Sydney metropolitan area, it would be possible to examine the patterns of taxi driver accidents for a large modern city on basic variables such as age, time, date and location. In terms of the current study, this would make an ideal backdrop to a more intensive study of drivers using a survey instrument.

There are obvious limitations with a study of an accident database of this kind. While a database may be prone to small errors in reporting due to the methods of collection (mainly police reporting), the broad general trends would still be worthy of examination. In terms of traffic psychology, there is very little scope for the study of individual differences as predictors of accident involvement beyond the most basic variables, such as age, due to the limited information about drivers kept with the accident data. Many other variables that would be of interest (such as time holding a car license, or time holding a taxi license) would require a direct link between licensing and accident databases, and this is not available in the current context. However, it is possible to examine the role of factors such as age, gender, time of day, day of the week, month of the year, and location with the available data. It would also be possible to relate accidents to a "typical" day and night shift, based on the standard times of these shifts.

One further important consideration is the relationship between R.T.A. taxi accident data and all taxi driver accidents. The accidents recorded by the R.T.A. represent only the more serious types of collisions that can occur on the road, that is, fatal accidents, serious and minor injury accidents, and accidents involving the towing of at least one vehicle. Any minor accident that did not

involve a fatality, injury or towing would not be included here. While it is difficult to speculate on the relationship between the more serious accidents examined in the R.T.A. data presented here and the total pattern of all taxi driver accidents (including minor accidents), the study of more serious accidents is of value in its own right due to the outcomes of such accidents.

While there are numerous controls or comparison groups that could be employed to assist the interpretation of this kind of data, many of these are difficult to obtain. One possible “control” would be to compare the accidents of taxi drivers within the Sydney metropolitan area with the accidents of “taxi-like” vehicles for the same area. In the current context, it would be possible to compare accidents involving taxi vehicles with accidents involving cars or light trucks (an example of a vehicle in the “light truck” category is a small van) but excluding taxi accidents, for the Sydney metropolitan area. While this comparison is only of limited value as a strict control variable, it does at least provide some basis for comparison that is of practical use. (comment : light trucks, vans etc may have significantly different handling and braking characteristics to cars; a control group made up of just cars may be more appropriate. It may be worth checking, if possible, whether the light truck crashes are broadly representative of the 'public' crashes analysed.)

Analysis of the above data that would be of value includes: urban versus regional taxi accidents, accident severity across the years of study for both taxi drivers and the public (“public” in this chapter will be used as shorthand for “cars and light trucks, excluding taxi vehicles, for the Sydney metropolitan region”), taxi and public accidents by age, taxi accidents by gender, taxi and public accidents by time of day, day of the week and month of the year, taxi accidents based on “typical” shift times, and an analysis of road use movement at time of impact for both taxi and public accidents. Road use movement does not describe fault or blame, but simply lists the “type” of accident based on the movement of the vehicles at impact. Descriptions of relevant codes is presented in the results.

2. METHOD

Through the assistance of the R.T.A., summary information about taxi driver accidents was obtained on the following variables: location comparing Sydney to the rest of N.S.W., accident severity by year, age (by R.T.A. categories), gender, time of day (in hourly units), day of the week, month of the year (total per month, and divided by taxi shift times, ie, 3am-3pm day shifts, and 3pm-3am night shifts), and location by local government area. From these data it is also possible to derive accident patterns for a “typical” day and night shift, although these figures are complicated by the minority of drivers who do not work within the normal shift times (drivers working a “semi-double”, that is,

a shift with starting and finishing times that cut across normal day and night shift times - such as 9am to 9pm).

It was also possible to gain summary information on the same variables listed above for all accidents involving a car or light truck that occurred within the Sydney metropolitan area, excluding taxi drivers. Data were obtained for accidents involving a taxi vehicle and accidents involving a car or light truck (excluding taxi vehicles) for 1993, 1994 and 1995 (1995 was the most recent yearly data available at the time of this study). In order to gain the most reliable estimate of general trends, accidents were averaged within each category across the three year period. Where this averaging was not performed, the results for individual years are presented.

3. RESULTS

3.1 Accidents by location within state

The R.T.A. accident database lists accidents involving a taxi vehicle by location within the state using the broad categories listed in table 1. The vast majority of accidents involving taxi drivers occur within the Sydney metropolitan region, and very few accidents occur in non-urban areas. In all of the tables and figures following table 1, only accidents from the Sydney metropolitan region have been used.

Taxi Accidents by area	Sydney Met. Area	Newcastle Met. Area	Wollongong Met. Area	Country Urban	Country Non-Urban	Country Unknown	Total
Average Accidents per year	1563.3	45.0	22.0	115.7	4.7	3.3	1754.0
Percentage	89.1	2.5	1.3	6.6	0.3	0.2	100.0

Table 1: Averages and percentages of total accidents involving a taxi vehicle averaged across 1993, 1994 and 1995 across N.S.W. state regions.

3.2 Accidents by severity

Table 2 shows total accidents and percentages by severity for both taxi drivers and the general public for 1993, 1994, and 1995. Note that the figures for taxi drivers are based only on taxi accidents in the Sydney metropolitan area, and that the general public figures are based only on accidents involving cars

and light trucks (excluding taxi vehicles) within the Sydney metropolitan area. Figure 1 compares relative percentages by severity for each group averaged over the three years examined. All data following table 2 reports only averages across the three years studies (1993, 1994, and 1995) rather than presenting data by individual years, and reports only total accidents, rather than by individual severity categories (due to the low values observed in many cases).

YEAR	TAXI	PUBLIC	% TAXI	% PUBLIC
1993				
Fatal	4	209	0.2	0.4
Serious Injury	90	2898	5.6	5.8
Other Injury	406	11772	25.1	23.5
Towaway	1118	35209	69.1	70.3
Total	1618	50088	100.0	100.0
1994				
Fatal	4	227	0.2	0.4
Serious Injury	92	3048	6.1	5.9
Other Injury	368	12454	24.3	24.2
Towaway	1051	35671	69.4	69.4
Total	1515	51400	100.0	100.0
1995				
Fatal	3	235	0.2	0.4
Serious Injury	105	3141	6.7	5.9
Other Injury	398	12336	25.6	23.3
Towaway	1051	37376	67.5	70.4
Total	1557	53088	100.0	100.0

Table 2: Totals and percentages for accidents by severity for those involving a taxi vehicle in the Sydney metropolitan area compared to those involving a car or light truck (excluding taxi vehicles) for the Sydney metropolitan area for 1993, 1994, and 1995.

Figure 1: Accident severity as a percentage of the total accidents for each group within the Sydney metropolitan area, averaged over 1993, 1994 and 1995, for accidents involving a taxi vehicle and accidents involving a car or light truck (excluding taxi drivers) respectively.

3.3 Accident by age

Figure 2 compares relative percentages of accidents by group according to age for taxi driver accidents compared with car and light truck accidents. It should be noted that these data are based on absolute figures within each category, and have not been adjusted for the relative percentage of drivers per age category.

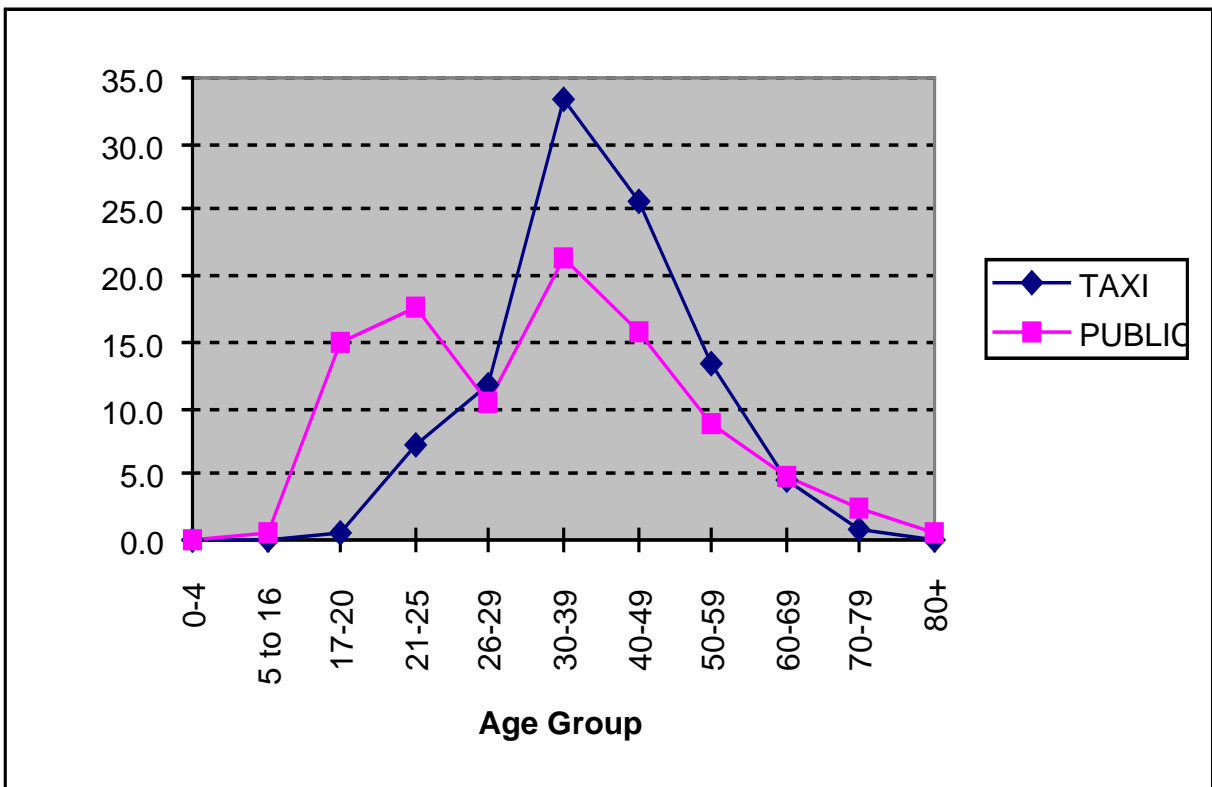


Figure 2: Percentage of total accidents by age group for taxi drivers compared to the public for the Sydney metropolitan area, averaged across 1993, 1994 and 1995.

3.4 Accident by gender

While the vast majority of taxi drivers are male, a small number of female drivers do work within this industry, and hence are represented within the R.T.A. figures. Table 3 lists the percentage of total accidents involving a taxi vehicle by severity and gender. Figures are not reported for the general public due to the large discrepancy between the public and taxi drivers in gender composition.

ACCIDENT SEVERITY BY GENDER	MALE	FEMALE
Fatal	0.2	0.0
Serious Injury	6.0	0.0
Other Injury	24.2	0.4
Towaway	67.8	1.3
Percentage of Total Accidents	98.3	1.7

Table 3: Accident severity by gender as a percentage of the total accidents involving a taxi vehicle, averaged over 1993, 1994 and 1995.

3.5 Accident by time of day

Figures 3 and 4 show the pattern of accidents (as percentages of total accidents for each category) by hours as averaged across weekdays (figure 3) and weekends (figure 4). It should be noted that these data do not control for changes in the proportion of taxis to other vehicles on the road at any given time. This is an important consideration as the number of taxi vehicles on the road does not vary to a great extent due to the nature of the work shifts (although reduced numbers are common between 1am and 5 am), but the number of cars and light trucks varies considerably, mainly due to the two “rush-hour” periods of 7am-9am and 5pm-7pm.

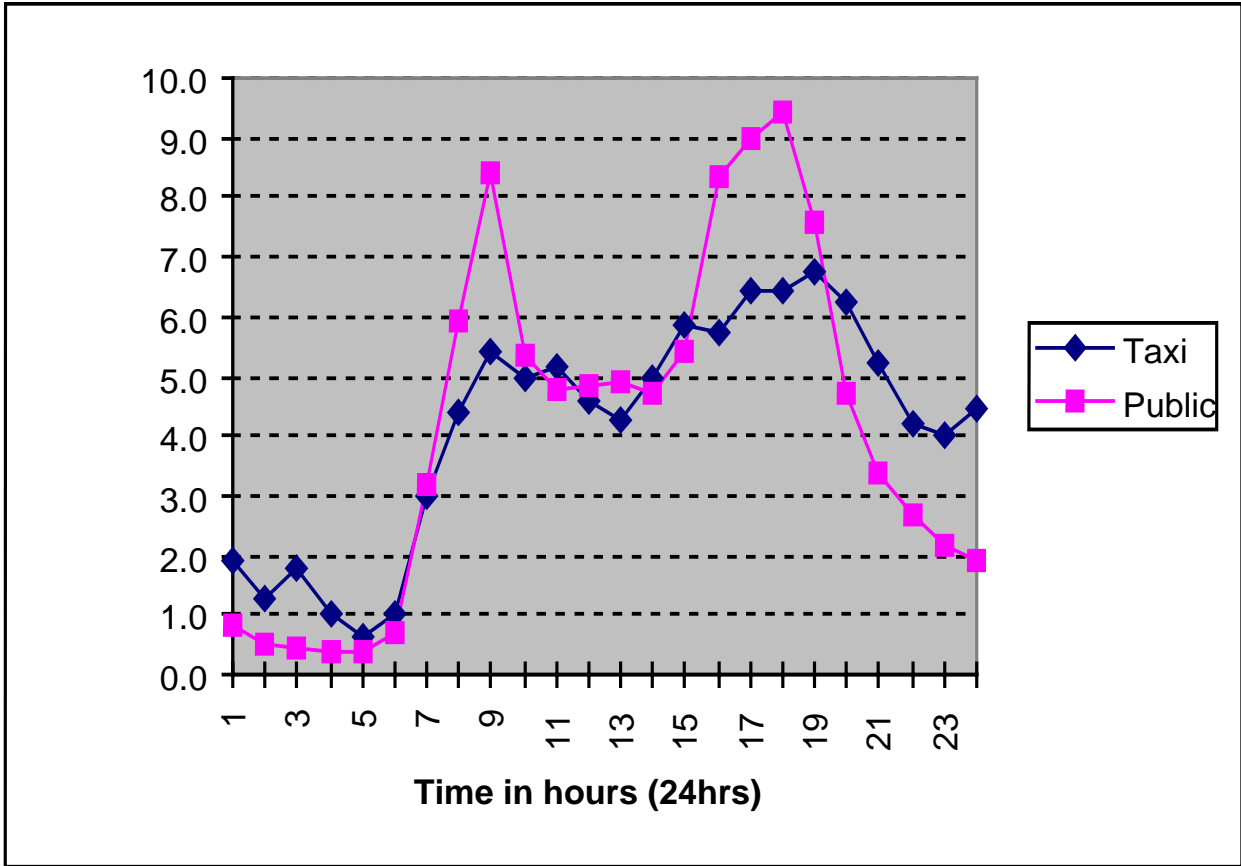


Figure 3: Average total accidents (as expressed as a percentage of total accidents within each group) by time of day in one hour units (24 hour clock) for all weekdays (Monday to Friday) for those involving a taxi vehicle in the Sydney metropolitan area compared to those involving a car or light truck (excluding taxi vehicles) for the Sydney metropolitan area averaged across 1993, 1994, and 1995.

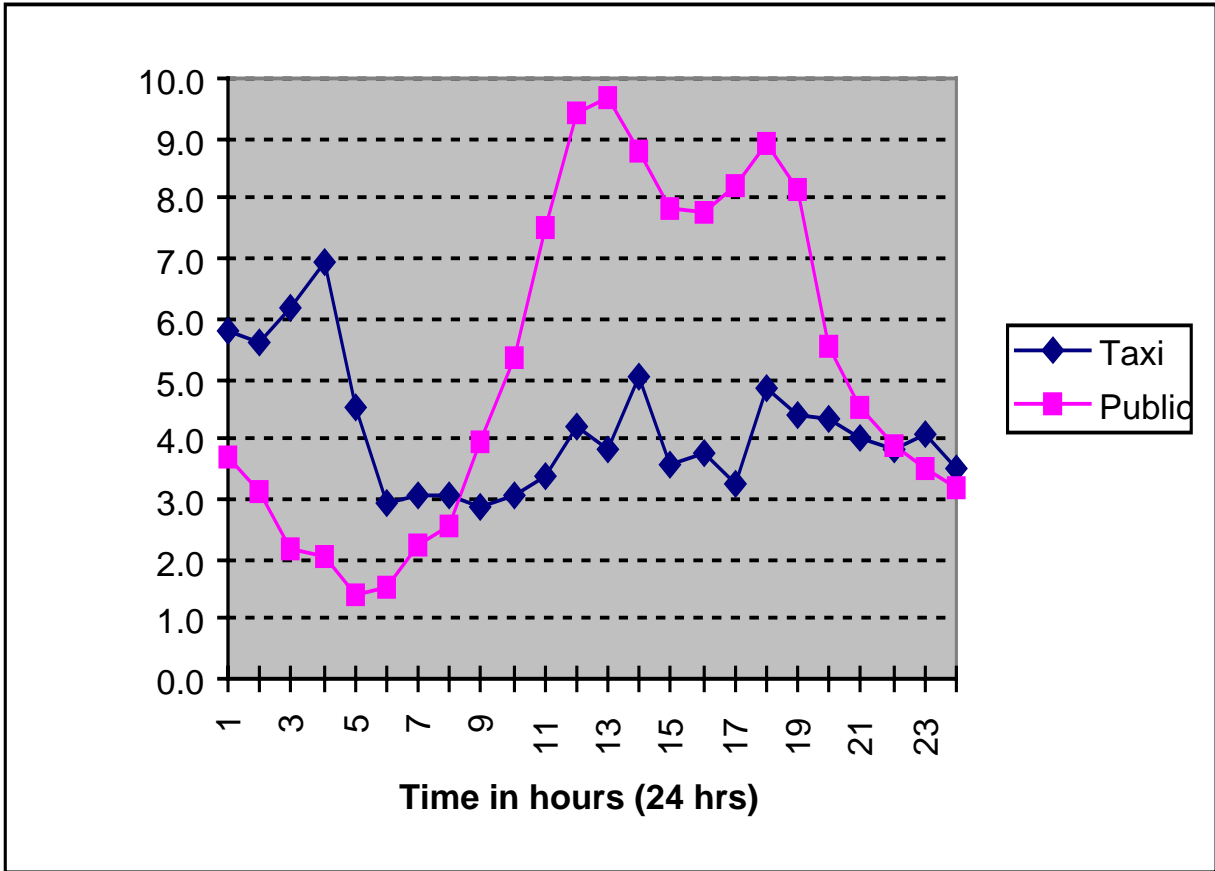


Figure 4: Average total accidents (as expressed as a percentage of total accidents within each group) by time of day in one hour units (24 hour clock) for weekends (Saturday and Sunday) for those involving a taxi vehicle in the Sydney metropolitan area compared to those involving a car or light truck (excluding taxi vehicles) for the Sydney metropolitan area averaged across 1993, 1994, and 1995.

3.6 Accidents by hour of shift

Day shift starting and finishing times are fixed at 3am and 3pm, and night shift starting and finishing time are fixed at 3pm and 3am respectively. However, few drivers from either shift period work the full 12 hours due to lack of work during the early hours of the morning. Average day drivers typically begin their shifts around 5am to 6am, and most end at 3pm, while most night shifts begin at 3pm, and the average night driver finishes between 1am and 2am on weeknights, or 2am and 3am on weekends. Thus, to calculate an approximate distribution of accidents by “stage during the shift”, that is, the number of accidents during each hour since the shift began, it is necessary to use the information given above, divided into weekdays and weekends. Figures 5 and 6 present data based on day

shifts starting at 5am and finishing at 3pm, and night shifts starting at 3pm and finishing at 2am for weekdays and 3am for weekends. It should be noted that drivers who work “semi-doubles” (that is, shifts which do not start and end at the normal shift times, but cut across one of the common end/start times) cannot be accounted for in this approach, and therefore add some amount of error to the data presented in figures 5 and 6

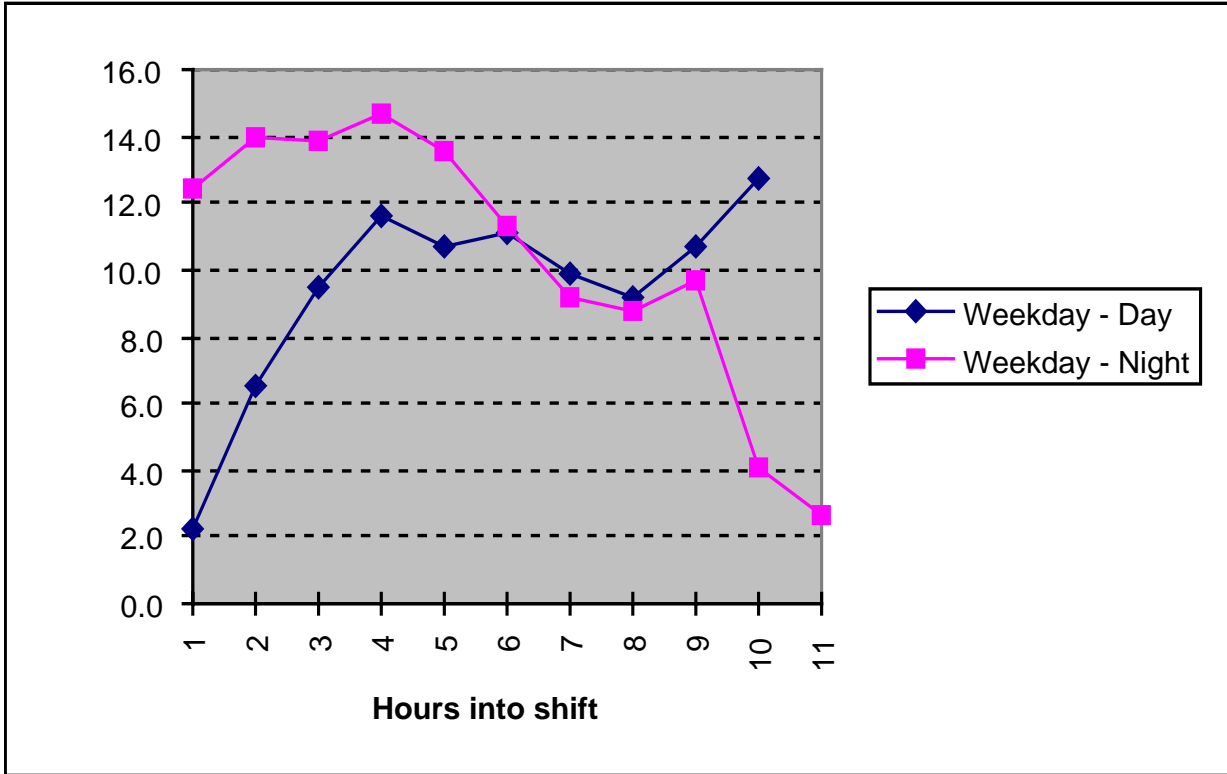


Figure 5: Total number of accidents involving a taxi vehicle by hour into shift for the average weekday shift for typical “day” shift times (5am to 3pm) and typical night shift times (3pm to 2am).

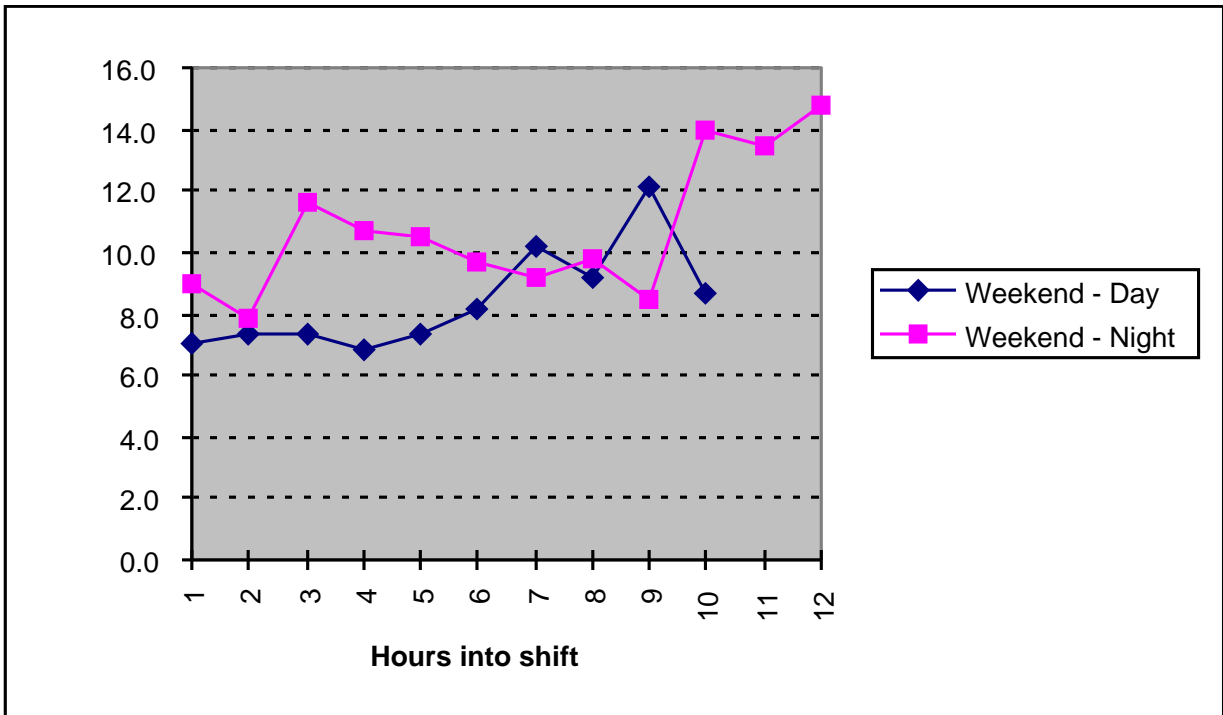


Figure 6: Total number of accidents involving a taxi vehicle by hour into shift for the average weekend shift for typical “day” shift times (5am to 3pm) and typical night shift times (3pm to 3am).

3.7 Accidents by month

Figure 7 presents the percentage of total accidents by month for both taxis and the public. As the number of days per month is equal for each comparison (eg, taxi January to public January), no correction has been made for unequal days per month. While yearly work patterns for day drivers are relatively stable, work patterns for night drivers exhibited seasonal variations, based on lower levels during the middle of the year, and higher levels approaching Christmas. Both day and night shift work patterns are low in January due to holidays. For this reason, the data presented for taxi drivers in figure 7 is split by shift times and represented in figure 8. To aid in comparison, the same data for the general public has been split by taxi driver shift times to examine any systematic variation between day and night shift times within the general public, and table 9 notes the percentage of total yearly accidents for each group when divided by the time periods used for taxi shifts.

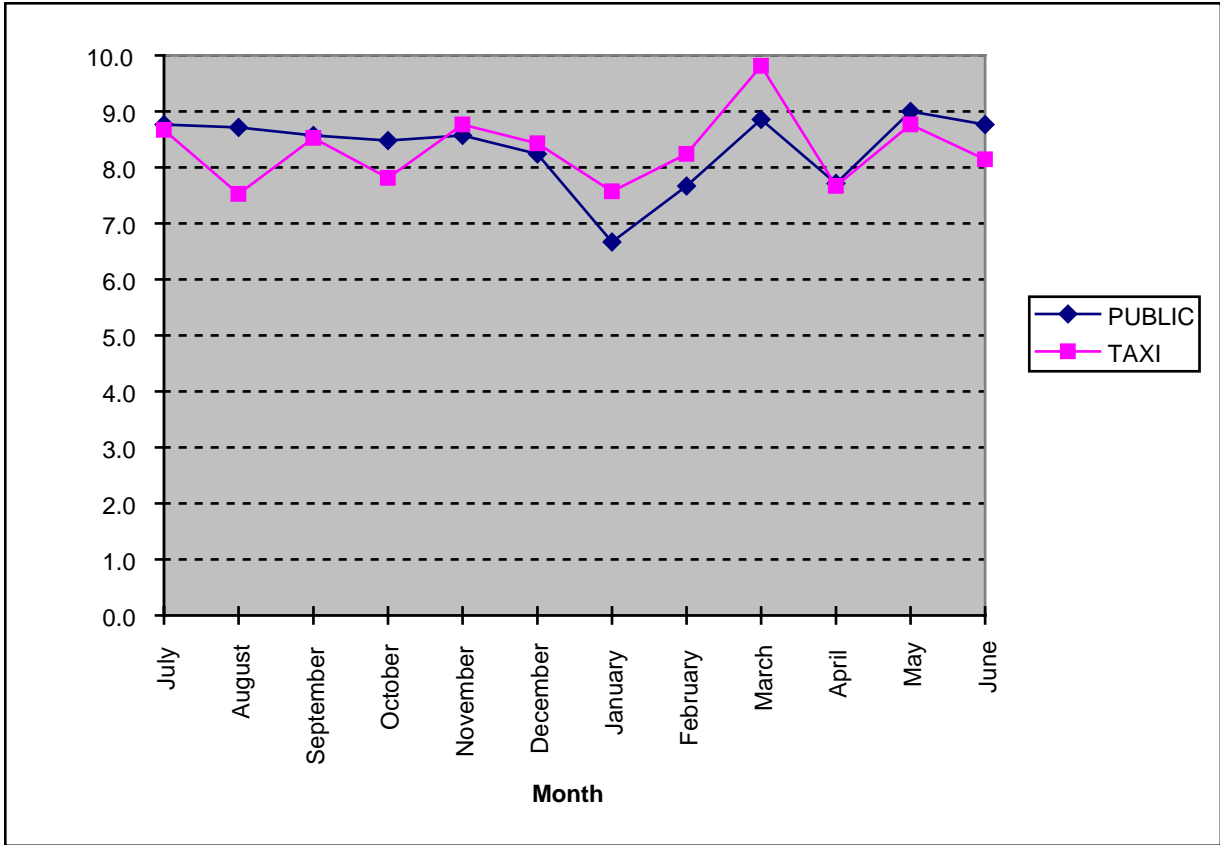


Figure 7: Percentage of total yearly accidents by month for accidents involving a taxi vehicle in the Sydney metropolitan area compared to those involving a car or light truck (excluding taxi vehicles) for the Sydney metropolitan area averaged across 1993, 1994, and 1995.

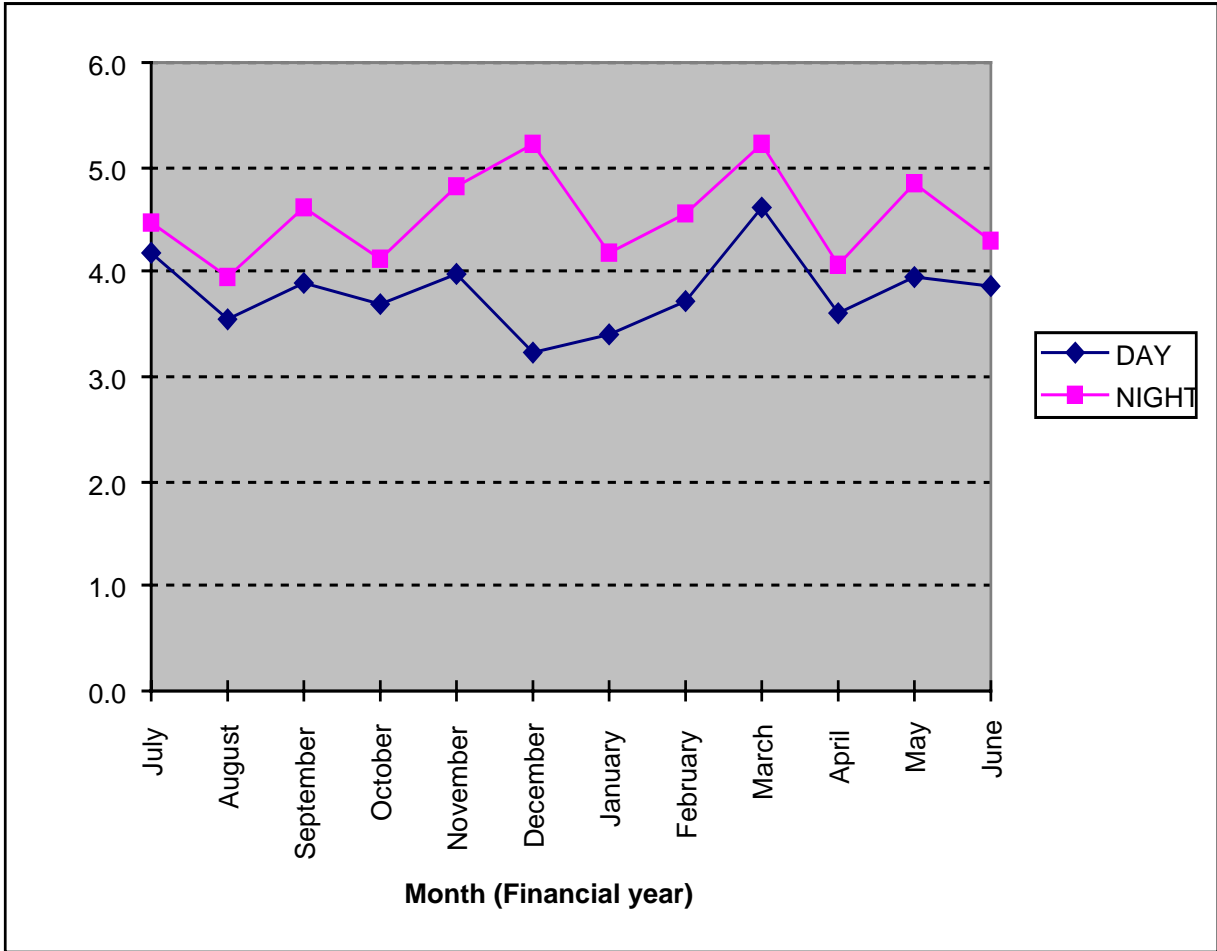


Figure 8: Percentage of total yearly accidents by month for accidents involving a taxi vehicle in the Sydney metropolitan area during day (3am to 3pm) and night (3pm to 3am) shift times, averaged across 1993, 1994, and 1995.

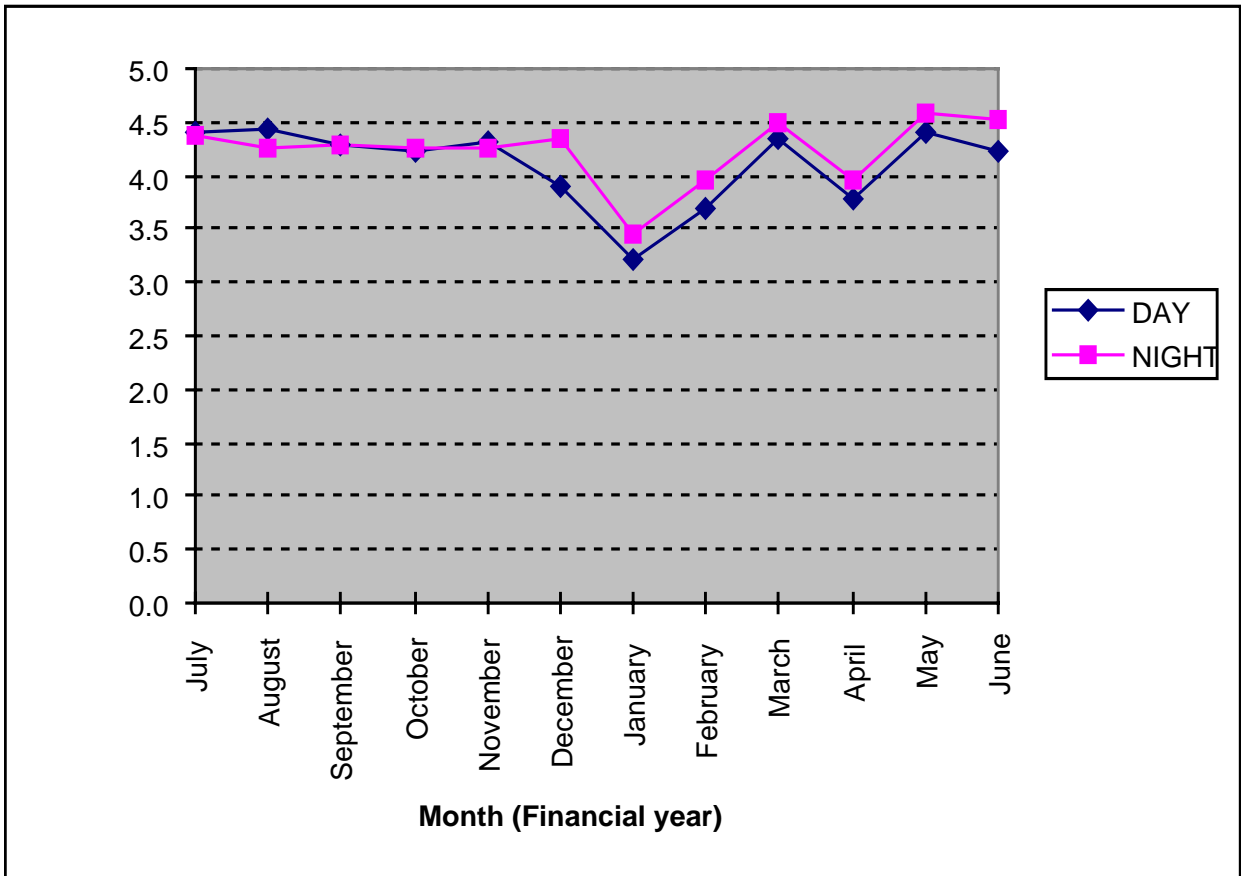


Figure 9: Percentage of total yearly accidents by month for accidents involving a car or light truck (excluding taxi vehicle) in the Sydney metropolitan area during day (3am to 3pm) and night (3pm to 3am) shift times, averaged across 1993, 1994, and 1995.

PERCENTAGE OF ACCIDENTS BY SHIFT TIMES ACROSS YEAR	0300-1500	1500-0300
Taxi drivers	45.7	54.3
Public	49.2	50.8

Table 4: Percentage of total yearly accidents for accidents involving a taxi vehicle and accidents involving a car or light truck (excluding taxi vehicle) in the Sydney metropolitan area during day (3am to 3pm) and night (3pm to 3am) shift times, averaged across 1993, 1994, and 1995.

3.8 Accidents by Road Use Movement (RUM) Codes

The top 5 road user movement descriptions for accidents involving a taxi vehicle and accidents involving a car or light truck (excluding taxi vehicles) were

calculated and are presented in table 5. Each table includes one category not listed in the top 5 of the other group, and the percentage and rank of this category is listed. The meaning of the RUM codes listed in table 5 is as follows: “rear end” is when the front of one vehicle collides with the back of another vehicle when both are travelling in the same lane, and in the same direction; “cross traffic” is when two vehicles both heading straight, but from two different streets collide, such as at an intersection; “right through” is when one vehicle turns right across the path of an on-coming vehicle which is travelling straight through; “right near” is when one vehicle is turning or attempting to turn across a street and is hit by a vehicle from the right which is travelling straight through; “pedestrian nearside” is when a pedestrian proceeds from the curb and is struck from the right by an on-coming vehicle travelling straight through; and “right rear” is when the front of one vehicle collides with the back of another vehicle which is turning or intending to turn right (for further details regarding RUM codes, interested readers should contact the R.T.A).

It should also be noted that an important pattern across accident severity was observed across one category of accidents - those involving pedestrians. As noted below, “pedestrian nearside” is ranked higher for taxi drivers than for the public. In addition, there was a disproportionate number of severe accidents involving pedestrians for taxi drivers, and 5 of the 11 fatalities listed for the three year period studied were the result of pedestrians being struck by taxi vehicles.

RUM TOP 5	RANK FOR TAXIS	% TAXI	RANK FOR PUBLIC	% PUBLIC
Rear end	1	27.3	1	27.5
Cross traffic	2	14.5	3	10.7
Right through	3	14.1	2	14.8
Right near	4	5.2	4	7.7
Pedestrian nearside	5	3.0	(13)	(1.6)
Right rear	(6)	(2.4)	5	4.0
Other	-	33.5	-	33.7

Table 5: Rank order and percentage for top 5 road user movement (RUM) codes for all accidents involving a taxi vehicle compared with all accidents involving cars and light trucks (excluding taxi vehicles) for the Sydney metropolitan area, averaged over 1993, 1994, and 1995 (see Appendix B for definitions of R.T.A. RUM codes).

3.9 Accidents by Local Government Area

Figure 10 presents percentages of total accidents for accidents involving a taxi vehicle and accidents involving a car or light truck (excluding taxis) by “Local Government Area” (LGA).

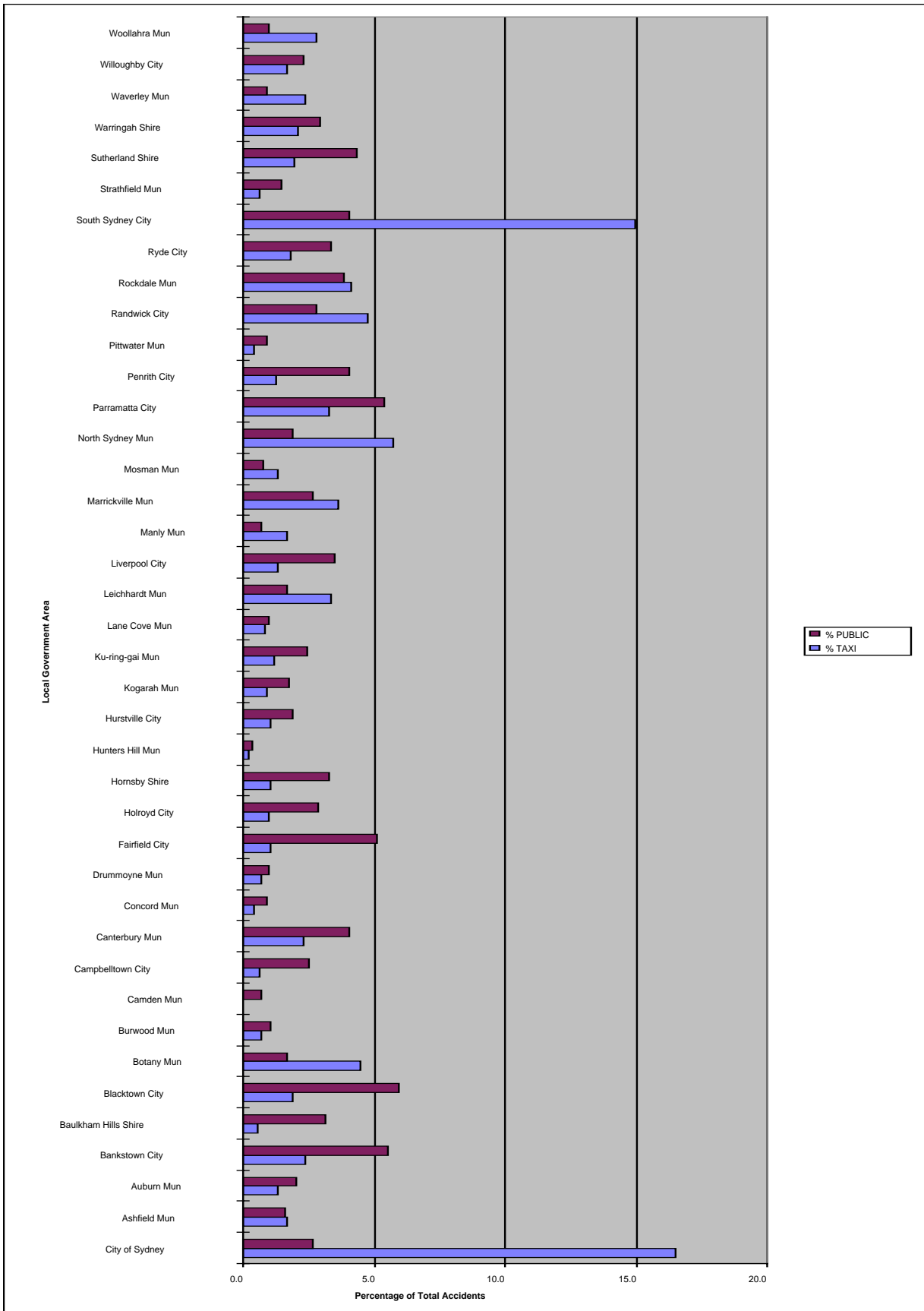


Figure 10 (see previous page): Percentages of total accidents involving a taxi vehicle compared with accidents involving cars and light trucks (excluding taxi vehicles) by Local Government Areas (LGAs), averaged over 1993, 1994, and 1995.

3.10 R.T.A. data compared to survey data

Full details of the data obtained with the survey instrument are contained in chapters 4 to 9. Several basic comparisons between these data and the R.T.A. data are relevant here. Approximately 50% of the drivers surveyed reported being involved in at least one accident during the past two years. However, the majority of these accidents were minor, and would not have been listed on the R.T.A. accident database. Of those accidents recorded in the survey, approximately 26% involved towing of at least one vehicle, 12% involved minor injury, and 2% involved serious injury. Of all accidents recorded in the survey, 33% of these would meet the R.T.A. criteria used above.

4. DISCUSSION

While the scope of this analysis is limited by the small number of variables available for study in relation to these accidents, it none the less provides interesting information about accidents involving a taxi vehicle compare with an appropriate “general public” group.

The vast majority of accidents (over 99%) involving a taxi vehicle occur in urban areas within N.S.W., and most of these (89%) occur within the Sydney metropolitan region. While a study of road safety issues for taxi drivers in smaller cities and country towns may well reveal different patterns to those found in this report, it is worth noting that this report’s focus on only taxi drivers within the Sydney metropolitan region is appropriate in the sense that these drivers make up the vast majority of the accidents recorded by the R.T.A. involving a taxi vehicle. Future studies could examine taxi drivers in these other areas, but as a first attempt at a detailed examination of road safety issues for taxi drivers, the limited focus on Sydney appears to have been appropriate. Further, as most taxi drivers worldwide work in large cities, this makes the current study generally applicable.

While there are small fluctuations in the distributions related to accidents involving taxi vehicles across different years, the averaged figures provide a good indication of general trends, as there were no major deviations across any of the variables studied for any one year. An example of this can be seen in the accident severity by year table (table 2). It is interesting to note that when accidents involving taxi vehicles are compared with an appropriate public comparison group, the distribution of accidents by severity is almost exactly the same for both groups. This finding contradicts an earlier finding noted by the

Motor Accidents Authority (1997) that found that taxi drivers were less likely to be involved in more serious accidents, and more likely to be involved in minor accidents, relative to the general public. While it is not possible to determine whether this assertion is true for all accidents involving a taxi vehicle (that is, those recorded by the R.T.A. as well as others not listed on the accident database), at least in terms of the R.T.A. data, the distributions by severity for accidents involving a taxi vehicle in the Sydney metropolitan region are similar to those involving cars and light trucks within the same area. This is an important finding, indicating that accidents involving taxi drivers, when analysed by severity, are not different to the general public (where general public is people driving similar vehicles under similar conditions). The different finding of the Motor Accidents Authority is almost certainly a by-product of an inappropriate comparison group. (Comment: perhaps they left out light trucks???)If, in this context, a general public comparison group is not limited to the approximate vehicle type as taxi drivers or the same location within which most drivers work, then confounding factors such as accidents related to different vehicle types and country driving are likely to distort the comparison.

The distribution of accidents involving a taxi vehicle by age indicates differences between taxi drivers and the general public. The problem of the high number of accidents in young drivers is not evident for taxi drivers, but this is almost certainly due to the small number of taxi drivers within this age group (only 4 of the 165 drivers responding to the survey were aged 25 or less). As the average age of taxi drivers surveyed was 41 years, it is interesting to note that the highest percentage of accidents involving taxi vehicles occurs in the age group below this, that is, the 30-39 age range. However, these figures should be viewed with caution if one wishes to interpret them to indicate the relative “accident-proneness” of certain age groups - without knowing the actual percentage of working taxi drivers within each group, it is not possible to determine the relative chances of accident involvement by age for taxi drivers. There are two problems with attempting to find this necessary control data: first, the “official” number of taxi drivers per age group, as recorded by the number of Taxi Authority cards issued by the Department of Motor Transport does not take into account the number of these drivers that have cards but do not currently work as taxi drivers. From discussion with industry representatives, this group may be as large as 50% of the total. For this reason, these figures cannot be treated as accurate reflections of working taxi drivers, and the figures are almost certainly skewed by age because of this factor. Second, even if these figures were known, they do not control for any variations in exposure related to age factors. This is an important problem, as many older drivers work day shifts, which characteristically involve lower average hours and kilometres driven when compared to night shifts. For these reasons, it was not possible to determine the relative “accident-proneness” of different age groups of taxi drivers by controlling for actual numbers of drivers and relative exposure.

The small number of female taxi drivers is evident in the very percentage of accident attributable to them (less than 2%). It is not possible to determine which gender is less “accident-prone” (if such as difference exists) for the same reasons as listed above for age.

There are a number of interesting findings presented concerning accidents across time, specifically for: average 24 hour periods for weekdays and weekends, accident rates by hour of shift for day and night drivers, and monthly patterns including a breakdown by shift time analysis. The comparison of accidents involving a taxi vehicle compared to the public for weekdays indicates that while the general trend of greater accidents during daylight hours for the public is partially true for taxi drivers, the peaks associated with “rush-hour” times are not evident. The likely reason for this pattern is exposure: the average number of taxi vehicles on the road during most hours of the day is reasonably constant (due to the nature of the shift system, and the primary difference between taxi drivers and the public in reasons for using the road, that is, to earn income and as a means of travel respectively), while the average number of public vehicles varies widely across time.

The pattern across weekends for taxi accidents shows an even “flatter” curve (compared to the weekday taxi accident pattern) for most of the day, particularly compared to the general public. Again, this is probably due to the more constant number of taxi vehicles on the road compared to the public. The important aspect of weekend taxi accidents patterns as revealed in figure 6 is that there is a relatively high number of accidents between 2am and 4am. The most likely reason for this is that these two hours are a very busy period of work on weekends for taxi drivers, as it is the time period during which many people who have been at nightclubs wish to go home, and many of these people use taxis due to prior ingestion of alcohol (and associated penalties for drink driving). At the same time, some night drivers finish their shifts prior to this period, and many day drivers do not start work until later that day (5-6am), hence a large number of the taxi drivers on the road at this point in time are night drivers who have already been working for 11 hours, and who often extend their shift time to 13 hours or more to benefit from the high level of income that can be made during this period.

The higher number of accidents during this period is probably due to a confluence of the effects of fatigue, higher levels of taxi fares (and therefore greater kilometres travelled per hour during this period), and the effects of the natural “dip” in circadian rhythm that occurs at approximately this time (NASA, 1996). Using the analogy of traffic “black spots”, Folkard (1996) has recently identified this period of the day as a “black time”, and this concept seems especially relevant to the work of taxi drivers during this period. The actual accident rate for taxi drivers during this period may be even greater than is apparent from the figures reported here, as the total number of taxi vehicles on the road from 2am to 4 am on weekends is less than in the hours prior to it due to

the lower number of taxi drivers working at this time (due to the reasons noted above).

This argument is also supported by the analysis of accidents according to the number of hours into the shift for day and night drivers across both weekdays and weekends. While weekday night drivers exhibit a steady reduction in the number of accidents as time progresses, there is a marked increase in accidents towards the end of weekend night shifts. Further, the average number of accidents for weekday day drivers is low initially, but this is not the case for weekend drivers. This effect may be a continuation of the weekend “black time” of 2am to 4am noted above.

The analysis of accidents by month indicates that taxi drivers have a generally similar yearly pattern to the public, although with higher relative rates during January, February and March. The breakdown of these data by day (3am to 3pm) and night shift (3pm to 3am) times does not indicate that the reason may be simply related to changes in work occurring in only one type of shift (eg night shifts). It is not immediately obvious why this seasonal variation exists, and further research would be required to investigate if some genuine phenomenon underlies this observed pattern. In terms of the breakdown of accidents by shift times, the only important difference in the pattern by months relates to December, where the number of accidents for day shifts decreases, but the number of accidents for night shifts increases. This pattern is weakly evident in the public comparison group as well. Increased numbers of taxi accidents during December may occur because of the greater number of fares available to drivers (greater numbers of fares result from the approach of Christmas and associated events such as office parties and other end of year celebrations, which predominantly use taxis at night, rather than during the day). As one taxi fleet owner noted, “the great thing about December is that I can get a driver for every cab I own for every night shift of the week, and that’s never possible any other time of the year”.

The breakdown by shift times also indicates that more accidents occur during the night shift period than during the day shift period. Table 4 gives the overall percentages for this on a yearly basis, and a comparison of figures 8 and 9 indicates that this pattern of greater night shift accidents for taxi drivers is not just the result of an overall trend of increased accidents during the night shift period for the public. While there is a slightly higher percentage (50.8%) of public accidents during the night shift period (compared to the day shift period), the percentage of accidents involving a taxi vehicle during the night shift period is considerably higher (54.3%) than for the day shift period. However, some estimate of the relative proportion of taxi vehicles on the road for both day and night shifts would be required before it could be concluded that this result indicates that night drivers are more likely to be involved in accidents than day drivers. It is possible that this increase may be an artefact of either higher relative number of night drivers (compared to day drivers), and/or the greater exposure

(in both hours worked and kilometres travelled) experienced by night taxi drivers compared to day taxi drivers (see chapter 5 for further details).

The analysis of road use movement RUM (codes) for taxi drivers and the public indicates that the major categories are similar for both groups. The one important exception to this is the 5th ranked taxi accident type “pedestrian nearside”, which is ranked only 13th for the general public, together with the general finding that pedestrian accidents were disproportionately represented in severe accidents. While it is not surprising that accidents involving pedestrians result in greater injuries or in fatalities, it is important to note that these accidents are over-represented within accidents involving taxi vehicles. While there are many possible reasons why this could be the case (such as taxi drivers working in more heavily “pedestrianed” areas, such as the city; and the problem of “drink-walkers” during night shifts - that is, intoxicated pedestrians who walk in front of vehicles, oblivious to the dangers of this act) this finding may be worthy of consideration at the level of government policy, such as increased taxi driver and public education. (Comment: It would be interesting to see how the pedestrian crashes split by time of day, in terms of the extent of the drink walker problem)

The analysis by Local Government Areas (LGAs) indicates that compared to the general public, the largest proportion of accidents involving taxi vehicles occur in and around the CBD. The higher relative percentages of taxi accidents for “City of Sydney”, “South Sydney City”, and, to a lesser extent, “North Sydney”, “Botany”, “Woollahra”, “Randwick City”, “Leichhardt” and “Waverley” illustrate this pattern. This is not a surprising finding considering that the CBD and surrounding areas are the main source of fares for taxi drivers, and hence these areas would experience greater relative taxi vehicle “traffic density”.

Finally, the relationship between the accidents recorded by the R.T.A. and those recorded by the use of the survey instrument requires discussion. Due to the problems of the low survey response rate (see chapter 3) there is no simple way of determining whether the survey accident details are representative of all taxi driver accidents or not. However, if it is assumed that the percentage of accidents recorded on surveys that meet the R.T.A. criteria (33%) is representative of all taxi driver accidents, then the average number of accidents per year involving taxi vehicles recorded by the R.T.A. (approximately 1560) indicates only one third of all taxi accidents. The real accident rate for taxi vehicles would be closer to 4700 per year. If the low survey response rate resulted in a bias in favour of drivers with “better” driving records (due to the request to check driving records with the R.T.A.), as has been indicated by some discussions with drivers (see chapter 3) then this estimate of 4700 taxi accidents per year would be an underestimate of the actual total number of accidents involving taxi vehicles per year.

In summary, the data presented above provide basic information about trends within taxi driver accidents for the Sydney metropolitan area as compared to accidents involving cars and light trucks (excluding taxi vehicles) for the same region. Some of the most important findings in this chapter are the similar distributions by accident severity for both groups, the different patterns of accident across day and night shifts, the finding of a “black time” for weekend night drivers between 2am and 4 am, and the high rate of taxi accidents involving pedestrian fatality or injury. Further research into this area, particularly research which can provide adequate controls for age, gender and relative traffic density for the data presented here would be of value.

Part 2: The Survey - Detailed Examination of Correlates of Accidents

The central aspect of this project was a detailed survey of taxi drivers concerning factors related to accident rate. Following a chapter on the methods used (chapter 3), a detailed discussion of attempts to predict accident rate using the data collected is presented (chapter 4). Chapters 5 to 8 present detailed analysis of the four specific road safety issues of interest in this project: demographics and job-related variables (chapter 5), optimism bias and risk-taking (chapter 6), fatigue (chapter 7) and personality (chapter 8).

CHAPTER 3: METHODS

The methods for the collection and analysis of the taxi collision data provided by the New South Wales Roads and Traffic Authority have already been discussed in Chapter 2. The rest of this report is based on a survey instrument that was distributed to individual taxi drivers. This chapter describes the methods relevant to this survey, including discussion of survey development, distribution and collection, and analysis of data.

1. DEVELOPMENT OF THE SURVEY INSTRUMENT

Prior to our 1993 study, we developed a survey to assess the role of both optimism bias and job-related variables in taxi driver road safety. The optimism bias questions contained in this survey were taken from several sources within the literature on this topic (Dejoy, 1989; McKenna, 1991; Weinstein, 1980), and some were written specifically for this project. They included general optimism questions of the style presented in Weinstein's original 1980 study, general driving questions from a number of sources, and two sets of questions about perceived relative frequency of illegal driving behaviour and perceived relative driving abilities (Dalziel & Job, 1994). For further details regarding this topic, see chapter 6. The job-related questions were developed based on extensive discussion with taxi drivers and industry representatives, and from the actual taxi driving experiences of one of the authors (JD). For further details regarding job-related variables, see chapter 5. In addition to questions concerning optimism bias and job-related variables, basic measures such as age, gender, experience, relevant measures of exposure, violation rates, accident rates, etc, were included, based on general findings of existing road safety research (Arthur, Barrett & Alexander, 1991).

Following the 1993 study, feedback on the survey (particularly concerning some of the job-related questions) was used to modify questions to produce those used in the present study (the complete survey is presented in Appendix A). Some minor modifications were also made to the accident details questions to assist with analysis of accidents according to the criteria used for the R.T.A. accident database.

New sections that were included in the current project's survey were the development of a taxi driver risk-taking scale, and the inclusion of two personality scales, a sensation seeking scale (Zuckerman, 1979, 1994) and an aggression scale (Buss & Perry, 1992). The inclusion of the risk-taking scale was designed to explore more explicitly the relationships between optimism bias, risk-taking and violation and accident rates - further details are provided in chapter 5. The inclusion of the sensation seeking scale was prompted by Burns

and Wilde's 1995 study of taxi drivers which showed that sensation seeking was correlated with driving behaviour and violation rates, but not with accident rate. The second personality measure (aggression) was added to examine the role of a different personality construct in driving behaviour, and because of anecdotal evidence suggesting that aggression may play an important role in accident causation in taxi drivers. For further details concerning these personality scales, see chapter 8.

In addition to the survey sections discussed above, two other aspects of the survey require discussion: the request for permission to check driving records, and payment to drivers for completing the survey. Within road safety research, requesting that drivers allow researchers to check their accident details has both advantages and disadvantages. The main disadvantage is that some drivers may not wish to be involved in a study where a request to check accident details is involved (even when drivers have the right to refuse this) due to the perceived invasion of privacy. Feedback on the 1993 study indicated that this was the case for at least some taxi drivers.

The main advantage of requesting permission is that it gives the researcher confidence that the accident rates reported are actually correct, due to the possibility of external verification. This is a major advantage in road safety research, as accident rate is normally low, and thus any differences between actual and reported rates can have large effects in overall analyses. While it is always preferable to check actual accident rates against official records, as some inaccuracies occur due to memory lapses (Elander, West & French, 1993), the "threat" of external checking ensures that drivers are more likely to answer accurately. The results of our 1993 study, together with the feedback received from drivers, support this argument (Dalziel & Job, 1997). The phenomenon of improved reliability in self-report as a result of potential external verification is termed the "bogus pipeline" effect (Evans, Hansen, & Mittlemark, 1977), and we have recently argued in favour of the use of this method within road safety research (Dalziel & Job, 1997).

In the current study, the benefits of a more reliable accident database were preferred over the sampling problem, and thus a request to confirm driving record was included. As it turned out, the driving record provided by the R.T.A. only listed violations, and thus only major accidents for which violations (such as negligent driving) were recorded could be verified. However, the inclusion of the request to check details (apart from actual later checking) would have had the desired "bogus pipeline" effect, and thus would have increased the reliability of the data collected when compared to the results of a study without this method.

Regarding payment to drivers, one of the major themes in the feedback to the 1993 study was that some drivers who did not return surveys would have been happy to complete the survey if they had been compensated for the lost earning time involved in this task. For this reason, the grant application for this project included a request for funding in order that drivers could be paid \$10 for

completing the survey. This compensation was calculated based on the time taken to complete the survey (20-30 minutes) when compared to the gross hourly earnings of drivers (approximately \$20-25).

2. DISTRIBUTION AND COLLECTION OF SURVEYS

In the original 1993 study, only drivers from a small regional taxi network were surveyed, and hence this may not be a representative sample of all Sydney metropolitan taxi drivers. The current study was designed to survey taxi drivers from all parts of the Sydney area from all taxi networks in order to provide a representative cross-section of taxi drivers within a large and diverse modern city. In the 1993 study we made drivers aware of the survey by broadcasting repeated messages to drivers throughout a two week period using the taxi network's computer dispatch system, indicating to drivers that surveys were available from the two central taxi gas stations. Surveys were then returned via boxes at these stations.

This method was not appropriate for the current study for a number of reasons. As drivers were spread throughout the Sydney metropolitan region, and worked for many different taxi networks, there was no simple way of sending a message to all drivers about the survey, or of having a small number of survey pickup points. While a few of the smaller taxi networks sent a message regarding the survey over their computer dispatch system (with a contact telephone number) to drivers once or twice, the larger networks were unwilling to assist us with our request for this message to be sent to drivers. However, as we had already planned to use direct distribution of surveys to drivers on major Sydney taxi ranks as part of our distribution procedure, and as a result of the reticence of the larger taxi networks, we used direct distribution as our primary method of distributing surveys. While a small number of requests for surveys were received by telephone (in response to the few messages that were sent over networks), the majority of surveys that drivers obtained were received via distribution at major taxi ranks.

In order to obtain a representative cross-section of drivers, surveys were distributed at different times and at different locations. In terms of location, the largest proportion of surveys were distributed at the two Mascot airport ranks (mainly at the domestic terminal rank, but some were distributed at the international terminal rank), due to the fact that the airport ranks draw a substantial number of drivers from throughout the Sydney metropolitan area. Approximately 50% of all surveys were distributed at the airport ranks. However, to minimise any hidden bias inherent in the selection of drivers for the airport rank, the rest of the surveys were distributed at a number of "high traffic" ranks throughout the Sydney region - these ranks included: numerous CBD ranks, Central Station, Strathfield, Parramatta, Bondi Junction, North

Sydney, Chatswood, Hornsby and Manly. In terms of the time at which surveys were distributed, approximately equal numbers of surveys were distributed at times that corresponded to typical day and night shifts, and in many cases surveys were distributed during both day and night shifts at the locations mentioned above. Surveys were distributed on every day of the week during both day and night shifts, and the number of surveys distributed was approximately equal for each day, with a slight over-sampling of weekend drivers due to the number of casual drivers who work only at these times. In summary, every effort was made to ensure a good distribution of surveys across different locations and times, so as to provide for an adequate cross-section.

Research assistants distributed surveys to drivers at taxi ranks while drivers were stationary awaiting their next fare. Surveys were distributed at the back of the "line" so as not to interfere with the taxis approaching the front of the ranks. When drivers were approached, a brief description of the nature and purpose of the survey was provided where possible, although many drivers asked for the survey without waiting for further details (an attitude of "yeah, sure, give me a survey, I'll have a look at it" was common). Where drivers appeared to have difficulty in understanding the survey itself (due to reading problems), a telephone number was provided to allow them to complete the survey over the telephone. Only a small number of drivers were identified that this applied to, and no telephone calls were received in order to complete a survey over the telephone - although a number of drivers did call for clarification of the meaning of some of the terms used in the survey.

While the method of survey distribution described above was useful for distributing a large number of surveys to many drivers from different areas and with different shift patterns, it has some drawbacks related to response rate. Due to the fact that surveys were handed to drivers without an attempt to gain driver details (so as to retain the anonymity of drivers during distribution), there was no way to contact drivers after the initial distribution to remind them to return the survey. Low response rates to surveys are common in general, and one of the few ways to improve response rates is to remind participants in some way (such as via reminder letters or telephone calls), but this was not possible given the circumstances of distribution. In addition, the fact that many drivers took the survey without waiting for a full description of the nature and purpose of the study would further reduce the overall response rate due to a percentage of drivers taking the survey who would not have been willing to complete it if they had waited to hear the full nature of the study (particularly the question concerning permission to check their driving record).

Attached to all surveys was a reply-paid envelope, addressed to the researchers, which allowed drivers to post back the survey once completed from any location without cost. This method is much more preferable to the use of collection boxes at taxi bases as was used in 1993. A taxi study "hotline" was also

provided for drivers to call if they had questions or problems while completing the survey.

3. RESPONSE TO THE SURVEY

On being approached to complete the survey, the initial responses of most drivers was positive. During the early stages of the project, almost all drivers (95-98%) accepted a survey, with very few negative responses. Towards the end of the project a lower percentage of drivers (80-90%) accepted surveys. The taxi study “hotline” received approximately 50 calls from drivers concerning many issues, including: requesting surveys, seeking clarification of questions, discussion of industry problems, suggestions for change to the industry, questions regarding the purpose of the study, and general feedback on the experiences of taxi drivers.

Comments made by drivers at the time of refusal indicated that there were three main reasons for not accepting a survey: some drivers had already received a survey, some drivers simply “did not want to participate” (this was the response of almost all refusals early in the project), and some drivers expressed negative opinions about the survey itself. This last group, while only a small number (less than 20 drivers during the life of the project), indicated that they objected to some aspects of the survey - particularly the request for permission to check their driving record, and some of the personality items. Also, some drivers objected to questions on the basis that they could not see any relevance between the items (eg, personality and optimism bias questions) and the issues that taxi drivers face in their day-to-day work. While both of these negative responses were only given by a handful of drivers, it appears from discussion with other drivers that these views were held by a number of drivers who had accepted surveys but who did not return them.

One further comment regarding negative responses to the survey is worth mentioning here. A few of the drivers’ comments when refusing a survey indicated that they did not distinguish between this project (an independent university study) and the Government regulatory bodies and related industry bodies (such as the Taxi Council) that control the industry. Statements such as “you bloody well haven’t done anything to improve our lot despite all your reforms, so why should I fill out your survey?” indicated that animosity felt by individual taxi drivers towards Government and industry bodies was mistakenly directed at an independent university-based study due to a misunderstanding of the relationship between those who “run” the taxi industry and this project. Many of the drivers who returned surveys also included extensive criticisms of the management of the industry, and these driver comments are discussed in detail in chapter 9.

Approximately 1500 surveys were distributed over an 8 week period during February, March and April of 1997. A total of 169 surveys were returned, although four of these surveys were from drivers who had already submitted a survey, and hence were removed. Thus the total response rate was approximately 11%. Several possible reasons for this low rate have already been mentioned, such as: the ready acceptance of surveys by drivers prior to a complete description of the project, the inability to contact drivers to remind them to return the survey, the request for permission to check driving records, and the use of questions to which drivers could not see any relevance. In addition, informal discussion with drivers indicated that some rumours regarding the survey circulated within the industry, particularly during the latter stages of the project. These rumours suggested that the survey was a “covert” action by either the Taxation Office or the Roads and Traffic Authority to find out information about drivers in order to announce a new “crackdown” on taxi drivers of some sort. While it can reasonably be expected that many drivers would have rejected such rumours, their possible impact on overall responses rates cannot be discounted. It should be noted that similar rumours circulated during our 1993 study, and it was for this reason that no questions regarding driver earnings was included in the current study. (One way to deal with possible sample bias associated with a low response rate is to try to collect demographic data on non respondents and compare them with respondents, but I suppose it’s too late to do that now.)

4. DATA ANALYSIS

Survey data were analysed using both spreadsheet and statistical computer programs, including “Excel”, “Statview”, and “SPSS”. The main statistics used within this report are descriptive statistics such as averages and correlations, and inferential statistics such as analysis of variance (ANOVA) and regression. In addition, a factor analysis was used to examine the structure of optimism bias and risk-taking questions, and reliability coefficients were calculated for the personality scales and the scales derived from the factor analysis. Statistical tests were one-tailed in the directions specified by prior hypotheses, or two-tailed where no specific prediction was indicated, and .05 was used as a criterion for significance. Where appropriate, each chapter contains specific details regarding the statistical tests that were used in the analysis of the data relevant to that topic. In cases of missing values, for some examples it was possible to estimate approximate values based on other information, such as calculating likely age based on time holding a car license. Where an appropriate estimate could not be based on other information, the average value for that question was used, or where this was not appropriate, the individual was removed for the particular analysis in question.

It should be noted that the role of statistics within social scientific research is changing (American Psychological Association, 1997). The use of null hypothesis testing as the fundamental method of examining the evidence for a given theory has been questioned at both theoretical (Gigerenzer, 1993) and practical levels (APA, 1997), and it appears that alternative methods of theory building and testing are now gaining wider acceptance. We have used a more careful approach to statistics already in our writings (see the discussion of the significant negative correlation between total break time and accident rate in Dalziel and Job, 1997), and these issues are relevant to the current project at two levels. Firstly, weak relationships that have theoretical importance, but which do not reach “significance”, should not necessarily be ignored, although one has to deal with such relationships with considerable caution. Similarly, weak relationships that do attain significance, but in the absence of some theoretical background, should also be treated with some caution, and should not necessarily be endorsed without qualification. These problems are especially acute when dealing with variables that are prone to inaccuracies, such as accident rate.

Secondly, significant relationships do not, on their own, imply direct causal mechanisms between the variables examined. Correlation does not equal cause, and this is relevant to some of this report, as it is argued that some of the “surface” correlations observed here are the result of underlying factors. Appropriate theoretical considerations must always be weighed in conjunction with the results of statistical testing in the discussion of the phenomena observed. While some may see this emphasis on the importance of theory in the use of statistics as an intrusion of “unscientific” considerations into the realm of hard numerical facts, this view is not sustainable in the light of criticisms concerning the use of either numbers (Michell, in press) or statistical testing (Gigerenzer, 1993) in social scientific research.

5. THE SAMPLE

While 169 surveys were returned, four drivers returned two surveys each. In one case, the driver had only been working for 2 weeks when the first survey was returned, but had been working for just over 2 months when the second survey was returned. In this case, the second survey was retained and the first discarded. In the other three cases, the second survey returned was discarded, and in two of the three cases, the second survey contained a high percentage of unanswered questions.

Thus the total sample size was 165 taxi drivers. However, some drivers had either limited experience or exposure (or both) as taxi drivers. While this sample of 165 was appropriate for analysis of basic driver variables such as age, shift patterns, working preferences, etc, it was not appropriate for any analysis

which required some degree of prior exposure (for example, it is inappropriate to examine correlates of accident involvement for a driver who has only driven a small number of shifts). While there is no single obvious amount of work which would constitute a “sufficient” quantity for a taxi driver per year, it was decided that a driver who drove one shift a week for at least one year (for example, a casual Saturday night driver working in 1996 only) would constitute an ecologically valid example of the minimum exposure required. Such a driver would have driven for approximately 50 shifts during the survey period. Using this as a guide, eleven of the drivers who returned surveys were removed due to lack of experience (one year or less) combined with insufficient exposure (less than 50 shifts). A further three drivers with more than one year of work as a taxi driver were removed on the basis of insufficient exposure alone. As a result, the total sample used for analysis of the relationships with variables such as accident and violation rate was the remaining 151 drivers.

Despite the low response rate discussed above, the distributions observed for the major variables examined in this study appeared to indicate a wide variety of responses and considerable individual differences between drivers. Approximately 50% of drivers reported being involved in at least one accident for the two year period of study (1995 and 1996), and 53% of drivers reported receiving at least one fine while driving a taxi for the period in question. The attempt to gain a broad cross-section of drivers appeared to be successful, with approximately equal numbers of day shift and night shift drivers, as well as a reasonable number of drivers who worked “semi-doubles”. Approximately equal proportions of owners, permanent drivers, casual drivers and drivers who work irregular shifts returned surveys, and the addresses of drivers were spread throughout the Sydney metropolitan region, including drivers from areas close to the CBD, and drivers residing in the north, west and southern districts of the city.

Caution is appropriate when interpreting the results from a study with a response rate of 11% - particularly those results which attempt to generalise to all drivers on the basis of simple averages, such as the average number of accident per taxi driver per year, where there are reasonable grounds for suspecting that scores on this particular variable are related to response bias (eg, accident rate). However, as many of the important results discussed in this report are concerned with relationships between variables, the key issue becomes one of sufficient variation within the variables tested, rather than just the representativeness of the sample. A similar argument is presented by Hemenway & Solnick (1994) regarding a study they conducted based on a telephone survey, in which correlations between variables was the main point of interest, not average rates of individual behaviour. While higher response rates strengthen the case for relationships discovered between variables, a low response rate on its own does not preclude the discovery of significant relationships where there is sufficient variation within the data.

As noted already, the question regarding permission to check the driving record of participants was the source of some negative responses to the survey, and hence may have decreased the overall response rate. An additional unexpected by-product of this question was that where drivers did give permission to check records, some gave limited information about their accidents in the accident details section, but wrote a statement to the effect of “see my driving record for details of this accident”. While there were no cases of drivers failing to record the actual number of accidents due to this reason, there were several cases of insufficient reporting of details such as the estimated repair cost of the accident, injury, etc. This insufficient recording does not affect the fundamental analysis of correlates of accident rate in chapter 4, but it does impose limits on the reliability of some of the associated analyses such as analysis of only accidents involving repair costs of at least \$2,000, or of accidents that would have been met the R.T.A. accident database criteria. For this reason, care should be exercised in the interpretation of these analyses, although the fundamental test of predictors of accident rate is unaffected by this problem.

In terms of permission to access driving records, approximately two thirds of the drivers returning surveys gave permission to check driving records. However, of this group, thirteen drivers signed both the “yes I give permission” and the “no I do not give permission” statements on the request form, and hence driving records were not sought for these drivers. As noted above, driving records were not useful in determining the details of most taxi driver accidents, but the request to check records itself would have helped to increase the reliability of self-report compared to a study in which this was not done.

The payment provided to drivers also had an unexpected by-product according to some of the drivers with whom this survey was discussed. While most drivers appreciated being compensated for their lost earning time while they completed this survey, a few drivers saw this compensation as part of a “covert” attempt to gain information about taxi drivers for purposes other than the ones stated. Towards the end of the project, this rumour appears to have been widely circulated, and again, although most drivers can be expected to have disregarded it, its role in diminishing response rate cannot be overlooked.

In summary, the survey used was based on revision of that used in the 1993 study, with the inclusion of scales regarding risk-taking, sensation seeking and aggression. Surveys were distributed at major Sydney taxi ranks at appropriate times to ensure a broad cross-section of all taxi drivers. Due to a number of difficulties in surveying this group, the response rate was low, but the degree of variation observed on the measures used was sufficient for the kinds of analyses that were planned. A total of 165 drivers returned surveys, and 151 of these had sufficient exposure and experience for inclusion in prediction of accident rate and related analyses.

CHAPTER 4: PREDICTORS OF ACCIDENT INVOLVEMENT AND VIOLATIONS

1. INTRODUCTION

Prediction of the causes of motor vehicle accidents is difficult due to complex interaction between variables and difficulties in controlling for confounding factors (Brown, 1982). Accidents are usually the result of a complex interaction of factors at several different levels (Fell, 1976), and these factors are not easily disentangled. The interaction of the individual, vehicle and context in the causation of an accident are not simple, and for any given example of one of these factors, its influence may be highly situation specific (such as a momentary lapse of attention, a brake failure, or a traffic light error) or may be more general (in the sense that it is the product of a longer causal chain stretching further back in time, such as falling asleep due to driver fatigue, a tyre blowout due to excessive wear and tear, or water on the road due to poor road design). The interaction between these factors is a further complication, such as an accident resulting from water on the road that may not have occurred if the speed of a vehicle had been less, or if better tyres were used. The recording and scoring of accidents themselves is hampered by considerable difficulties in choosing appropriate methods of analysis, and in gaining accurate details. Given these reasons, it is not surprising that the prediction of accidents is difficult.

In terms of the factors that cause accidents, some studies that have failed to discover any significant predictors, while in some cases where predictors have been found, these have been difficult to consistently replicate. While some basic predictors, such as age and exposure, have been shown to be related to accidents in a reasonably robust manner (Arthur, Barrett & Alexander, 1991), the interpretation of these two predictors are the subjects of considerable debate within road safety research. Indeed, rather than continuing the study of the possible contribution of individual, vehicular, and contextual factors, a recent article has gone so far as to suggest that, effectively, “being in the wrong place at the wrong time” is one of the major predictors of accident involvement (Asalor, Onibere & Ovuworie, 1994). (Sounds good but is it helpful in developing countermeasures?)

It is not just the factors related to accident involvement that have proved difficult to elucidate, but accidents themselves pose special problems as a dependent variable. These problems include debates over terminology (“accident” versus “crash” - Job, 1995), through to difficulties in whether to analyse the variable as a continuous or categorical variable (“accident rate” versus a “non-accident/accident” split, even a “non-accident/single accident/multiple accident split”, Pestonjee & Singh, 1980), and debate over the

appropriate statistical procedures to use during analysis (Oppe, 1992). Even scoring the accidents themselves is difficult, as there are several theoretically justifiable approaches to this issue, such as whether to score all accidents, or whether to restrict analysis to certain types of accidents (for example, Parker, West, Stradling & Manstead, 1995), or even whether to attempt to control for exposure within accident rates themselves. In particular, restrictions on which accidents are scored may be based on criteria such as repair cost, “severity” standards (such as those of the R.T.A. - see chapter 2), or examination of the circumstances of the accident, such as whether the vehicle was stationary at impact, or whether the driver was “at fault” or not (determining fault is also difficult). (Comment: another area that may be of interest is looking at 'near misses' and whether there are correlates between the rate of near misses and accident rates - the advantage being that near misses are presumably more common, and drivers are perhaps less reticent about reporting them)

None of the above issues are easily answered, and the lack of consensus within the road safety research community is perhaps an indication of both the difficulty of the task and of the need for more research. Road safety research may justifiably be thought of as an “immature” science (in Kuhn’s sense - 1975), as there are many competing theories, with similar levels of support, that deserve investigation at an exploratory, rather than confirmatory, level. In addition, the role of hypothesis-testing in psychology is changing (as discussed in chapter 3), and road safety research is a good example of an area that, due to its immature status, deserves the broader range of analytic procedures that are common in exploratory research. Provided that researchers do not mistake the existence of a significant relationship for “convincing proof” of their theory, but rather see their task as one of contributing to the incremental understanding of the factors that predict accidents, the methods discussed below may be of value.

1.1 Statistical analysis of accidents

In terms of factors related to accident rate, simple correlations between individual continuous factors and accident rate, or one way analysis of variance for categorical factors and accident rate, will provide basic indications of which factors, in terms observed data, are related to accident involvement. Obviously this analysis needs to be based within theory regarding which factors are relevant, but considering past difficulties in finding evidence for apparently valid factors, this general approach will provide indicators of the possible causes of accidents. This analysis will draw attention to factors which may be appropriate for model building for the prediction of accident rate.

Depending on the time period used, accident rate will result in a distribution (for the subjects examined) that may be appropriate for linear regression. However, due to the limited range that this distribution may have,

and the likelihood of a large percentage of subjects having no accidents, linear regression may not be the best statistical test for prediction, due to the possibility of violations of the assumptions of linear regression when using accident rate as a dependent variable. The alternative of using a longer time period may not be appropriate where psychological factors such as attitudes and personality are used, as these predictors may not be stable across longer timeframes. The question of whether accident rate should be used within linear regression is empirical, in the sense that an answer may be determined by appropriate assumptions tests during the early stages of model building. Where violations of the assumptions occur, an alternative statistical procedure should be considered, such as logistic regression - which is theoretically meaningful as drivers can be divided into one of two categories, those who have not had accidents, and those that have. While both linear and logistic regression of accident involvement will be prone to error, due to the relative infrequency of accidents and the multitude of possible causes for any one accident, logistic regression does provide a sound method of statistical testing which does not involve the assumptions of linear regression. One problem, however, of using logistic regression is that individual factors which are predictive of involvement in multiple accidents, (such as, perhaps, excessive risk-taking while driving) may lose some predictive power (relative to their contribution to analysis of accident rate) when used in to analyse the dichotomous non-accident/accident variable.

Hence, the question of the appropriate way to analyse accidents (having determined a method of scoring) can be determined by testing of the data itself, beginning with linear regression, followed by logistic regression if linear regression proves to be inappropriate. In building a predictive model, those variables that seem most significant from individual correlation and ANOVA analysis can then be used as possible predictors. Depending on the results of the early stages of model building, those factors that are not important to the model can be removed until the simplest predictive model has been determined. While it would normally be preferable to then validate the model developed, this may not be possible due to the relative difficulty of finding predictors of accident rate as the entire sample will almost certainly be needed to establish a credible model.

The question of choosing between statistical tests raises the general issue of the most appropriate way to treat accidents as dependant variables. While accident rate (in this case, the number of accidents during the previous two years) can provide general indications when used with simple tests, such as correlation and ANOVA, it may not be best suited to linear regression where it does not fit the assumptions of the linear regression model. However, the alternative of using two categories, those who have not had an accident versus those who have, has the problem of “truncating” accident rate, thus potentially reducing the importance of predictors that are appropriate for multiple accidents across a period of study. There does not seem to be a simple solution to these problems, although running both linear and logistic regression may assist in

gaining an overall picture of factors that predict accidents, provided that acknowledgment is made of the problems of repeated analysis of the same data.

Apart from choosing between the above statistical procedures, it may also be important to consider limiting the type of accidents that are recorded for analysis. While it has been argued above that the starting point for this kind of research should always be total accidents, it may be interesting to examine the predictors of specific types of accidents following the total accident analysis. Two promising examples of this approach are the study of only non-stationary accidents (Parker et al, 1995), and the study of only those accidents that are reasonably serious (such as those involving repair costs of \$2,000 or more). Non-stationary accidents are a useful category, as they allow the researcher to examine only those accidents in which the driver was moving at the time - that is "active". By removing "passive" accidents, it may be possible to eliminate some accidents for which there were no important predictors related to the currently examined driver. Analysing accidents involving repair costs over \$2,000 may provide indications of the specific factors that lead to more serious accidents, which may be different to those factors that predict all accidents. Thus for the current study, it seemed appropriate to examine not just total accidents as a dependent variable, but also non-stationary accidents and accidents involving repair costs over \$2,000.

In addition to the study of accidents, one can study violations (that is, traffic fines - excluding parking fines) using similar methods to those described above. While violation rates may be related to accident rates, they are also worthy of study in their own right as a general indication of the degree of illegal driving behaviour exhibited by drivers. In addition to attempting to predict violation rates, it would also be worthwhile examining the relationship between overall accident rate and violation rate, and between violation rate and the more specific accident categories, such as those with repair costs over \$2,000, those involving the towing of at least one vehicle, and those involving injuries.

Due to the findings of previous research, there are many possible factors that may be predictors of accidents and of violations, but no specific variables that would definitely be predictors. For this reason, it is preferable to begin with a large number of possible predictors (as identified by previous road safety findings or on the basis of hypotheses considered during the current project - especially due to discussion with individual taxi drivers about their perceived predictors of accidents) and then reduce these based on which variables prove to be significant predictors. The variables chosen for the current attempts at model building were: age, education, time holding a car license, time holding a taxi license, total hours of work per week, a variety of exposure variables (average hours per shift, per week and per year, average kilometres travelled per shift, per week and per year, average shifts per week and average km/hour), number of breaks, average minutes of total break time per shift, driving style, optimism bias, risk-taking, aggression, sensation seeking and violation rate, and the

categorical variables of shift type, vehicle type, job dispatch computer location, rank/hails preference, city/suburb preference, being asleep at the wheel or not, and having a sleeping disorder or not. The same variables were used for the violation rate analysis, except that violation rate was removed as an independent variable and accident rate was substituted for it.

2. METHOD

The general methods of the collection and analysis of the data presented here are described in chapter 3. In particular, the selection of only those drivers with sufficient exposure and experience are discussed in detail in this section. The total number of drivers used in the analyses conducted below was 151, but due to the fact that some drivers did not answer all questions, the total number of subjects in any given analysis may be less than this due to the removal of subjects with missing values.

Total accident rate for the two year study period (1995 and 1996) was the main dependent variable studied, but in addition to this, a breakdown of accidents was based on whether or not the taxi vehicle was stationary at the time of the accident. This was possible due to a question in the accident details section regarding whether the vehicle was stationary or not, and this answer was confirmed by checking the description of the accident given in a separate question asking drivers to describe how the accident occurred. A third accident analysis was planned, that of accidents involving repair costs over \$2,000, but this was not possible in the current sample due to the small number of accidents in this category (43), combined with missing information related to these accidents. Violation rate was also studied, based on the total violations for the period of study (2 years).

3. RESULTS

For the 151 drivers used for this analysis, a total of 121 accidents were reported for the two year period, with an average of .8, and a range from 0 to 4. Of these, 89 were classed as “non-stationary accidents”, with an average of .6 and a range from 0 to 4. The total number of violations reported by these drivers during 1995 and 1996 (total) was 161, with an average of 1.1, and a range of 0 to 6. All of the drivers in these analyses were male, as the two female taxi drivers returning surveys were both removed due to lack of experience and exposure (along with 12 other male drivers - see chapter 3).

3.1 Prediction of accidents

Initially, the variables that were hypothesised to be predictors of accident involvement, based on previous theoretical and empirical work, were examined for simple relationships with accident rate. For further discussion of the individual variables themselves and inter-relationships between them, see chapter 5, 6, 7 and 8 (especially chapter 5). This examination indicated that many

of these variables were not significantly related to accident rate, including: optimism bias, average minutes of total break time per shift (contrary to our earlier finding - Dalziel and Job, 1997), number of breaks per shift, time holding a car or taxi license, education, total hours of work per week, sensation seeking and violation rate. In addition, neither total working hours per week, nor most of the exposure variables examined were related to accident rate - only total average hours per shift was significant (see below). Finally, several categorical variables that were thought to be related to accident involvement were not significant: employment type, location of the job dispatch computer, working style questions (city/suburb and rank/hails preference), or falling asleep at the wheel of the existence of sleeping disorders.

Significant positive correlations were observed between accident rate and the driving style question (recoded so that lower values indicate more relaxed driving), risk-taking, average hours per shift, and aggression. However, the relationship between aggression and accident rate ($r = .17$, $p = .035$) was primarily due to the anger subscale ($r = .27$, $p = .001$), as each of the other subscales were not significantly correlated with accident rate (in each case $r < .1$, $p > .05$). Due to this finding, and the comment by Buss and Perry (1992) that anger is the “bridge” between the other subscales of aggression, it was decided that only the anger subscale would be used in subsequent analyses. See chapter 8 for further discussion of the aggression scale.

Of the categorical variables, the “have you ever fallen asleep at the wheel?” question yielded a significant relationship with accident rate when split into “yes” and “no” groups (mean accident rate for “yes” = 1.2, “no” = .7, $F(1,147) = 5.41$, $p < .05$). However, this variable was also significantly related to risk-taking ($p = .004$) and average hours per shift ($p = .03$), and thus it was suspected that this variable would not make an independent contribution to the model where these other factors were included. This question is discussed in more detail in chapter 7.

Vehicle type (sedan, wagon or special vehicle) was also significantly related to accident rate (mean accident rate for sedan = .95, wagon = .43, special = .20). Due to the small number of “special vehicles” observed (2), this category was combined with “wagon” to create a single dichotomous variable of “sedan” versus “wagon/special vehicle” which was a significant predictor of accident rate ($F(1,148) = 8.42$, $p < .01$). Vehicle type was not significantly related to any of the other variables correlated with accident rate, and thus was expected to make an independent contribution to the overall model.

3.2 Dealing with correlation among variables

As regression (both linear and logistic) is based on the assumption of independence between predictors, correlations among variables can adversely affect

model building. Inspection of the correlations between the significant variables listed above indicated that the driving style question was related to all variables (see table 6 below). This is not surprising, given that it is a single item question about overall driving style:

- Q13. "Consider your style of taxi driving, are you a "hard driver" or a relaxed driver?
 (1) I drive in a very "hard" way (3) I drive in a moderately relaxed way
 (2) I drive in a moderately "hard" way (4) I drive in a very relaxed way

This item is best regarded as a single item measure of general driving behaviour that may be useful in survey research where only limited time and space is available, due to its correlations with age, anger and risk taking. However, for the purposes of model building it is inappropriate due to the fact that it is only a single question and because of its correlations with other variables. For these reasons, it was removed from all subsequent analyses. For further discussion of this question, see chapter 6.

	1	2	3	4	5	6	7
1. Age		-0.14	-0.19*	-0.07	-0.25**	-0.15	-0.14
2. Anger			0.31**	-0.06	0.32**	0.27**	0.26**
3. Risk-taking				0.10	0.38**	0.22**	0.26**
4. Total hours/shift					0.08	0.26**	0.19*
5. Driving style						0.21*	0.22**
6. Accidents							0.90**
7. Non-stationary accidents							

* = $p < .05$, 2-tailed

** = $p < .01$, 2 tailed

Table 6: Correlation matrix for factors associated with total number of accidents (8) and total number of non-stationary accidents (9).

The remaining problem was the relationship between anger and risk-taking. While it is conceivable that these two constructs may share some connection, their primary usefulness is as independent predictors, due to the different theoretical background and applications of each predictor if significant. Regression using correlated variables may be misleading due to the inflation of standard errors, and the fact that regression coefficients may be unstable (SPSS, 1997). There are three main solutions to this kind of problem - combining variables, stepwise regression or principal components analysis. In the current context, combining variables was not appropriate due to the important theoretical differences between anger and risk-taking. Stepwise regression was rejected on the basis that it is essentially a "number-driven" rather than "theory-

driven” method of analysis, and hence is prone to producing results specific to the particular dataset in use but which may not be the most appropriate theoretical predictors (particularly when using relatively small samples). Principal components analysis is limited by the fact that the regression coefficients produced by regression using the derived factor scores (rather than the original variables) are applicable only to factor scores. That is, these coefficients do not apply directly to the original items used in the principal components analysis or their total scale scores (such as the total scores of risk-taking or anger derived from the sum of the individual items). While the correlation between the factor scores and scale totals is likely to be high, it is important to realise that these are not exactly the same thing.

For the present study, the determination of genuine predictors of accident rate was considered more important than the problem of interpreting regression coefficients, and hence principal components analysis was used to deal with the problem of correlation between these two variables. To attempt to derive a “risk-taking” factor and an “anger” factor, a principal components analysis using varimax rotation was conducted, specifying two factors. The rotated factor matrix is given in table 7 below. This two factor solution accounted for 38.7% of the total variance, with the “risk-taking” factor accounted for 25.7% of the variance, and the “anger factor” accounting for 13% of the variance. The factor scores derived from this solution were saved as variables and used in all subsequent regression analyses.

Due to the fact that varimax rotation produces orthogonal factors, the correlation between the risk-taking factor scores and the anger factor scores was zero. The correlation between the risk-taking factor scores and the original risk-taking variable (the risk-taking scale total) was .98, and the correlation between the anger factor scores and the original anger variable (the anger scale total) was .96. Due to the high correlations between factors and original scales and the difficulty of interpreting individual factor scores, in analyses elsewhere in this report the scale totals have been used, rather than factor scores (although where analyses elsewhere include both anger and risk-taking scale scores, it should be recognised that a small degree of shared variance exists between these scale scores). A significant negative correlation ($r = -.19$, $p = .024$) was observed between the risk-taking factor and age, in keeping with prior findings on risk-taking and driving behaviour (Jonah & Clement, 1986). No other significant relationships were found between the factors and any of the remaining variables of interest.

QUESTION	FACTOR 1 ("risk-taking" factor)	FACTOR 2 ("anger" factor)
RT.1	.45	
RT.2	.50	
RT.3	.64	
RT.4	.60	
RT.5	.68	
RT.6	.60	
RT.7	.69	
RT.8	.54	
RT.9	.64	
RT.10	.62	
ANG.1		.57
ANG.2		.55
ANG.3		.67
ANG.4		.26
ANG.5		.69
ANG.6		.75
ANG.7		.69

Table 7: Rotated factor matrix of the principal components analysis (varimax rotation) of risk-taking and anger scale questions (blank cells indicate factor loadings of .25 or less).

3.3 Using linear regression to predict accident rate

Following the preliminary steps described above, linear regression was used to determine predictors of accident rate, and predictors of non-stationary accident rate. While these two dependent variables are highly related ($r = .9$), they are distinct theoretical entities due to the concept of “active” and “passive” accidents (Parker et al, 1995).

Following an initial attempt at model building, it was found that age did not make a separate contribution to the model once other variables had been included. The “falling asleep at the wheel categorical” variable also was not predictive following the inclusion of other variables (risk-taking and average hours per shift). The remaining four variables (anger factor, risk-taking factor, average hours per shift, and vehicle type) were all found to be significant predictors of accident rate. The overall model was significant ($F(4,138) = 9.2$, $p < .0001$), and accounted for 21% of the total variance. In terms of individual predictors, anger, risk-taking and average hours per shift were all positively correlated with accident rate, with the anger factor significant at $p < .001$, vehicle type and average hours per shift significant at $p < .01$, and the risk-taking factor significant at $p < .05$. The vehicle type category variable indicated that non-sedan drivers had lower accident rates than sedan drivers.

The regression equation produced was:

$$\text{Accident Rate} = .28(\text{Anger}) + .17(\text{Risk-taking}) + .13(\text{Average hours per shift}) - .5(\text{Vehicle type})$$

The constant was not significantly different from zero, and has thus been omitted. This model indicates that accident rate increases with increasing levels of anger, increasing levels of risk-taking and increasing length of shifts. It also indicates that sedan drivers have higher accident rates than other drivers (wagons and special vehicles)

For the prediction of non-stationary accidents, the same overall pattern was found. The overall model was significant ($F(4,138) = 7.8, p < .0001$), and accounted for 18.4% of the total variance. The pattern of relationships between individual variables and accident rate was the same as above, and the anger factor was again significant at $p < .001$, while vehicle type, average hours per shift and the risk-taking factor were significant at $p < .05$. The regression equation produced was:

$$\text{Non Stationary Accident Rate} = .25(\text{Anger}) + .18(\text{Risk-taking}) + .08(\text{Average hours per shift}) - .4(\text{Vehicle type})$$

Again, the constant was not significantly different from zero, and has thus been omitted. The pattern of relationships between accident rate and predictors was the same as noted above.

However, linear regression may not be appropriate for the study of accident rate due to the small number of accidents involved, and the large number of drivers with no accidents. The limited distribution of the dependent variable may lead to violations of the assumptions of linear regression. Figure 11 illustrates the distribution of the dependent variable (accident rate) for the current sample. The distribution for non-stationary accidents was even more positively skewed.

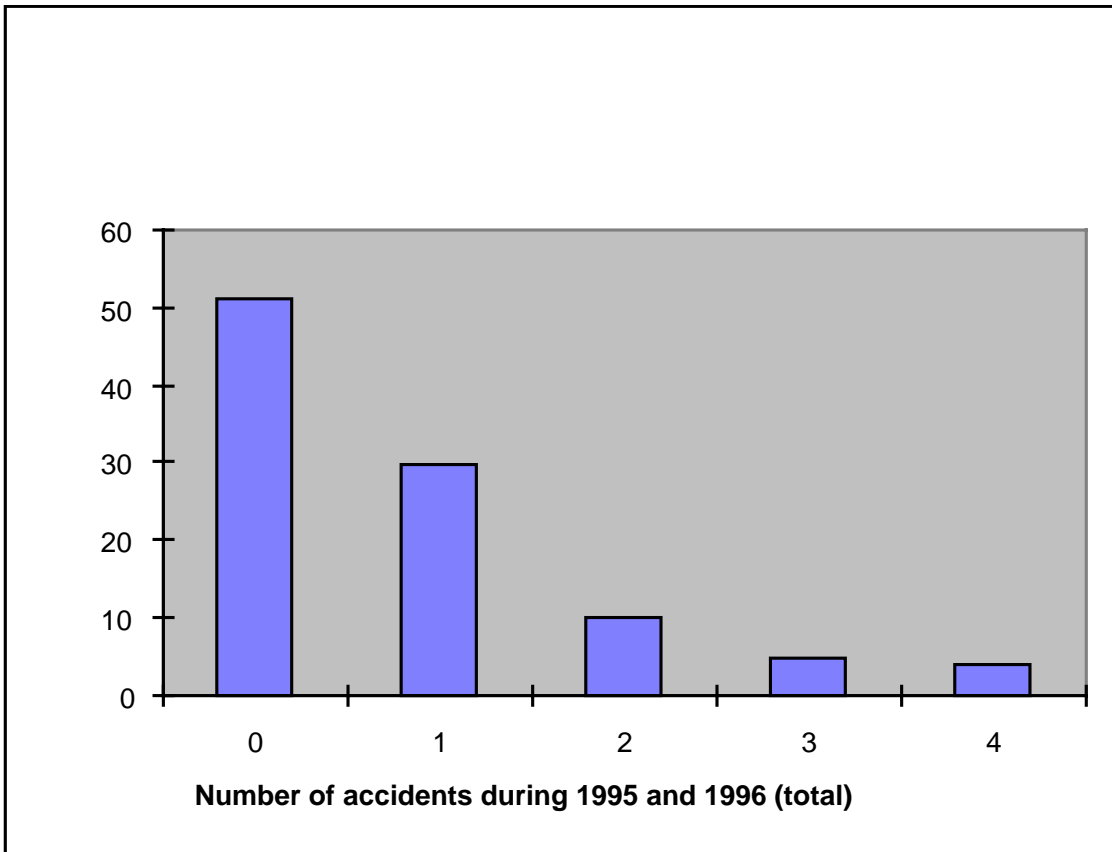


Figure 11: Percentage of drivers by accident rate for the 2 year study period (1995 and 1996).

The four main assumptions of linear regression were tested for the two models presented above. While the test for independence of error was satisfied (Durbin-Watson = 2.15 for accident rate, 2.18 for non-stationary accident rate), the tests of normality, linearity, and equality of variance all indicated that linear regression may not be appropriate for this set of data. The patterns observed in each case appeared to be related to the high number of drivers with zero accidents, and the effect of this on the overall linear regression procedure. The main problem that these patterns indicated was that prediction of accident rate for drivers with no accidents appeared to be prone to greater error than drivers with at least one accidents, which is not a surprising result given that approximately 50% of drivers had zero accidents for the two year period. To address the possible problems identified above, logistic regression was then considered for the variables of accident involvement and non-stationary accident involvement.

3.4 Prediction of accident involvement using logistic regression

Unlike linear regression, which deals with a continuous dependent variable, logistic regression uses a single dichotomous dependent variable, such as a non-accident/accident split. Fortunately, this dichotomous approach to accident rate is theoretically meaningful, as it provides an indication of the likelihood that a driver will either be involved in an accident or not, based on the independent measures that are found to be predictive. As a non-parametric test, it makes fewer assumptions than linear regression, and is an appropriate alternative when the assumptions of linear regression are not met.

The two cases analysed above (accident rate and non-stationary accident rate) were recoded into dichotomous variables and reanalysed using logistic regression. For the first case (non-accident versus accident), the overall model was significant (model chi-squared = 20.8, df = 4, p = .0003). In terms of individual predictors, the anger factor was significant at $p < .01$, vehicle type and average hours per shift were significant at $p < .05$, but the risk taking factor was not significant in this model, $p = .21$. Logistic models are best interpreted based on the relative contribution of each factor as a function of odds ratios. This function is the log of the odds of not having an accident (Odds NA) divided by the odds of having an accident (Odds A). The model was:

$$\text{Log(Odds A/Odds NA)} = 1.7(\text{Anger}) + 1.3(\text{Risk-taking}) + 1.2(\text{Average hours per shift}) + 1.5(\text{Vehicle type - sedan})$$

This model has the same set of relationships between predictor variables and accident rate as above, except that here vehicle type is based on comparing non-sedans to sedans (see equation). Risk-taking was retained in the overall model, however, due its importance in the two linear regression models, the second logistic model (see below) and its theoretical importance. Possible reasons for its lesser importance in this model are discussed below. The classification table of predicted group membership to observed group membership is given in table 8, and the overall percentage of correct predictions was 65.7%. Figure 12 presents the observed group for each driver compared to their predicted probability of group membership. There were no cases where the studentized residual for an individual was more than two standard deviations from the mean residual, indicating that the model was not unduly affected by outliers.

Observed	Predicted		Percentage Correct
	0	1	
0	53	20	72.6%
1	29	41	58.6%
Overall Percentage Correct			65.7%

Table 8: Observed versus predicted group membership for non-accident (0) versus accidents (1), based on logistic regression, including percentage of correct predictions for each group.

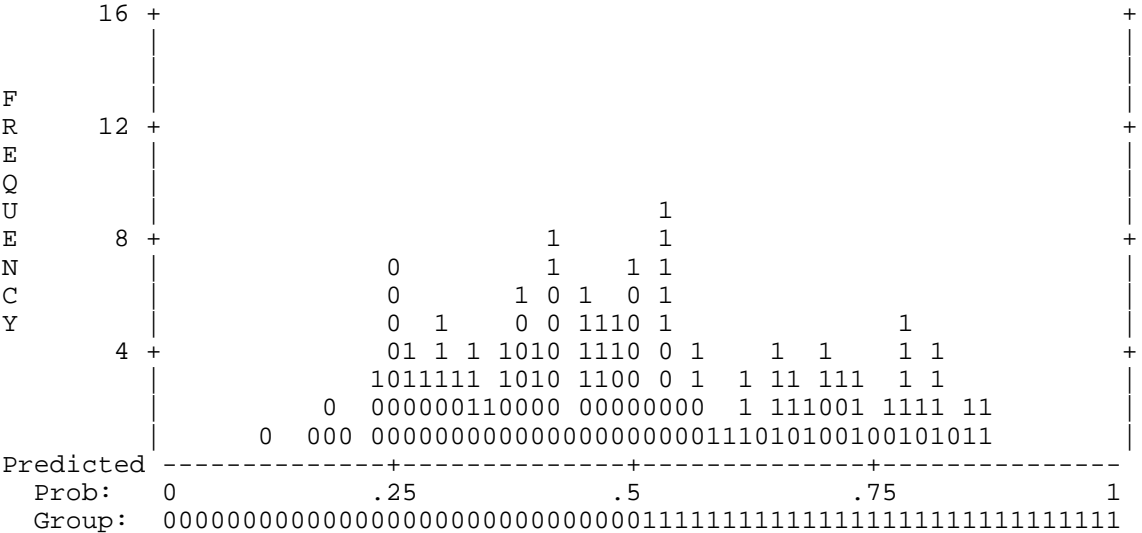


Figure 12: Observed group membership by predicted probability of group membership for non-accident (0) versus accident (1) drivers (from SPSS output). Y-axis indicates the frequency of cases for a given predicted probabilities, ranging from 0 to 1.

For the second model (non-stationary accident versus no non-stationary accidents), the overall model was significant (model chi-squared = 26.3, df = 4, $p < .0001$). In terms of individual predictors, the anger factor was significant at $p < .01$, the risk-taking factor and vehicle type were significant at $p < .05$, but average hours per shift was not significant in this model ($p = .19$). Again, the pattern of relationships between accident rate and predictors was the same as for the other logistic model. In this case, the logistic model is the log of the odds of

not being involved in a non-stationary accident (Odds NSA) divided by the odds of being involved in a non-stationary accident (Odds SA). The model was:

$$\text{Log}(\text{Odds SA/Odds NSA}) = 1.9(\text{Anger}) + 1.6(\text{Risk-taking}) + 1.1(\text{Average hours per shift}) + 1.7(\text{Vehicle type - sedan})$$

As above, average hours per shift was retained in the overall model for the same reasons as the inclusion of risk-taking above, and possible reasons for its lesser importance in this model are also discussed below. The classification table of predicted group membership to observed group membership for this second model is given in table 9, and the overall percentage of correct predictions was 73.4%. Figure 13 presents the observed group for each driver compared to their predicted probability of group membership, this time for non-stationary accidents versus no non-stationary accidents. There was one case where the studentized residual for an individual was more than two standard deviations from the mean residual, but this single outlier is not sufficient to unduly affect the overall model. This driver did not give permission to check his driving record, and thus it is possible that he may have incorrectly recorded his accident rate as zero.

Observed	Predicted		Percentage Correct
	0	1	
0	77	12	86.5%
1	26	28	51.9%
Overall Percentage Correct			73.4%

Table 9: Observed versus predicted group membership for no non-stationary accidents (0) versus non-stationary accidents (1), based on logistic regression, including percentage of correct predictions for each group.

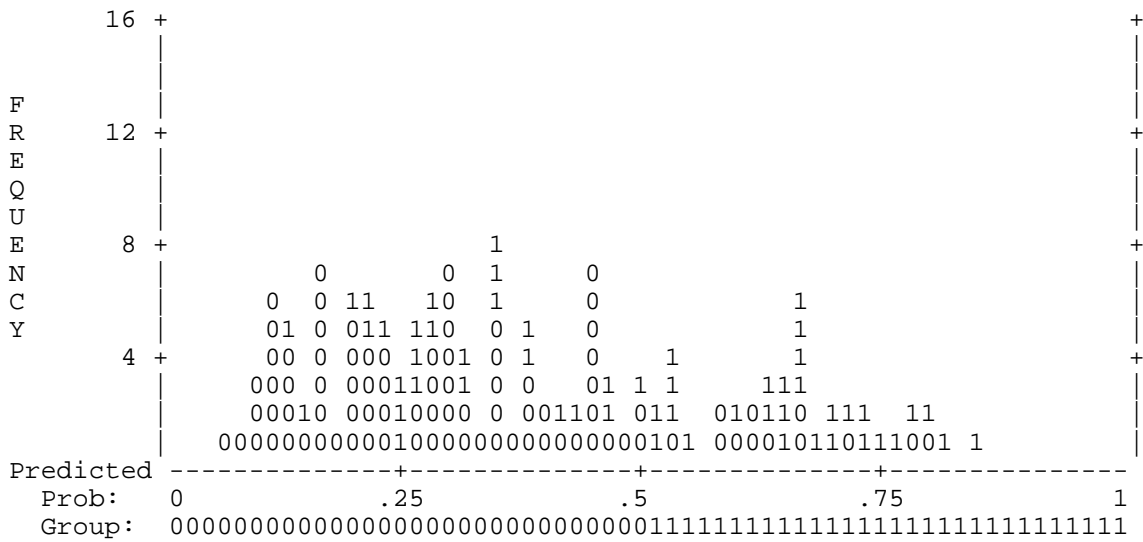


Figure 13: Observed group membership by predicted probability of group membership for no non-stationary accidents (0) versus non-stationary accident (1) drivers (from SPSS output). Y-axis indicates the frequency of cases for a given predicted probabilities, ranging from 0 to 1.

3.5 Prediction of violations

Using the same procedures as listed above, regression was used to predict violations - that is, receiving one or more fines for illegal driving behaviour (excluding parking fines). While most variables were not significantly related to violation rate, the anger subscale of aggression, time holding a taxi license, average kilometres driven per week and average kilometres per hour were found to be significantly correlated with violation rate. Significant group differences were noted for the categorical variables of rank/hails/both preference (1 way ANOVA, $F(2, 146) = 4.53, p < .05$), and shift type (day/night/semi-double; 1 way ANOVA, $F(2, 143) = 4.05, p < .05$). The four continuous variables were entered into a linear regression without coding dummy variables for the category data due to the possibility of violations of the assumptions of linear regression (as above). Initial attempts at model building indicated that average kilometres per hour did not make an independent contribution to the model once the other variables were taken into account, so it was removed from subsequent analyses. The remaining three factors were significant predictors of violation rate - the overall model was significant ($F(3, 140) = 6.69, p = .0003$) and accounted for 12.5% of the variance. Of the individual factors, both anger and time holding a taxi license had negative coefficients and were significant at $p < .05$, while total weekly kilometres had a positive coefficient and was significant at $p < .01$. The regression equation produced was:

$$\text{Violation rate} = .00064(\text{Total km/week}) - .052 (\text{Anger Subscale Total}) - .028(\text{Taxi license}) + 1.32$$

However, the same pattern of violations of the assumptions of linear regression that was found in the analysis of accident rate was observed here. This was not surprising, given that violation rate exhibited a similar distribution to accident rate (see figure 14). For this reason, logistic regression was again used, this time based on a dichotomous non-violation (NV)/violation(V) variable.

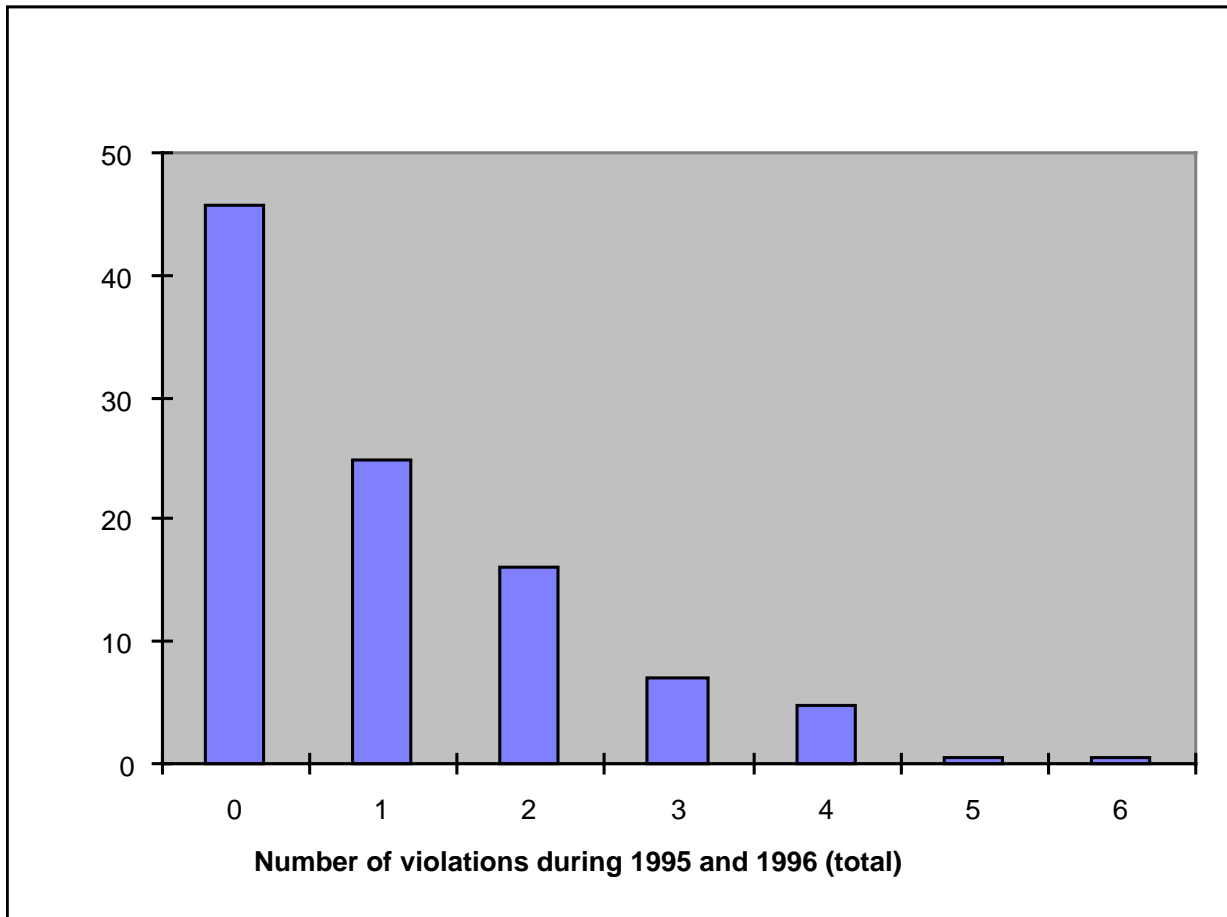


Figure 15: Percentage of drivers by violation rate for the 2 year study period (1995 and 1996).

As logistic regression allows for category variables, both rank/hails preference and shift type (day/night/semi-double) were included. Initial analysis indicated that average kilometres per hour, anger, and shift type did not make a significant contribution to the model once other variables had been included, and so only the variables of total km/week, time holding a taxi license and the category variable of rank/hails preference were included. The overall

model was significant (model chi-squared = 16.6, df = 4, p<.001), and increased total km/week and decreased time holding a taxi license predicting likelihood of a violation at p<.05. Drivers who hunted for hails (hails) were more than twice as likely to have received a fine as drivers who do not have a preference between ranks and hails, and drivers who wait on ranks (ranks) were half as likely to be fined as drivers with no preference(Comment: Is there any evidence that drivers who hunt for hails are under more economic pressure? More importantly, is there any evidence that hunting for hails is economically beneficial, after the fuel costs come out? If not then could outlawing this practice lead to a reduction in violations and serious crashes? Or is there no direct correlation between hunting for hails and serious accident rate? (both of these comparisons were significant at p<.05). However, the odds ratio associated with total kilometres per week was close to one, indicating that despite the significance of the overall model, this individual predictive factor was not a particularly clear discriminator. The model produced was:

$$\text{Log(Odds V/Odds NV)} = .9(\text{Taxi license} + 1.0(\text{Total kilometres per week}) + 2.1(\text{Hails preference}) + .5(\text{Rank Preference})$$

As in the accident rate logistic regression, there were no cases where the studentized residual for an individual was more than two standard deviations from the mean residual, indicating that the model was not unduly affected by outliers. Table 10 presents the predicted group membership according to the logistic model, and Figure 15 presents group membership by predicted probability.

Observed	Predicted		Percentage Correct
	0	1	
0	30	35	46.2%
1	15	64	81.0%
Overall Percentage Correct			65.3%

Table 10: Observed versus predicted group membership for no violations (0) versus violations (1), based on logistic regression, including percentage of correct predictions for each group.

4. DISCUSSION

Despite the normal difficulty in predicting factors associated with accidents, the above analyses present a reasonably compelling account of those factors associated with accident rate, and to a lesser extent, those associated with violation rate. The model presented for the prediction of overall accident rate (based on linear regression) accounted for 21% of the overall variance, which is according to Cohen & Cohen (1983) is a relatively good predictive model by commonly accepted standards within psychology, and therefore an important achievement in the field of road safety research. While the model for predicting violation rates was not as adequate (accounting for only 12.5% of the variance observed), the findings concerning the relationship between more serious accidents and violation rates are important. There are a number of qualifiers to these results, such as the problems of using a dichotomous variable in logistic regression, the violations of the assumptions of linear regression, the difference between the current time-based analysis and a kilometre-based analysis, and the relationships between statistics, theories and model building. Each of these is addressed below.

The slight differences in the significance levels of risk-taking in the first logistic model, and in average hours per shift in the second logistic model, may be due to the loss of some predictive power related to multiple accidents due to the truncation of accident rate to a simple “accident” category. In the case of all accidents, it is reasonable to argue that risk-taking may be particularly relevant to involvement in multiple accidents during the given time period, leading to a reduction in its overall contribution to the model once multiple accidents are reduced to a single accident category. Similarly, the reduction in the contribution of average hours per shift to the non-stationary accidents logistic model may be due to the possibility that removing all stationary accidents and then truncating non-stationary accidents to a single category may have removed accident variance mainly attributable to sheer exposure. This reduction of the importance placed on the length of time one is on the road, hence reducing the chances of involvement in an accident which is not strongly related to driver factors, may be the outcome of the use of this dichotomous variable. An example of an accident not strongly related to driver factors other than exposure is being struck from behind while waiting at a set of traffic lights, a case in which there may be no involvement of the driver in the causal processes that led to the accident, other than being on the road for long enough periods that this possibility might arise (or falling asleep at the wheel at the lights?). It should also be pointed out that it is common in some areas of research that use predictive models of this kind (such as in medical research) to retain non-significant variables on the basis that they do make some small contribution to the model despite failure to attain significance. This inclusion is often based on the variable being “clinically

interesting”, that is, related to some valuable theoretical issue which deserves inclusion even if it does not reach the criterion of significance used. Such inclusions, however, need to be viewed with caution, and replication of such findings are valuable in determining the importance of the model developed.

It is difficult to know how to assess the violations of the assumptions of linear regression. While these are potentially genuine problems, they do not seem to have adversely affected the general findings - that is, that several independent factors (anger, risk-taking, shift length and vehicle type) are related to involvement in accidents, as this pattern of predictors was more or less constant across the four attempts at model building. Other researchers (West, Elander & French, 1993) have noted a similar finding of consistent patterns regardless of whether linear regression or other methods are used, and the findings of the current project support this contention. It is argued here that the reason for the violations of linear regression is the relatively large proportion of drivers with zero accidents and the effect of this on the overall procedure. If the only result of this problem is greater error related to predictions for drivers with zero accidents, then this is not a substantial difficulty, as most of the interest in road safety research is primarily based on the predictors of having one or more accidents. The differences in the predictive models for violation rate between linear and logistic procedures may be related to this problem, but it may be a product of a less satisfactory overall model, which had considerably less explanatory power than its accident rate counterpart, thus producing unstable predictors. In the case of the current project, and in the absence of other criticisms from existing road safety research, it appears that the overall products of this exercise in building a predictive model for factors associated with accidents has been worthwhile.

An important distinction needs to be drawn between the time-based approach of analysis used here, and an “accident rate per kilometres driven” approach, which was not adopted. By basing our study on the number of accidents across a two year period for all drivers, regardless of the amount of exposure (above a baseline level of 1 shift per week), we have provided a predictive model which predicts the likelihood of accidents during a two year period based on aspects of the personality of the driver, the length of their average shift, and the type of vehicle they drive. However, this model does not take into account the number of kilometres driven by any particular driver in assessing their accident-risk, although kilometres driven was included as a potential predictor of accident rate and was found not to make a significant contribution to the model. This means that while the number of accidents per kilometre will vary from driver to driver - and that full time drivers are likely to have driven a much greater distance per year than casual or irregular drivers - that the relative kilometres driven is not a predictor of whether they are involved in an accident or not. Rather, the predictors are anger, risk-taking, average length

of shifts and vehicle type, and it is these, rather than kilometres driven, that predict accident involvement.

The final qualification concerns the general use of statistics, theory and model building presented here. As discussed in chapter 3 and in the early section of this chapter, road safety researchers need to use exploratory tools of analysis to a greater extent than in other more mature areas of scientific research. For this reason, null-hypothesis testing, based on specific predictions developed from well articulated theories is often not appropriate. However, significance levels can still provide some general indication of the possible strength of relationships (according to Fisher's view of statistics, Gigerenzer, 1993), although these will always need to be tested by further studies to replicate the relationships observed. A good example of the importance of attempts at replication is evident within this project. In our previous study, we noticed a significant negative correlation between average minutes of break during a shift and accident rate. This relationship was not sustained in the current research, although the direction of the correlation was in the hypothesised direction. All of the results in this chapter should be treated cautiously until further studies can confirm the importance of the identified factors, lest they be products of an unusual sample or error.

The similar findings for both total accidents and non-stationary accidents replicate an interesting finding of Parker et al (1995) that drivers more at risk of involvement in "active" accidents are also more at risk of involvement in passive accidents. While this may initially seem as a surprising finding, as passive accident would appear to involve little if any contribution from the "passive" driver in the immediate causation of the accident. However, as Parker describes it, "[those at higher risk of accident involvement] are not only more likely to run into others, but to put themselves in situations where others run into them". It is worth noting that this finding has been replicated for taxi drivers, and as an example of professional drivers, generally with greater experience than the average member of the public, this is an important extension of Parker's findings.

The results of the prediction of violation rate analysis are less satisfactory than those associated with accident rate, and the change in predictor variables appears to be related to the generally low level of prediction in the overall model. However, two findings related to accident involvement are important. First, there was no significant correlation between violation rate and accident rate - indeed, the direction of the correlation was negative. Second, despite the above finding, when violation rate was compared to only "more serious" accidents, such as those involving expensive repairs, towing or injury, there was a consistent significant pattern of higher violation rates for drivers who were involved in accidents of this kind as opposed to those who were not. This finding is not simply a product of greater risk-taking by the drivers concerned, which could be hypothesised to lead to both greater violation rates and more serious accidents, as this was not a significant predictor of these three accident

categories. (Comment: Could it also indicate that 'reported' risk-taking is not a reliable predictor of 'actual' risk-taking?) It seems that other factors, perhaps such as the effects on driving behaviour of mild social deviance (West, Elander & French, 1993), are the cause of the observed relationship. Regardless of the reasons, it appears that while violation rate is not significantly correlated with accident rate, it is related to the smaller category of “more serious” accidents.

While chapters 5 to 8 discuss the main variables studied in this project and their importance for taxi driver road safety in detail, some comments about the significant predictors discovered here are appropriate. The fact that two of the four predictors are psychological factors - that is, anger and risk-taking, is a significant finding for road safety research in general, and for psychological approaches to this topic in particular. Personality is one of the most promising areas of research in the prediction of driver behaviour accident involvement, and the current study further supports this contention. The finding that risk-taking, but not optimism bias, is a predictor of accident involvement is also important, given previous theories (Finn & Bragg, 1986; Matthews & Moran, 1986; Svenson, 1981) regarding the need to reduce driving optimism so as to reduce risk-taking, and hence reduce accident rates. The current findings help to clarify the theories involved here, as accident rate is related to risk-taking, but that optimism bias is not related to either risk-taking or accident rate. These issues are developed further in chapter 6.

The finding that average number of hours per shift, but not any of the other exposure measures, is related to accident rate is also an important finding. It indicates that on their own, driving longer distances, or working more shifts are not significant predictors of accident rate, but that overall length of shifts is important. While this indicates the role of exposure as a basic variable in predicting accident rates, it also implies that fatigue may be playing a role in overall accident rates via the intervening variable of shift length. This issue is discussed in more detail in chapter 7.

The finding that vehicle type is a significant predictor of accident rate is more difficult to explain. The casual observer might be tempted to assume that this must be due to some superior vehicle qualities of the wagon and special vehicles in terms of design over the normal sedan. However, anecdotal evidence from taxi drivers indicates that wagons are generally less “sturdy” on the road, and that sedans are generally preferred. There are two possible reasons for the finding observed here, both related to hidden driver selection factors. First, wagons are commonly owned by single vehicle owners, and as a result are often well maintained, as compared to sedans, some of which are maintained by taxi bases where maintenance levels are not always equivalent to individual owners. Second, wagons may be preferred by drivers who have a particular driving style which does not place drivers at equivalently great risk of accident involvement as other drivers, although there were no observed difference in risk-taking or anger between sedan and wagon drivers. Further research of the specific

differences between sedan and wagon drivers is needed to fully understand the possible reasons for the differences observed here.

Finally, some of the factors that were not significant predictors of accident involvement require acknowledgment. As mentioned, exposure variables other than average hours per shift, (i.e.?)-optimism bias, time holding a car or taxi license and age were not significant predictors. Apart from anger, the remaining aspect of aggression, and sensation seeking were not found to predict accident rate. The finding that sensation seeking was not significantly correlated with accident rate is contrary to Burns and Wilde's 1995 study of taxi drivers. However, sensation seeking is significantly correlated with risk-taking (which is a predictor of accident rate), thus indicating that sensation seeking does play some role in the overall causal mechanism that lead to accidents, via the factors that may motivate actual risk-taking behaviour on the road by taxi drivers. The findings of what is not a predictor, as well as what is, should be of considerable value to a greater understanding of the road safety issues relate to taxi drivers.

CHAPTER 5: JOB-RELATED VARIABLES AND DEMOGRAPHICS

1. INTRODUCTION

There has been limited research into taxi drivers and issues related to their road safety, and basic information about working conditions and driver demographics are difficult, if not impossible, to find (Dalziel & Job, 1997). As was discussed in the first chapter, there have been a number of studies reported in the literature that have used taxi drivers as subjects, but there is very little research specifically about taxi drivers themselves. This is surprising given the important role that taxis play in modern society as part of the transport system, and especially as an alternative to drink driving.

To help rectify this dearth of “basic” knowledge, the current study used a detailed and comprehensive set of questions concerning the working conditions of drivers and their experience of the job. These questions examined demographic issues such as: age, gender, ethnicity, and education; and five working conditions related topics: employment (employment type, additional work, and shift type - day/night/semi-double), experience (time holding a car and taxi license), exposure (weeks per year, average shifts per week, average km per shift, average hours per shift, etc.), the taxi vehicle (vehicle type, computer location and maintenance), and working style questions (driving style, rank/hails preference, city/suburb preference, breaks). These survey questions were the product of extensive industry consultation and are a development of questions used in the original 1993 survey, together with driver feedback following the 1993 study. Collectively, they represent the main facets of the experience of working as a taxi driver. For details concerning question wording, see the complete survey in Appendix A - especially Section 1.

In addition to basic knowledge about taxi driver demographics and working conditions, it is possible to examine how these variables relate to road safety issues. In the context of the current chapter, there are six major factors that may be of relevance. These are four different psychological traits - optimism bias, risk-taking, sensation seeking, and aggression; and two measures of driving behaviour outcomes - violation rates and accident rates. The first of these six comparison variables is optimism bias (Weinstein, 1980), specifically optimism about driving abilities compared to other taxi drivers (Dalziel & Job, 1994). While previous studies have mainly examined optimism bias on individual questions, it is preferable to treat the phenomenon as a set of related general constructs regarding optimism concerning one’s future. In the current study, optimism bias concerning a variety of driving abilities was shown to be based on a single “driving optimism” factor, and hence may be treated as a single variable, based on total scores for a “driving optimism scale” (see chapter 6 for further

discussion). In terms of demographics and the work-related variables listed, it was hypothesised that optimism would be positively correlated with age, and time holding a car and taxi license (based on previous findings that greater experience is related to increased optimism, Job, 1995), but it was not expected that there would be any further relationships with the other work-related variables examined.

The second major comparison variable is risk-taking while driving. Past studies of optimism bias have assumed that high levels of optimism are related to higher risk-taking (Finn & Bragg, 1986; Matthews and Moran, 1986; Svenson, 1981). In the current study, measures of both driving optimism and risk-taking were used to independently examine the effects of each of these factors on road safety issues (for further discussion of the relationship between these two variables, see chapter 6). Risk-taking, a general personality trait with wide ranging applications in human behaviour (Zuckerman, 1979, 1994), was expected to be related to general factors such as experience, exposure and driving style, as well as more context specific factors such as hunting for fares rather than waiting on ranks. In terms of the variables listed, it was hypothesised that risk-taking would be negatively correlated with age, positively correlated with average kilometres driven per hour and driving style (where lower driving style scores indicate more relaxed driving), and negatively correlated with number and total time of breaks; and that risk-taking would be higher in city drivers (relative to suburban drivers) and in those who hunt for hails (relative to those who wait on ranks). In general, risk-taking was expected to be higher for drivers who exhibit behaviours that suggest a less “relaxed” driving style, together with those behaviours that involve higher levels of sensory stimulation.

The third variable is sensation seeking, as measured by Zuckerman’s Form V Sensation Seeking Scale (SSS - Zuckerman, 1994). Sensation seeking is a general personality trait that is relevant to driving behaviour (Jonah & Clement, 1984). Of special relevance here is a study of taxi drivers conducted by Burns and Wilde (1995), in which sensation seeking was measured, and found to be highly correlated with driving at high speeds and careless lane changing. Sensation seeking was also found to be positively correlated with traffic violations, but there was no significant relationship observed between SSS scores and accident rate, although the authors acknowledge that this lack of relationship may be a product of their relatively small sample size (51 drivers) and the relative infrequency of motor vehicle accidents. In the current context, SSS scores were expected to be negatively correlated with age, positively correlated with average km/hour, positively correlated with driving style and negatively correlated with number and length of breaks; and higher SSS scores were expected for drivers who preferred the city (relative to the suburbs), and who preferred to hunt for hails rather than wait on ranks. In general, higher levels of sensation seeking were hypothesised to be correlated with behaviours which involve greater activity and risks, such as higher average km/hr and a preference for “hunting”

for fares rather than waiting passively for them on ranks. A significant relationship between sensation seeking and risk-taking was also expected (see chapter 8 for further discussion).

The fourth major comparison variable is aggression. Aggression scale scores have been shown to be related to actual aggressive behaviours (Buss & Perry, 1992), including driving behaviour (Donovan, Marlatt, & Salzberg, 1983). To overcome any problems related to situation specific measures of aggression (such as those used in some driving scales), a general aggression scale was used to measure this trait, rather than a scale that relates only to road behaviour. An appropriate scale of this type is Buss & Perry's (1992) aggression questionnaire. They argue that anger is central to the measurement of aggression, based on the fact that anger appeared to be the "bridge" between other aspects of aggression, as observed during the development of their aggression measure. Anecdotal evidence suggests that aggression is a common response for some taxi drivers to frustration caused by situations involving both traffic and passengers. In terms of the variable listed here, aggression was expected to be positively correlated with driving style. Further detailed discussion of aggression and taxi drivers is contained in chapter 8.

The fifth variable worth examining here is violation rate, that is, the number of traffic infringements (apart from parking fines) received during the two year study period. As violation rates provide a behavioural index of risky driving behaviour in the form of law-breaking, and indirectly measures exposure, it would be expected that violation rate would be negatively correlated with age, positively correlated with all exposure measures and with driving style; and that higher violation rates would be associated with drivers who hunt for hails (rather than sit on ranks).

The final, and arguably most important variable is accident rate, measured as the total number of accidents (of any sort) while driving a taxi during the two years studied. While significant correlates of accident rate have been difficult to find, the current study hypothesised that accident rate would be negatively correlated with experience, positively correlated with exposure, positively correlated with driving style, and negatively correlated with number and length of breaks; and higher accident rates would be expected for casual and irregular drivers (rather than permanent drivers and owners).

2. METHOD

A full discussion of the methods used for this survey are contained in chapter 3. Based on the variables of interest described above, the data presented below have been divided into the following sections: demographics, employment, experience, exposure, taxi vehicle, and working style. Within each area, two sets of analyses are presented. The first set of analyses explores "basic"

information gained from this survey for each of the areas listed above, and presents means and other simple statistics. The second set of analyses explores how the basic data presented relate to the six comparison variables of interest to a psychological approach to road safety issues: optimism bias, risk-taking, sensation seeking, aggression, violation rate, and accident rate. Data presented in the first part of each section will be based on all drivers answering these questions, which will usually be the total 165 drivers who returned surveys unless there were missing values. Data presented in the second part of each section are based on either overall one way analysis of variance calculations for category variables or correlation for numerical variables, using only the 151 drivers with sufficient experience and exposure information to justify inclusion in analyses that are based on some extended period of work as a taxi driver (minus any cases of missing values).

3. RESULTS

Results used throughout this chapter are based, in part, on the three correlations matrices presented below. Table 11 lists the correlations between job variables (excluding exposure variables) and the six comparison variables, table 12 lists the correlations between exposure variables and the six comparison variables, and table 13 lists the correlations among all job related variables (including exposure).

3.1 Demographics

The average age of taxi drivers returning surveys was 43 years, with a standard deviation of 11, and a range from 21 to 68 years. This is similar to the findings of our earlier study which found an average of 41 years, with a range of 20 to 69 years (Dalziel & Job, 1997). The vast majority of drivers are male - only two females returned surveys, and both of these had not been taxi drivers for long enough to be included in the accident analyses, due to insufficient exposure and experience (see chapter 3 for further details). This low percentage of females appears to be part of the nature of the industry - both Burns and Wilde (1995), and our 1993 study did not have any female drivers (for additional discussion of this issue, see chapter 2). Ethnicity was measured by a question about the "main language spoken at home". Of those surveyed, 56% spoke English as the main language at home, while 44% spoke a language other than English. Education was measured by a question about "number of years of formal education". The average length of education reported was 12 years, with a range from 3 to 20 years. This average is approximately equal to completion of secondary schooling, although this figure may be inflated due to some drivers misunderstanding the

question as “age when education was completed”, rather than “years of education”. Misunderstandings of this type would inflate an individual’s score by four to five years, thus making this variable potentially unreliable as a measure of actual education.

Of the hypotheses concerning demographic variables, there was a significant negative correlation observed between age and the variables of risk-taking, sensation seeking and aggression. However, no significant relationship was observed between age and optimism bias or violations. Education was not significantly correlated with any variables. A significant overall group difference was observed for age by employment type (owners = 47.7, permanent driver = 43.3, permanent casual = 41.7, irregular = 36.0, 1 way ANOVA, $F(3, 147) = 5.9$, $p < .001$).

3.2 Employment

Of the four employment types listed, 25% of drivers designated themselves as owners, 32% as permanent drivers, 27% as permanent casuals, and 16% as irregular drivers. When total hours on the road per week (see exposure below) was combined with any other regular non-taxi driving work or study, the total average hours of work per week is 58 hours, with a standard deviation of 16, and a range from 16 to 112 hours.

No significant group difference was noted for accident rate between employment groups, although a significant overall employment group difference was noted on sensation seeking scores (averages: owner = 10.0, permanent driver = 14.4, permanent casual 16.7, irregular = 12.4, 1 way ANOVA, $F(3, 143) = 8.2$, $p < .001$), although the relatively lower scores for irregular drivers is not as might have been expected.

The average number of shifts per week according to shift type was: day = 4.3, night = 4.1, and semi = 3.3, but the average kilometres per week according to shift type was: day = 1110km, night = 1310km, semi-double = 1560km, indicating that although day drivers work more shifts on average per week, they cover less kilometres during this time, most probably due to different traffic conditions compared to night drivers, and the longer average shift length of semi-double drivers (see below). A significant overall difference between shift types was found for age (day mean = 46, night mean = 40, semi-double mean = 48, 1 way ANOVA, $F(2, 142) = 5.3$, $p < .01$) and time holding a car license (day mean = 24, night mean = 27, semi-double mean = 19, 1 way ANOVA, $F(2, 142) = 5.4$, $p < .01$). Of the six comparison variables considered here, the only significant differences observed for shift type was for violations, (day mean = .7, night mean = 1.3, semi-double mean = 1.1, 1 way ANOVA, $F(2, 141) = 4.1$, $p < .05$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age		-0.14	0.01	0.88	0.49	-0.27	-0.10	0.09	0.07	-0.20	-0.19	-0.24	-0.11	-0.16
2. Education			-0.03	-0.11	-0.12	0.01	-0.04	-0.06	-0.04	0.00	0.09	0.13	0.02	-0.02
3. Total hours work/week				0.09	0.06	-0.01	0.11	0.13	0.05	0.01	-0.03	0.03	0.09	0.10
4. Car license					0.45	-0.26	-0.10	0.10	0.15	-0.23	-0.07	-0.26	-0.04	-0.14
5. Taxi license						-0.09	-0.22	0.09	0.16	-0.10	-0.14	-0.21	-0.17	-0.06
6. Driving style							-0.08	-0.16	-0.11	0.39	0.21	0.24	0.06	0.21
7. Number of breaks/shift								0.49	-0.03	0.01	0.06	-0.09	0.07	0.05
8. Total break length									0.11	-0.08	0.06	-0.04	0.00	-0.08
9. Optimism bias										-0.03	0.08	-0.03	0.10	-0.06
10. Risk-taking											0.37	0.35	0.05	0.23
11. Sensation seeking												0.18	0.11	0.12
12. Aggression													-0.05	0.18
13. Violation rate														0.09
14. Accident rate														

Table 11: Correlation matrix for job variables and the six comparison variables (9 to 14). Correlations above .17 are significant at alpha = .05 (2-tailed).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Average hours/shift		0.77	0.09	0.14	-0.06	0.09	-0.10	0.06	0.04	0.11	0.09	0.00	0.12	0.27
2. Average kilometres/shift			0.08	0.18	-0.04	0.12	-0.05	0.26	0.03	0.12	0.07	-0.10	0.04	0.09
3. Total hours/week				0.90	0.57	0.74	0.75	-0.10	0.11	0.04	-0.13	-0.03	0.17	0.05
4. Total kilometres/week					0.50	0.85	0.62	0.27	0.11	0.11	-0.03	-0.07	0.26	0.08
5. Total hours/year						0.71	0.72	-0.07	0.11	-0.13	-0.24	-0.14	0.06	-0.14
6. Total kilometres/year							0.50	0.26	0.06	0.06	-0.02	-0.09	0.26	0.07
7. Average shifts/week								-0.16	0.11	-0.11	-0.23	-0.14	0.05	-0.14
8. Kilometres/hour z-scores									0.03	0.11	0.10	-0.15	0.16	-0.01
9. Optimism scores										-0.03	0.08	-0.03	0.10	-0.06
10. Risk-taking											0.37	0.35	0.05	0.23
11. Sensation seeking												0.18	0.11	0.12
12. Aggression													-0.05	0.18
13. Violation rate														0.09
14. Accident rate														

Table 12: Correlation matrix for exposure variables and the six comparison variables (9 to 14). Correlations above .17 are significant at alpha = .05 (2-tailed).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age		-0.14	0.01	0.88	0.49	-0.27	-0.10	0.09	-0.07	-0.01	0.06	0.01	0.24	0.10	0.12	-0.10
2. Education			-0.03	-0.11	-0.12	0.01	-0.04	-0.06	0.01	0.00	-0.14	-0.10	-0.11	-0.04	-0.19	0.08
3. Total hours worked/week				0.09	0.06	-0.01	0.11	0.13	0.26	0.24	0.75	0.70	0.35	0.62	0.35	-0.04
4. Car license					0.45	-0.26	-0.10	0.10	-0.06	-0.03	0.11	0.09	0.23	0.17	0.09	-0.02
5. Taxi license						-0.09	-0.22	0.09	-0.04	-0.06	0.09	0.02	0.29	0.14	0.13	-0.15
6. Driving style							-0.08	-0.16	0.08	0.04	0.02	0.08	-0.10	0.05	-0.09	0.09
7. Number of breaks/shift								0.49	0.01	0.04	0.01	0.02	-0.04	0.00	-0.06	0.02
8. Average total length of breaks									0.03	0.06	0.01	0.02	0.06	0.04	-0.03	0.05
9. Average hours/shift										0.77	0.09	0.14	-0.06	0.09	-0.10	0.06
10. Average kilometres/shift											0.08	0.18	-0.04	0.12	-0.05	0.26
11. Total hours/week												0.90	0.57	0.74	0.75	-0.10
12. Total kilometres/week													0.50	0.85	0.62	0.27
13. Total hours/year														0.71	0.72	-0.07
14. Total kilometres/year															0.50	0.26
15. Average shifts/week																-0.16
16. Kilometres/hours z-scores																

Table 13: Correlation matrix for all job variables (including exposure). Correlations above .17 are significant at alpha = .05 (2-tailed).

3.3 Experience

The average period of holding a car license for taxi drivers is 22 years, with a standard deviation of 11, and a range of from 2 to 44 years. The average period holding a taxi license is 10 years, with a standard deviation of 8, and a range of 1 month to 36 years. However, time holding a taxi license was positively skewed, with only a third of drivers having more than 10 years experience as taxi drivers (see figure 16). The average age of drivers when they first begin taxi driving is 33 years (with a standard deviation of 10 and a range from 19 to 59 years), and the average time holding a car license prior to beginning taxi driving is 12 years. Approximately 14% of drivers began taxi driving before the age of 24 years. Of the 13 drivers removed from the accident analyses reported elsewhere due to lack of exposure, 11 of these had a year or less of experience as a taxi driver. A total of 29 of the 165 drivers (18%) surveyed had been working as taxi drivers for 2 years or less.

The correlation between time holding a car and taxi license ($r = .45$) indicates that while these variables are strongly correlated, they are far from the same measure - individuals begin their careers as taxi drivers at many different ages. Time holding both a car and a taxi license were negatively correlated with aggression, and there was also a significant negative correlation between risk-taking and time holding a car license, and between violations and time holding a taxi license. While not reported in the correlation matrix, there was a significant positive correlation between the overall optimism scale (both taxi driver and general public comparison groups combined) and time holding both a car and taxi license ($r = .17, p < .05$)

3.4 Exposure

The average number of weeks of work during 1995 and 1996 was 37 weeks, although this number is misleading due to new taxi drivers and those who only do taxi driving as a "second job" (those who have other work commitments). When these drivers are omitted from the analysis, the average number rises to 43 weeks per year, with 30% of drivers working 50 or more weeks per year, and 8% working every week of the year. The average number of shifts per week is 5, with a standard deviation of 1.3 and ranging from 1 to 7. The average distance travelled and hours on the road varies from shift to shift and from day to day. The following table summarises these averages for day shifts, night shifts and semi-doubles.

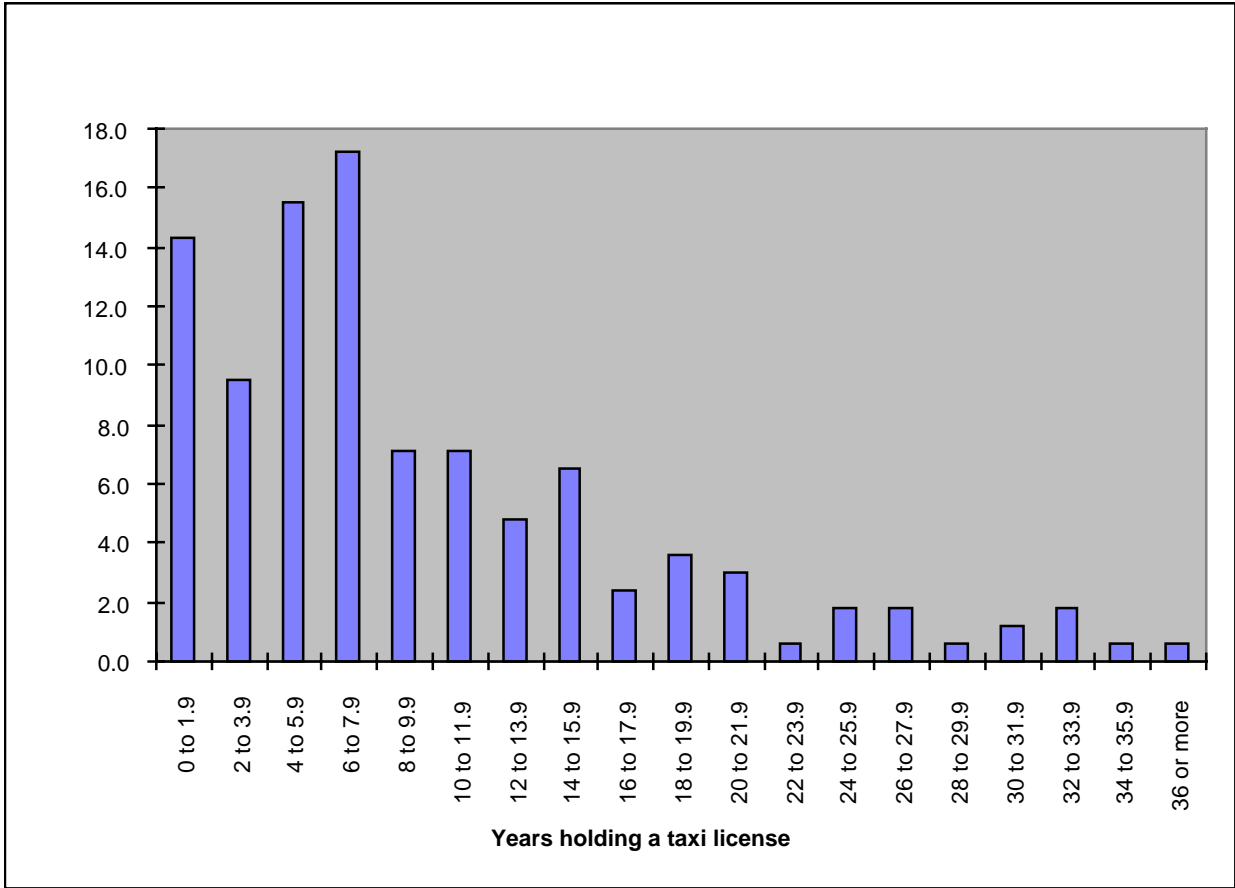


Figure 16: Years holding a taxi license by percentage of all taxi drivers returning surveys.

	Day hrs	Night hrs	Semi hrs	Day km	Night km	Semi km
Monday	9.5	10.1	13.1	210	247	301
Tuesday	9.5	10.2	13.0	211	249	300
Wednesday	9.5	10.6	13.5	211	264	306
Thursday	9.6	11.1	13.4	216	283	315
Friday	9.6	11.7	14.5	218	327	349
Saturday	9.7	10.8	14.3	217	287	364
Sunday	9.8	9.4	16.0	218	235	403

Table 14: Averages for total hours on the road and total kilometres driven for day, night and semi double taxi driver shifts for each day of the week.

The weekly average time on the road for day shifts is 9.6 hours, the weekly average for night shifts is 10.7 hours, and the average for semi-doubles is

13.9 hours. The weekly average distance driven for day shifts is 214km, for night shifts, 270km, and for semi doubles, 334km. It should be noted that these weekly averages are not simply the averages of the above values due to variation in number of drivers working any particular shift. The average total hours on the road per week for all drivers surveyed is 51 hours, and the average total distance driven is 1200km per week. However, these figures include both full time (4 or more shifts per week) and “part-time” drivers (less than 4 shifts per week). If the calculations are based on full-time drivers only, the average number of shifts per week is 5.4 shifts, the average time on the road per week is 59 hours (with a range from 39 to 101 hours), and the average distance driven is 1400km per week (with a range from 500 to 2600km). In terms of total exposure per year, the total average hours per year for a taxi driver is approximately 1800, and the total average kilometres driven per year is approximately 51,000. For full-time drivers only, the total hours rises to approximately 2,230 hours on the road per year, and to approximately 61,500 kilometres per year. Of the 165 drivers surveyed, six drove over 100,000 km/year. The average kilometres covered per hour for taxi drivers is approximately 24km/hr, although there are important shift differences - for days, 22.5km/hr, for nights, 25.6km/hr, and for semi-doubles, 23.9km/hr. For this reason, average km/hour was converted to a z-score, based on the type of shift driven. This process minimises the different effects of traffic density on potential km/hour according to time of shift.

The correlations among exposure variables provide general support for a distinction between hour and kilometre-based measures of exposure. While strong positive correlations exist between these two types of measures, they are far from perfectly linear, indicating that each of these approaches captures different exposure data. Greater discrepancies exist between yearly measures, which indicates that taxi driver work patterns across a year period are not particularly stable for some drivers.

A significant positive correlation was observed between weekly and yearly total kilometre exposure measures and violation rate. Also, a significant set of relationships between total hours per year and age, time holding a car and taxi license was observed, indicating that older, more experienced driver tend to drive more than others per year.

Due to the fact that average hours per shift was found to be a significant predictor of accidents in chapter 4, comparisons were made between this variable and others discussed in this chapter to find any important covariates. Other than those reported in the correlation matrix (average kilometres per shift and total hours worked per week - both of which are partly based on average hours per shift), the only other significant relationship observed was between average shift hours and shift type (as reported above - day drivers have the lowest average shift hours, and semi-double drivers have the highest).

3.5 Taxi vehicle

Of the three main vehicle types, 74% drove sedans, 23% drove wagons, and 3% drove “special vehicles”, that is, taxis that have been designed for transporting passengers with disabilities, such as people using wheelchairs. Unlike the taxis of the past that used a radio-based job dispatching system, current Sydney taxis use a computer based system. While there are several particular computer models used for this purpose, all of them have a small LCD display (which can usually be illuminated for night driving) with space for approximately 4-8 lines of text of around 60-80 characters. The entire unit is typically 20-30cm long, approximately 5-10cm wide, and around 5 cm in depth, but its mounting location varies. Of the three main locations, 71% are mounted on the right-hand side of the steering wheel on top of the dashboard, 16% are mounted on the left-hand side of the steering wheel (ie, in the centre of the vehicle) on top of the dashboard, and 9% are located on the left-hand side of the steering wheel at approximately the same height as the centre of the steering wheel (that is, below the dashboard). A further 4% of computers were at another location, and there were no taxis without a computer.

In terms of perceived vehicle maintenance, 73% of drivers described their vehicle as “well” or “very well” maintained, with 22% of drivers describing their vehicle as satisfactory, and 5% of drivers describing their vehicles as “poor” or “very poor”. The 1993 study had six questions on taxi quality, and while these questions did not have the same wording or response scale as the current study, one of the 1993 questions is worth mentioning here. In response to a questions about the overall quality of the taxi vehicle, 55% described it as better than satisfactory, 30% described it as satisfactory, and 15% described the taxi vehicle as worse than satisfactory.

While no predictions concerning the relationship between the type of taxi vehicle driven and the six comparison variable were specified, it seemed appropriate to examine any variables potentially related to this factor due to its importance in the models developed in chapter 4. Despite its significant prediction of accident rate, no relationships were found between any of the comparison variables and vehicle type, nor were any relationships discovered between any of the remaining job variables and vehicle type.

3.6 Working style

Drivers were surveyed concerning the general location in which they spent the majority of their driving time: 35% mainly worked in the city (CBD), 18% mainly worked in the suburbs, and 47% of drivers worked in both areas approximately equally. Drivers were also asked whether they preferred to hunt

for hails (“hails” are people waiting by the side of the road trying to flag the first cab that drives past) or wait on taxi ranks. While most drivers (64%) do not have a preference, 24% of drivers prefer to hunt for hails, and 12% prefer to wait on taxi ranks. The average number of breaks per shift is 2, with a range from 0 to 5. The average total minutes of break per shift is 42, ranging from 2 to 160 minutes. Many drivers either have one relatively long break (30 to 60 minutes), or several shorter breaks (eg three breaks of 15 minutes each).

When questioned about their overall driving style on a four point scale, 3% of drivers described themselves as “very hard” drivers and 22% described themselves as “moderately hard” drivers, while 54% described themselves as “moderately relaxed” drivers and 21% described themselves as “very relaxed” drivers. This driving style question was recoded so that higher values indicated a “harder” approach to driving, and lower values indicated a more relaxed approach to driving. This question was significantly correlated with many of the other measures discussed here, including age ($r = -.27$) and time holding a car license ($r = -.26$), as well as risk-taking ($r = .39$), sensation seeking ($r = .21$), aggression ($r = .24$), and accident rate ($r = .21$). However, driving style was not significantly correlated with any of the exposure measures, or with optimism bias or violation rate. Also, there were no significant group differences between category variables, such as rank/hails or city/suburbs preference, and driving style.

4. DISCUSSION

The following discussion of the above data is divided into the six categories in which it was presented (ie, demographics, employment, experience, exposure, taxi vehicle, and working style), followed by some general concluding comments. This information should be of interest to those who wish to gain a detailed understanding of taxi driver demographics and working conditions, and their relationship to psychological aspects of driving behaviour, together with violation and accident rate. However, due to the exploratory nature of this work, and the lack of other studies with which to compare these data, the results presented here should be viewed with some caution, and significant results should be interpreted judiciously. Further research is needed to expand general knowledge about taxi driver working conditions and their correlates.

4.1 Demographics

There are several interesting aspects of these results. The extremely low representation of women within this industry is striking, and it appears that of the few existing female drivers, some of these only remain within the industry

for a relatively short period of time. This finding also indicates that where results of this study can be argued to be relevant to the general public (such as in optimism bias and risk-taking), these results may only be applicable to males - further research of the general population is needed to explore the relationship between gender and the topics discussed in this report. The large number of drivers from non-English speaking backgrounds (NESB) is also a common facet of taxi industries, although this finding is different to that of our previous study, in which only one driver did not speak English at home. The reason for this difference is that the earlier study was based on a single regional taxi cooperative, based in an area with a low percentage of people from NESB backgrounds, whereas the current study was a Sydney-wide survey of drivers from all areas, and hence more representative of the entire workforce. This high proportion indicates that while English language ability is a license requirement of all taxi drivers, drivers come from a wide variety of cultural backgrounds, and hence education of drivers needs to be presented in ways that are appropriate to those from both English speaking and non-English speaking backgrounds.

The negative correlation between risk-taking and age indicates that older drivers do not, in general, take as many risks while taxi driving, although the model presented in chapter 4 notes that once risk-taking has been included in the prediction of accident rates, age is not an additional separate predictor. While the correlation between age and optimism was not significant, the positive sign of the correlation is in keeping with previous research that suggests that optimism bias increases with age (Job, 1995). These findings imply that while age itself is not a major factor in taxi driver accidents, it is related to risk-taking, and therefore older taxi drivers (on average) take less risks while driving than younger drivers, although there will obviously be many individual exceptions to this finding. The age difference by employment type finding is not surprising - owners need to accumulate considerable finances prior to purchasing a taxi vehicle and license plates. The finding that casual and irregular drivers are generally younger indicates that where these driver have higher accident rates than other types of drivers, this is not solely due to age, but rather that age is influential in other important factors such as risk-taking.

4.2 Employment

The employment type question illustrates clearly to the external observer that not all taxi drivers experience the same working conditions - there are important intra-industry differences between drivers. Some taxi drivers are owners of their vehicles, some drive full-time, some part-time, some only drive irregularly. However, regardless of the type of employment, the vast majority of taxi drivers work long hours. The average time on the road as a taxi driver is 51 hours per week, and when this work is combined with any other work or study

completed “on the side”, the average total work for a taxi driver is 58 hours per week. These long hours, combined with the apparently poor financial rewards and lack of personal safety (see chapter 9) would appear to make taxi driving one of the less rewarding jobs in modern society.

While the average number of shifts per week is greatest for day drivers (when compared to night drivers and semi-double drivers), it is important to note that average kilometres travelled shows the opposite pattern, indicating that semi-double drivers cover the most distance per week. The higher violation rates for night and semi-double drivers may be related to the greater distances they cover per week, in conjunction with lower traffic density at night. The age difference indicates that night drivers tend to be younger, and hence less likely to be owners. The finding that sensation seeking levels are higher in night drivers is probably related to this age difference, perhaps combined with the fact that taxi driving at night tends to involve more “excitement” from dealing with a greater percentage of inebriated passengers. Day drivers, particularly older day drivers, give their reason for not driving at night as mainly due to trouble from passengers, rather than any aversion to the time of day itself.

4.3 Experience

One of the most interesting findings regarding taxi driver experience is the wide variety of ages at which drivers begin their taxi driving “career”. Drivers enter the profession at many different stages of life, and for many different reasons, and this is reflected in the variety of starting ages. Time holding a taxi license is also varied, and while there are some taxi drivers who have worked in the industry for over ten years, they are a minority group. The relatively high number of drivers with little experience tends to indicate that the workforce is not particularly stable, and discussion with drivers supported this impression. While it is possible that taxi driving involves special driving skills over and above the general driving skills acquired in the early years of having a license, the pattern of relationships to other variables was very similar for both car and taxi license, indicating that time holding a car license is probably the more important general predictor.

4.4 Exposure

The extensive exposure data reported here provides detailed information on the differences across both shifts and drivers. Day shifts are generally shorter and cover relatively less distance (even accounting for their shorter duration?). Night shifts are generally longer and cover more distance, whereas semi-doubles tend to be the longest shifts and cover the most distance, in particular, the

Sunday semi-double shift. The reason for the Sunday pattern is that there is limited work available during either the day or night shift on this day, and hence some owners and drivers work a single long shift (as opposed to two relatively short shifts). While most drivers work from 4 to 6 shifts, a number work less (as casual drivers) - but these drivers frequently have other jobs, bringing overall working hours to the high average reported (58 hours per week).

The calculations for total exposure per week were based on the figures for individual days, together with driver comments about their usual weekly work pattern. These self-reported figures by drivers for average time and kilometres driven are a good reflection of actual figures due to the job requirement of completing a "worksheet" at the end of each shift which includes entries for both total time and total kilometres, hence acquainting drivers with these figures on a regular basis. Calculations for total exposure per year are based on a question regarding the number of weeks worked per year combined with the results of the weekly analysis. This process appears to have yielded more appropriate total yearly exposure figures than those derived from single "how many kilometres did you drive last year?" style questions, as were used unsuccessfully in our 1993 study, and also in Burns and Wilde's (1995) study of taxi drivers. Another important finding for these analyses is the substantial differences between hours and kilometres driven - these two exposure estimates do not exhibit a perfect linear relationship, and considering the important shift differences in these figures, acknowledgment of both of these exposure measures seems important for research on this group of road users. While the current project has generally used a time-based approach to analysis, it would be interesting to attempt a kilometres-based approach to the study of taxi drivers. However, as many of the variables of interest cannot be easily or accurately measured on a "per kilometre" basis, a time based approach was preferable for this project.

The significant relationship between total weekly and yearly kilometres and violation rate is probably related to average speed and time of day, as noted above. The significant shift type relationship with average hours per shift is indicative of possible trends in taxi driver work patterns that have already been noted, that is, older day drivers tend to drive shorter shifts and cover less distance, and have less accidents, whereas younger night drivers drive for longer during their shift and cover greater distance. However, these trends conflict in the case of semi-double drivers, who are older, but drive for longer. In this case, time on the road is the more important determinant of accident rate. However, all of these trends should be viewed with caution, as there will be many exceptions to these, and there are other more important predictors of accident rate than age and shift type, such as anger and risk-taking.

(Question: I'm interested in the question of whether drivers who work other jobs have a higher accident rate/distance or are more likely to have fallen asleep at the wheel than other drivers, as you might expect if fatigue were an issue. Do you have any data that might cast some light on this?)

4.5 Taxi vehicle

While the majority of taxi vehicles are sedans, a substantial minority of these vehicles are station wagons (with a much smaller percentage being vehicles for people with disabilities). The interesting finding concerning vehicle type is its predictive nature in the models presented in chapter 4, and the fact that there appear to be no other variables which are related to vehicle type. There are two possible reasons for this finding: first, that sedans are not as safe as the other vehicle types due to some unknown aspects of vehicle design that plays a causal role in the occurrence of accidents. However, from discussion with drivers, this option seems unlikely, as the wagon vehicle is viewed by drivers as less, rather than more, safe in terms of its handling on the road (when compared with a sedan). A second possible reason arose from discussion with drivers which indicated that wagon drivers do not necessarily have the same working patterns as sedan drivers. The reasons for this relate to the greater storage capacity of the wagon vehicle, which is often used for “longer” fares such as trips to the airport. In addition, there may be other more subtle differences between wagon and sedan drivers related to personality and motivation which are yet to be discovered. Further research into the differences between sedan drivers and wagon drivers is needed to explore this possibility.

The finding of higher levels of perceived vehicle maintenance in the current study (as compared to the 1993 study) is almost certainly the result of new regulations introduced during the intervening period which placed an upper limit on the age of taxi vehicles (of six years). This change resulted in many older vehicles being “decommissioned”, and new vehicles being purchased to take their place. Discussion with drivers and subjective impressions of the current taxi fleet indicate an improvement in overall vehicle quality during the past four years.

4.6 Working style

The findings regarding working style again indicate the heterogeneity of working patterns among taxi drivers. For example, some prefer to work in the CBD, while others prefer the suburbs, and some prefer to “hunt for hails” (that is, travel along main roads where fares are common in the hope of being hailed), while others prefer to wait on ranks for their fares. In terms of breaks during the shift, drivers tend to have several shorter breaks, or a single long break (often around the middle of the shift). Total break time was not significantly related to accident rate in this study.

The driving style question appears to be the best single item predictor of accident rate found in this study, and scores on this simple four point question were correlated with many of the major variables examined here, such as risk-

taking, sensation seeking and aggression. It appears that the dimension of relaxed to hard driving is a good “marker” for both driving outcomes (risk-taking and accidents) and the causes of this approach to driving (sensation seeking and aggression). However, discussions with drivers indicated that an additional important causal factor in driving style may be missing here - that of need for earnings (see chapter 8 and 9). Drivers report taking more risks and being more likely to be involved in accidents if they are forced by external financial pressures to gain levels of income beyond that which they normally acquire. Further research is also need to explore the influence of this factor in driver behaviour and accident involvement. On the basis of the findings here, the driving style question is suggested as a good single item measure for field research where time is at a premium. (Comment: The finding that 'hard driving' is correlated with higher accident rates is of interest to FORS from the point of view of getting across the message to corporate fleets that 'hard driving' is not only expensive, but dangerous. What would be interesting in the context of taxis is to find out whether 'hard driving' actually means that you earn any more per shift, after fuel. If you don't then it's just a practice that is expensive, dangerous and frightening to the customers and we have a strong case for reform.

4.7 Summary

This chapter presents detailed information concerning the working habits of taxi drivers, and included data on many of the variables that relate to the job of taxi driving. The overarching theme of the findings presented here is that not all taxi drivers are similar, nor do they experience similar working conditions, nor do they drive in similar ways - there is a great deal of variation between drivers on most of the questions considered. Images of taxi drivers which assume that they are “all the same” are far from accurate, and any approach to studying, educating or regulating this industry needs to begin by recognising the diversity among drivers.

Some of the more important findings here include: the wide range of experience among taxi drivers (which is not solely based on age differences); the many differences between day, night and semi-double drivers; and the various possible exposure measures that are relevant to taxi drivers, and the differences between these measures. The finding that vehicle type was a significant predictor of accident involvement, but that no other variable was related to this variables is a fascinating result that will require more research to explore possible reasons for this finding. Finally, the single item driving style question was found to be correlated with many of the factors of interest to this study, and hence is recommended as a question for future field research where there is insufficient time to explore all of the measures of personality and attitudes examined in this report.

CHAPTER 6: OPTIMISM BIAS AND RISK TAKING

1. INTRODUCTION

Optimism bias can be defined as a systematic error in perception of an individual's own status relative to group averages, in which negative events are seen as less likely to occur to the individual than average compared with the group, and positive events as more likely to occur than average compared with the group (Weinstein, 1980). Also referred to as unrealistic optimism, this effect has been replicated in numerous general studies (Perloff, 1987; Perloff & Fetzer, 1986; Weinstein, 1982, 1983, 1984, 1987; Weinstein & Lachrendo, 1982) and in a series of studies into the relationship between optimism bias and driving behaviour (Dalziel & Job, 1994, 1997; DeJoy, 1989, 1992; Finn & Bragg, 1986; Job, 1990, 1995, Matthews & Moran, 1986; McCormick, Walkey and Green, 1986; McKenna, 1993; McKenna, Stanier & Lewis, 1991; Svenson, 1981; Svenson, Fischhoff & MacGregor, 1985). The robustness of this phenomenon has now been demonstrated over many different scenarios, including different types of questions, different cultural groupings, and different age groups (Job, 1990; Perloff & Fetzer, 1986; Weinstein, 1987).

In road safety research, optimistic biases have been established regarding chances of accident involvement and injury (DeJoy, 1992; Job, 1990; McCormick et al, 1985), despite Weinstein's (1980) initial finding of pessimism concerning injury in a motor vehicle accident. Several studies have also investigated optimism bias in risk perception and risk taking (Dalziel & Job, 1994; DeJoy, 1989, 1992; Finn & Bragg, 1986; Matthews & Moran, 1986; Svenson, 1981). The consistent conclusion of this research is that optimism bias exists for a wide range of road-related events (e.g., accidents, injury), as well as for individual driving behaviours (e.g., risk-taking, driving abilities). Optimism bias and risk perception are among the most promising examples of the importance of attitudes to road safety research within the current literature.

However, the empirical relationships between optimism bias, risk-taking while driving and accident involvement remain unclear. Some past research and road safety advertising campaigns have been based on the assumption that high levels of optimism are related to feelings of unrealistically high ability and invulnerability, which lead to greater risk-taking, ironically resulting in higher accident rates (Finn & Bragg, 1986; Matthews & Moran, 1986; Svenson, 1981). But in most studies, data are only collected regarding optimistic attitudes to road events, driving abilities, risk perception and/or risk-taking alone, without the essential comparison measures of accident rates or actual risk-taking while driving. While DeJoy (1992) attempted to rectify this problem through a "problem driving index" (a combined scale of self reported accident

involvement, violations, and licence revocations), the best test of the empirical applicability of optimism bias is examining its relationship to actual risk-taking while driving and accident rates.

While a few studies have examine roads safety issues as they related to taxi drivers (Burns & Wilde, 1995; Corfitsen, 1993; Edwards, Hahn & Flieshman, 1977; Koh, Ong, & Phoon, 1986; Lisper, Laurel & Stening, 1972; Tillman & Hobbs, 1949), no studies of taxi drivers by other researchers have explored the role of attitudes (such as optimism bias) and their relationship to actual risk-taking and accident rates. However, our 1993 study indicated that these issues may be worthwhile avenues for future research on taxi drivers (Dalziel & Job, 1994). Thus, in the current study, several optimism bias and risk-taking issues were considered in further detail, such as: basic levels of optimism bias in taxi drivers and differences in optimism scores for alternative comparison groups, the development of a general driving abilities optimism scale, the development of a taxi driver risk-taking scale, the role of controllability in optimism bias, the relationship of context to optimism bias concerning accident involvement, the relationship between optimism bias and illegal driving behaviours, and the relationship between the optimism and risk-taking scales and their connection to accident rate and other variables of interest. These conceptual background to these issues is developed below.

1.1 Optimism bias and risk-taking

There are two problems associated with the measurement of optimism bias. First, the comparison group used for the questions must constitute a genuine basis for examining possible optimism. Existing research (Job, 1990) suggests that tests of true optimism bias should use comparisons relative to a person of the same age and sex as the respondent. Further, in the case of taxi drivers, comparisons with members of the general public may be misleading if taxi drivers (as a group) perceive their driving abilities to be superior to those of the general public, as we found in our 1993 study (Dalziel & Job, 1994). For this reason, it is appropriate to use “the average taxi driver of the same age and sex as yourself” as the main optimism bias comparison group. An additional “average motorist of the same age and sex as yourself” comparison group can be included to examine the relationship between optimism for different comparison groups, and to confirm the earlier finding that taxi drivers perceive their group as having superior driving abilities to the average motorist.

The second difficulty in the measurement of optimism bias is that past research has used individual questions for comparisons with other variables (such as accident rate), but these questions have not been combined to form either a “general optimism factor” or “issue-specific optimism factors” (or both). For this reason, it is unclear whether the different questions used constitute a

general predisposition to think optimistically when individuals compare themselves to groups, or if the exhibited optimism is only question specific. If optimism bias is not a general trait, then the results of optimism bias studies should be recognised as being based on only question specific effects. When Stankov (1996) examined the relationship between individual optimism questions and a possible optimism factor (based on all questions combined), his results only indicated question specific effects. However, this may not be the case for optimism regarding particular issues, such as driving abilities. The current study sought to address this issue by including a set of driving abilities questions, in order to examine whether “driving abilities optimism bias” constituted a single factor. In addition, if a single factor was found and thus a scale could validly be constructed, this general predisposition to optimistic thinking about driving abilities could be compared to accident rate and other variables of interest.

The most appropriate way to test the assumption that optimism bias leads to increased risk-taking (due to perceived greater skill and invulnerability) and hence eventually to increased accident rate is to specifically test each step in this theory. The potential for the development of a driving abilities optimism scale has been described above, but a scale that measures actual risk-taking behaviour while driving is needed to test the second step in this theory. Without this scale, it is difficult to disentangle the relative contribution of either optimism or risk-taking to accident rate, or the possible relationship between these variables. Further, a general risk-taking scale may fail to capture risk-taking behaviours related to the specific demands of the job of taxi driving. For this reason, it was decided that a new “taxi driver risk-taking” scale would be developed for the current project. This scale could include questions concerning general risk-taking while driving (such as speeding, illegal U-turns, and running red lights) and risk-taking specific to the job of taxi driving (such as cutting across traffic to get to a person hailing the taxi even when there is a slight risk of an accident). Due to the successful applications of the Driving Behaviour Questionnaire (DBQ -Parker, Reason, Manstead & Stradling, 1995; Parker, West, Stradling & Manstead, 1995) in studying the frequency of particular driving behaviours in the general population, the same response categories as used in the DBQ were considered appropriate for the more specific taxi driver risk-taking scale developed here.

Based on the theory outlined above, it was expected that the driving optimism scale would be positively correlated with both risk-taking and accident rates, and that the risk-taking scale would be positively correlated with accident rates. To better understand possible causes of both optimism bias and risk-taking, the relationships between the optimism bias and risk-taking scales and age, time holding a car and taxi license, sensation seeking (Zuckerman, 1979, 1994) and aggression (Buss & Perry, 1992) were also examined. For further information about sensation seeking and aggression, see chapter 8.

1.2 Optimism bias and controllability

Weinstein (1980) indicated that greater perceived controllability was associated with greater levels of optimism bias, and further research has confirmed this finding (DeJoy, 1989; Job, 1990; McKenna et al, 1991). McKenna (1993) has argued that the optimism bias phenomenon is actually a product of "illusion of control", rather than any genuine optimistic bias. He examined differences in optimism bias regarding accident involvement where individuals are either drivers or passengers, finding significant optimism in the driver condition (illusion of control) but not the passenger condition (no control). In the current context, McKenna's ideas were further examined using controllable and uncontrollable accidents in addition to the driver/passenger questions.

1.3 The effect of context on optimism bias

The examination of differences in optimism bias related to accident involvement is an important theoretical issue that can be addressed in the current study. As optimism bias has been shown to be affected by context information (Job, 1990), it was expected that optimism regarding accident involvement would be affected by the knowledge and memories used in making a judgement regarding one's standing relative to the average. Specifically, it was hypothesised that those drivers who record information about their accident rates before the relevant optimism questions would show differences to those drivers who record information about their accident rates after the relevant optimism questions. This contextual effect can be examined by using two different questionnaire section orderings.

1.4 Optimism bias and illegal driving behaviour

Optimism bias may be related to risk-taking behaviour such as illegal driving manoeuvres, but existing studies have examined the attitudinal phenomenon without exploring its relationship to actual behaviours (Finn & Bragg, 1986; Matthews & Moran, 1986). Thus the current study questioned drivers about illegal driving manoeuvres within the optimism bias question section, and also asked drivers to record actual frequencies of illegal driving behaviours within the risk-taking scale.

To explore the relationship between optimism concerning being fined for illegal driving behaviours and actual frequencies of these behaviours, it is possible to divide drivers into those who do not perform specified illegal behaviours and those who do, and then examine differences in optimism bias between these two groups. Analysis of this kind can determine if only drivers

who do not perform these actions are optimistic about not receiving a fine, or if optimism exists for all drivers. In addition, it is possible to examine differences in violation rates for these two groups of drivers - that is drivers who do report performing the illegal behaviour and those who do not, to see if violation rates reflect reported behaviour. In the current context, it is possible to examine three specific illegal behaviours: running a red light, doing an illegal U-turn, and speeding (at 15km/hr or more above the speed limit).

Thus the current study sought to examine several specific hypotheses: first, as an extension of past findings, that taxi drivers exhibit optimism bias on general and road related questions compared to both other taxi drivers and the general public (for driving abilities questions only); second, that taxi drivers view the driving abilities of their group of road users more optimistically than the general public; third, that optimism and risk-taking may be considered as separate general traits which are positively correlated with accident rate; fourth, that perceived controllability is related to optimism bias; fifth, that context and accident involvement together are related to optimism bias; and sixth, that optimism bias regarding violations is related to illegal driving behaviour and actual violation rates.

2. METHOD

Chapter three contains a detailed discussion of the methods used for the survey section of the current project. Within this survey, a series of general and road-related attitudinal questions were asked in which subjects compared their relative chances of positive and negative events to the average taxi driver of the same age and gender as the driver, and their relative driving abilities compared with both the average taxi driver and the average driver of the same age and gender. Ratings were made on a seven point scale, (e.g., "Compared to the average driver of the same age and sex as yourself, how likely are you to be injured in a road accident, as a driver?" - 1, much less likely than average; 2, less likely than average; 3, slightly less likely than average; 4, average; 5, slightly more likely than average; 6, more likely than average; 7, much more likely than average). Questions covered a range of positive and negative general items (Weinstein, 1980), as well as a group of driving-related items, and questions concerning accidents and driving abilities (DeJoy, 1989; Job, 1990; and Weinstein, 1980). Analysis of individual optimism bias questions was conducted using t-tests with a comparison value of 4 ("average"). Paired t-tests were used to examine differences between the general public and taxi driver comparison groups.

Two different survey orderings were used. Subjects were randomly assigned to either the type “A” format, in which the optimism bias questions were asked before any questions regarding accident involvement and specific accident details; or the type “B” format, in which the optimism bias questions were asked after any questions regarding accident involvement and specific accident details. Ninety four drivers completed the type A survey, and seventy three completed the type “B” survey. These two different survey orderings were also used for the controllability question variations. Finally, a question was included allowing drivers to indicate if they did not complete the survey in order.

3. RESULTS

3.1 General optimism bias findings and comparison group differences

Significant optimism bias values were obtained for the positive general question “Stay healthy during next winter”, but not for the other positive optimism question “Win a large sum of money”. Significant optimism bias values were obtained for all negative general questions: “Develop a mental illness”, “Being a victim of burglary”, “Developing cancer”, “Having a drinking problem”, and “Attempting suicide”. All significant values were at $p < .001$.

For the driving questions, significant optimism bias values were recorded for all questions at $p < .001$ (“Injured in a road accident as a driver”, “Injured in a road accident, as a passenger”, “Booked for an illegal U-turn”, “Booked for speeding”, “Booked for running a red light”, “Having an accident while taxi driving during the next 2 years”, “Have an accident because you failed to give way”) except for the last question (“Have an accident because someone else failed to give way”, which was significant at $p < .05$). For the driving abilities questions (see table 15), significant optimism bias scores were obtained for all questions on each comparison group, except for the ability “To drive safely when very tired” compared to other taxi drivers, for which no optimistic bias existed.

For the driving abilities questions, all items exhibited significant between groups differences, indicating that individual taxi drivers believe their group of road users (taxi drivers) have superior driving abilities compared to the average driver, in addition to the individual taxi driver's belief that he has superior driving abilities compared to the average taxi driver.

Driving Abilities	Taxi Driver (1-group t)	Av. public (1-group t)	Taxi/public (paired t)
To drive safely at high speeds	4.78 p<.001	5.46 p<.001	-.69 p<.001
To drive safely when very tired	4.21 ns	5.16 p<.001	-.96 p<.001
To minimise injury to self in an unavoidable accident	4.84 p<.001	5.43 p<.001	-.59 p<.001
To swerve around a sudden road hazard	5.07 p<.001	5.67 p<.001	-.60 p<.001
To regain control in an out-of-control skid.	4.84 p<.001	5.3 p<.001	-.45 p<.001

Table 15: Averaged scores and significance levels for seven point driving abilities optimism scale items (1-Much less able than average, 4-Average, 7-Much more able than average) for taxi drivers compared with the average taxi driver (column 1), the average member of the public (column 2), and the mean difference between judgements of each group (column 3).

3.2 Optimism bias and risk-taking

To examine the relationship between optimism bias regarding driving abilities and risk-taking, a principal components analysis was performed on the items of the two optimism scales (taxi driver and general public comparison groups) and the taxi driver risk-taking scale. Due to the earlier finding of no significant correlation between these scales (see chapter 4), an orthogonal factor structure was specified (using varimax rotation).

The two observed factors account for 50.5% of the variance observed: the optimism bias factor accounts for 31.6% of the variance, while the risk-taking factor accounts for 18.9% of the variance. While each set of optimism bias questions clearly load on a common factor, it is only the “taxi driver” comparison group questions that represent genuine “optimism bias” (as comparisons by taxi drivers between their driving abilities and the general public may be based on genuine skill differences, where as comparisons with other taxi drivers directly indicates an optimistic bias within the group). For this reason, only the total score for questions 2.1 to 2.5 has been used elsewhere in analysis that makes use of the concept of optimism bias. The factor structure was the same when questions 3.1 to 3.5 were removed and the analysis rerun (factor loadings were also approximately equal).

QUESTIONS	FACTOR 1 (Optimism bias)	FACTOR 2 (Risk-taking)
OB2.1	0.76	
OB.2.2	0.65	
OB.2.3	0.79	
OB.2.4	0.77	
OB.2.5	0.78	
OB.3.1	0.80	
OB.3.2	0.77	
OB.3.3	0.86	
OB.3.4	0.85	
OB.3.5	0.83	
RT.4.1		0.45
RT.4.2		0.49
RT.4.3		0.67
RT.4.4		0.63
RT.4.5		0.72
RT.4.6		0.59
RT.4.7		0.70
RT.4.8		0.50
RT.4.9		0.64
RT.4.10		0.66

Table 16: Factor matrix of a principal components analysis using varimax rotation of driving optimism questions (taxi driver comparison group - 2.1 to 2.5; and general public comparison group - 3.1 to 3.5) and risk-taking questions (blank cells indicate factor loadings of .25 or less).

Due to the clear factor structure observed and the theoretical meaning of these factors, it is possible to treat these two sets of questions as scales. The reliability (using Cronbach's alpha) of the risk-taking questions (4.1 to 4.10) was .79, and Guttman's split half reliability (first 5 items versus second 5 items) was .76. The reliability of all optimism questions (2.1 to 2.5 and 3.1 to 3.5) was .93. The reliability of the taxi driver comparison group questions was .88, and the reliability of the general public comparison group was .92. Table 17 presents the individual item analysis for the risk-taking scale, and table 18 presents this analysis for the taxi driver optimism scale (questions 2.1 to 2.5). The mean of taxi driver risk-taking scale was 10.6, and a standard deviation of 6.1. All items had standardised item-whole correlations above .3. The optimism bias scale (5 items - those from the taxi driver comparison group only) mean was 23.7, and a standard deviation of 6.4. All items had standardised item-whole correlation above .5

Item	Mean score	Standard deviation	Alpha if item excluded
1. Cut across traffic to get to someone hailing you even when there is a slight risk of an accident	1.1	1.1	.79
2. On major roads where hails are common, drive as fast as is necessary to stop another taxi from getting in front of you	1.2	1.1	.78
3. Run a red light	.6	.7	.77
4. When you get a job to a quiet area, drive back very fast to get back to where the work is	1.7	1.4	.78
5. Turn right across a busy road even when there is a small chance of collision	.8	.9	.76
6. Keep driving even though you are very tired	1.0	1.0	.78
7. Do an illegal U-turn	1.3	1.1	.77
8. Change lanes without checking properly for vehicles in other lanes	.5	.7	.79
9. Drive at more than 15km/hour above the speed limit.	1.3	1.1	.77
10. Take a radio/computer job that is far from your current position, and which you will have to drive fast to get to on time	1.2	1.0	.77

Table 17: Item analysis for the taxi driver risk-taking scale

Item	Mean score	Standard Deviation	Alpha if item excluded
1. To drive safely at high speeds	4.8	1.5	.84
2. To drive safely when very tired	4.2	1.6	.88
3. To regain control in an out-of-control skid	4.8	1.6	.83
4. To swerve around a sudden road hazard	5.1	1.6	.83
5. To minimise injury to self in an unavoidable accident	4.8	1.6	.86

Table 18: Item analysis for the taxi driver optimism bias scale

As noted in chapter 4, optimism bias was not correlated with risk-taking ($r = -.03, p > .05$) or accident rate ($r = -.06, p > .05$), and was not predictive in the models developed. However, there was a significant positive correlation between risk-taking and accident rate ($r = .22, p < .01$) and scores on the taxi driver risk-taking scale were a predictor of both accident rate and non-stationary accident rate in the models developed. Table 19 presents the correlation matrix for the optimism scale, risk-taking scale, age, time holding a car and taxi license,

sensation seeking and aggression. Due to the importance of anger in predicting accident rate (see chapter 4), the anger subscale was included separately, in addition to the total aggression score.

	1	2	3	4	5	6	7	8
1. Optimism bias scale		-0.03	0.07	0.15	0.16	-0.03	-0.13	0.08
2. Risk-taking scale			-0.20*	-0.23**	-0.10	0.35**	0.31**	0.37**
3. Age				0.88**	0.49**	-0.24**	-0.14	-0.19*
4. Car License					0.45**	-0.26**	-0.15	-0.07
5. Taxi License						-0.21*	-0.19*	-0.14
6. Aggression							0.83**	0.18*
7. Anger (subscale)								0.11
8. Sensation Seeking								

* = $p < .01$ (2-tailed)

** = $p < .01$ (2-tailed)

Table 19: Correlation matrix for variables potentially related to optimism scale scores (Q2.1 to 2.5) and risk-taking scale scores (Q4.1 to 4.10).

3.3 Optimism bias and controllability

In terms of McKenna's (1993) controllability questions, significant optimism bias was found for both driver and passenger conditions. However, a significantly greater degree of optimism was exhibited in the passenger condition rather than the driver condition, (mean difference between driver and passenger questions = .75, two-tailed paired t-test, $t = 6.31$, $p < .001$). To further test differences in the role of controllability, drivers were presented with a controllable and an uncontrollable accident situation (questions 14 and 15 respectively). Two different versions of these questions were asked - half in one survey (type "A") and half in the other surveys (type "B") - and these different surveys were randomly distributed to drivers. Type "A" surveys described the collision as "Have an accident (but not be injured) because . . .", whereas the type "B" surveys described the collision as "Killed in an accident because . . .". The mean optimism scores for type A surveys on question 14 (controllable - accident not serious) was 2.6 ($t = -11.9$, $p < .001$), and the mean optimism scores for question 15 (uncontrollable - accident not serious) was 4.1 ($t = .8$, $p > .05$), whereas the mean optimism scores for type B surveys on question 14 (controllable - fatality) was 1.8 ($t = -14.3$, $p < .001$) and the mean optimism score for question 15 (uncontrollable - fatality) was 3.2, ($t = -7.8$, $p < .001$).

The controllable questions (14) elicited a greater degree of optimism than uncontrollable questions (15), mean difference = -1.7 ($t = 12.6$, $p < .001$), and the fatal accident questions elicited a greater degree of optimism than the non fatal accident questions (mean difference = .86, $t = 4.2$, $p < .001$). The mean difference in

optimism scores between question 14 and 15 for the type A survey (accident not serious) was -1.9 (two tailed paired t-test = -9.9, $p < .001$), while the mean difference in optimism scores between question 14 and 15 for the type B survey (fatality) was -1.5 (two tailed paired t-test = -7.8, $p < .001$).

3.4 The effect of context on optimism bias

To test the effects of context on optimism bias (by using a question on previous accident involvement in different locations within the survey), Q8 “Injured in a road accident, as a driver” and Q13 “Have an accident while taxi driving during the next two years” were analysed using a 2 factor accident group by questionnaire order ANOVA. Twenty three drivers who indicated that they had not completed the survey in order were removed from this analysis to avoid any possible contamination of the order effect due to prior exposure. No significant main effect differences or interaction effects were observed in the degree of optimism reported for either question.

3.5 Optimism bias and illegal driving behaviour

Illegal driving behaviour was examined by dividing drivers into groups according to whether they ever performed each of the illegal behaviours of running a red light, performing an illegal U-Turn, and speeding (over 15km/hr above the speed limit). This was done by assigning drivers to a “non illegal behaviour group” if they scored zero (never) on the relevant question of the risk-taking scale (3, 7 and 9 respectively), or an “illegal behaviour group” if they scored one to five (hardly ever to nearly all the time). These groups were then compared to both the relevant optimism question about relative chances of being fined, and to the average violation rate for each of these behaviours.

Violation	Non-action group OB	Action group OB	Mean Difference	
Rates				
Running a red light (t value)	2.0 -13.9	3.1 -4.9	-1.1 -4.4	NA = .2 A = .5
(significance)	$p < .001$	$p < .001$	$p < .001$	$p < .01$
Doing an illegal U-turn (t value)	1.7 -12.9	3.1 -5.7	-1.4 -4.9	NA = .07 A = .17
(significance)	$p < .001$	$p < .001$	$p < .001$	ns
Speeding (15km/hr above limit) (t value)	2.1 -9.2	3.5 -3.5	-1.4 -4.5	NA = .4 A = .5
(significance)	$p < .001$	$p < .001$	$p < .001$	ns

Table 20: Average optimism scores regarding being fined for illegal driving behaviours, divided by whether drivers report ever doing this behaviour or not (the first column represents those who never do this behaviour - “non-action” group, the second column represents those who report doing this behaviour - “action” group) including t-values and significance compared to 4 (average chance). The third column (mean difference) indicates the mean difference, t-value and significance between these two groups, and column 4 reports the average violation rate for each group, and whether these values are significantly different from one another.

4. DISCUSSION

4.1 General optimism bias findings and comparison group differences

The overall hypothesis of the existence of optimism bias for both negative general and driving-related questions was supported, as well as for relative driving abilities. It should also be noted that the pattern of optimism bias observed here is the same as in our 1993 study (Dalziel & Job, 1994), which indicates that the earlier findings regarding optimism bias were not the result of a unique group of taxi drivers, but rather an example of a general phenomenon that has been replicated in the current study. The comparison group difference indicates that taxi drivers as a group view themselves as having superior driving abilities to the general public. This implies that general road safety campaigns may not be considered by taxi drivers as applying to them (because their superior abilities makes them exempt from warnings for the general public, see Weinstein, 1987). One possible solution to this problem may be found in group specific, industry-based road safety initiatives.

4.2 Optimism and risk-taking

The development of both a driving abilities optimism bias scale and a taxi driver risk-taking scale appear to have been successful. The psychometric properties of these scales are satisfactory, and indicate that these two general factors are well measured by the variety of different specific questions used. The development of a driving abilities optimism bias scale is a significant step forward for optimism bias research, as it indicates that this phenomenon is not question specific, but rather more general. In the case of the questions used here, the scale is a useful measure of the unrealistic optimism of drivers when comparing themselves to others, and hence scores on this scale are good

candidates for use in testing the role of unrealistic optimism and driving overconfidence in general road safety research.

Even more important, however, is the finding that among taxi drivers, optimism is unrelated to risk-taking. Indeed, the sign of the correlation was negative, although the value was not significantly different from zero. In addition, it was found that risk-taking, but not optimism bias, was a significant predictor of accident involvement. The meaning of this pattern of results is as follows. Some previous theoretical accounts have assumed that the relationship between optimism and accident involvement was that optimism bias leads to greater risky driving behaviour, which eventually results in higher levels of accident involvement across groups with high optimism bias (Finn & Bragg, 1986; Matthews & Moran, 1986). However, the relationships between optimism bias and other variables has not previously been carefully examined, and the development of an optimism bias scale here is a new development for this area of research. In this study, significant optimism bias was found, but it was not related to risk-taking or accident rate. However, risk-taking on the road, as measured by the taxi driver risk-taking scale developed here, was a significant predictor of accident involvement.

These findings are probably not specific to just taxi drivers, but further research will be needed to examine this issue. It is suggested that optimism concerning driving abilities is probably unrelated to actual accident rates for experienced drivers, but that actual risk-taking on the road would be a significant predictor (once other variables, such as exposure, are controlled for). However, it is speculated here that this may not be the case for young drivers, particularly young male drivers, where optimism bias may indeed be a causal factor in actual risk-taking. That optimism bias might have a different effect on young drivers is potentially due to both age and maturation factors (such as perceived invulnerability), together with lack of experience of actual driving conditions. These suggestions may explain why increased driver training has the ironic result of sometimes increasing accident rates among young drivers - particularly where this training focuses on advanced driving skills (Council, Roper & Sadof, 1975), as this training may instil inappropriate levels of confidence.

If young drivers are given the impression that they have greater driving abilities than they actually do as a result of such training, then this optimistic view of their abilities may lead to greater risk-taking in the absence of well developed driving skills for "real" road conditions (Gregersen, 1996). This problem would not arise with more experienced drivers completing advanced driver training, as any overconfidence created would be mediated by better general driving skills fostered by prolonged exposure to genuine traffic environments. These speculations require further research, but the ideas presented here may be useful in unlocking the problems associated with understanding the role of optimism in traffic accident causation for both

experienced and inexperienced drivers, and may help to answer some past criticisms of the application of optimism bias to road safety (McKay, 1994). The relationship between the findings here concerning optimism bias among taxi drivers, and their potential implication for the general population are discussed further at the end of this chapter.

4.3 Optimism bias and controllability

In testing McKenna's (1993) "illusion of control" explanation of optimism bias, a reversal of the pattern of results predicted by McKenna was found for the driver versus passenger conditions, with significantly more optimism concerning injury found in the passenger rather than driver condition. This is almost certainly due to problems associated with these two conditions not being equivalent as measures of optimism bias, as some estimate of relative time in a vehicle as a driver and passenger is required. Taxi drivers are particularly good examples of this problem, as the proportion of their time on the road as a passenger is usually very small.

However, the issue of controllability was further explored through differing types of accidents. The higher levels of optimism associated with seemingly controllable accidents as opposed to relatively uncontrollable accidents indicates the role of perceived control in optimism bias (Job, 1990). In terms of possible explanations for the origins of the optimism bias phenomenon, perceived control has been linked to a "cognitive errors" account of the phenomenon (Lee & Job, 1992; Weinstein, 1987) and the finding presented here supports this theory. However, the additional finding that in each case the fatal accident was regarded with greater optimism than the non-fatal accident may indicate the possible role of "defensive denial" within the optimism bias phenomenon as well.

Previous research has found little support for defensive denial (Job, 1990; Weinstein, 1987) as an explanation of how optimism bias arises and is maintained. The mechanism that produces and maintains these optimistic biases is suggested to be a combination of both defensive denial and cognitive errors of judgement. These findings are suggestive of important differences within the optimism bias phenomena itself, and future research needs to attempt to disentangle these possible underlying factors.

4.4 The effect of context on optimism bias

Despite our earlier finding that context affects optimism judgements, in particular, that judgements about relative risk of injury are differentially affected by recall of past involvement or non-involvement in accidents, the current study did not support this finding. As the results presented here were based on a larger and more representative sample of taxi drivers, and in the absence of other evidence to support the earlier finding, it may be that this finding regarding the effect of context was specific to the particular group studied in 1993. While the concept of context affecting judgements is theoretically plausible, until further

evidence can be found to support it, the value of this finding must remain uncertain.

4.5 Optimism bias and illegal driving behaviour

The findings regarding optimism bias and illegal driving behaviour indicate the robust nature of the optimism phenomenon. While drivers who do not perform illegal behaviours are highly optimistic about their chances of not being fined for this behaviour, drivers who do perform these behaviours are also optimistic about their chances. The results show that although there is a significant difference in the level of optimism between these two groups, the drivers who do perform these actions are still significantly optimistic about their chances of not being fined compared to the average taxi driver. This finding is made even more striking by the fact that for the question of running a red light, the “action” group had a significantly higher violation rate for this type of behaviour than the “non-action” group, and yet was still optimistic about their relative chances. As demonstrated in our 1993 study (Dalziel & Job, 1994), optimism is typically highest for those taxi drivers who have some justifiable reason for this optimistic view of their chances (such as not performing a particular behaviour), however, when one examines the group who would be thought to be at greater risk of a given event (due to the fact that they do perform the particular behaviour), members of this group also generally have an optimistic view of their chances as well. These findings indicate that optimism bias within taxi drivers is a general phenomenon that appears to be relevant to all drivers, not just those who act in ways that place them at lower risk of negative events.

4.6 Taxi drivers and the general public

The question of whether the results presented here can be generalised to the average road-user deserves further consideration. This study is valuable even if there is no relationship between taxi drivers and the general public, as taxi drivers themselves are a little studied group. The findings here help to shed light on attitudes and driving behaviour within this important group of road-users and members of the public transport system, and implications for safety campaigns directed specifically at them. But it is plausible that the differences between taxi drivers and the average motorist in terms of the ideas presented above are not particularly great.

Taxi drivers, like other motorists, form opinions about their driving habits and abilities based on observation of themselves and others, and according to optimism bias theory, make certain systematic mistakes in their judgements of

their relative chances in terms of positive-self and negative-other biases in their judgements (Job, 1990). Also, taxi drivers, unlike other professional groups such as bus and truck drivers, have similar vehicles, similar areas of driving and are under similar environmental conditions and stressors as the average road user. While important differences remain between taxi drivers and the general public, such as different motivations for driving (income rather than travel) and longer average periods of time on the road (resulting in fatigue - see Dalziel & Job, 1997 and chapter 7), it is possible that taxi drivers share a great deal in common with the average motorist in terms of attitudes to driving. While taxi drivers may make their optimism bias judgements based on different knowledge to the average driver (resulting from greater time periods on the road and subsequent proficiency), the general underlying structures of attitude and personality that give rise to optimism bias would be similar if not the same across human groups. The robustness of the optimism bias phenomenon, and its existence across many different subject groups and situations supports this contention.

Although further studies of the population are required to explore this result, several practical implications follow if the results here are relevant to the general public. First, traffic safety campaigns directed at lowering optimism bias with the goal of reducing levels of risky driving behaviour and subsequent increased accident rates may be ineffective due to the apparent lack of the previously supposed relationship between these variables. Second, optimism bias may not be a problem for road safety per se, and it may even be the product of the benefits of safe driving (i.e., lack of accidents - observe the negative sign of the correlation between optimism and accident rate). Thus people who exhibit high levels of optimism may be incorrect targets in attempts to improve road safety. Third, optimism bias may still be relevant to accidents among young drivers due to possible differences in the optimism bias phenomenon regarding its influence on inexperienced versus experienced drivers. Further research into this issue could be of great benefit to road safety.

CHAPTER 7: FATIGUE

1. INTRODUCTION

There has been considerable interest in the problems of driver fatigue in recent years (as demonstrated by the International Fatigue and Transport Conferences in Fremantle - eg, Hartley, 1996), and many road safety researchers currently recognise fatigue as a problem of approximately equal importance to drink-driving and speeding. While driver fatigue may have devastating consequences, particularly in the case of single vehicle “run-off-road” accidents resulting from “driver asleep” (Fell & Black, 1996), it is difficult to identify. Fatigue leaves no obvious biological traces that can be used to externally identify fatigued drivers (such as blood alcohol levels can be used to identify drink-drivers), nor does driving while fatigued always show obvious driving behaviour aberrations (such as with speeding) until the moments immediately prior to a fatigue-related incident.

As Brown (1994) has argued, fatigue is primarily a subjectively experienced phenomenon, and its hazards include not just physiological impairment (such as slower reaction time) but also psychological impairment in the form of worsened mood and impaired judgement. In addition, fatigue impairment, like alcohol impairment, may have the insidious effect of reducing meta-cognitive abilities to evaluate one’s impairment, hence increasing risk due to the inability of drivers to realistically assess their own driving performance. Fatigue can result from lack of sleep, circadian rhythm disruption (NASA, 1996) and from prolonged performance of a task (Crawford, 1961) - all of which are potentially relevant to taxi drivers due to the nature of their work (Dalziel & Job, 1997).

Prior to the 1993 study, no study of the fatigue issues associated with taxi driving had been presented in the literature. The 1993 study indicated several issues of interest: many taxi drivers work long hours per week (average hours of driving as a taxi driver was 50 hours, and total average work per week was 59 hours); only a relatively small percentage report having ever fallen asleep at the wheel (5-12%, depending on definition); a significant negative correlation was observed between accident rate and total average break time per shift - but that this relationship may be complicated by employment and personality variables; and that optimism bias regarding the ability to “drive safely while very tired” was significantly less than other “skill” abilities such as the ability to “swerve around a sudden road hazard”. Since the time of the original study, Corfitsen (1993) has examined fatigue and reaction time among night shift taxi drivers, and these results may be compared with those of young male drivers (Corfitsen, 1994).

The present study sought to replicate the findings of the 1993 study with several extensions. In the first of these developments, a question regarding accidents while driving home after completing a taxi shift was included, as was a question on the existence of sleeping problems (in addition to the “asleep at the wheel” question used previously). Second, it is possible to examine the fatigue-related factors that predicted accidents, going beyond the simple negative correlation between total breaks length and accident rate observed in the 1993 study. In building a more comprehensive predictive model, it was possible to examine the inter-relationships between breaks and other fatigue-related factors (such as average hours per shift) and the other variables included, such as optimism bias, risk-taking, aggression and sensation seeking. This provides a basis for examining the speculation that fatigue issues may be related to aspects of personality or motivation (Dalziel & Job, 1997). Third, a question regarding driving while very tired was included in both optimism and risk-taking scales, and hence the relationship between these particular questions and other variables can be examined further.

2. METHOD

The general methods used in this study are described in detail in chapter 3. The working conditions questions relevant to fatigue issues were:

Q7. How many breaks do you normally take during a shift (for gas, a meal, etc.), and how long are each of these?

Q14. Apart from when you are stationary at a rank, have you ever fallen asleep at the wheel (even just for a few seconds) while driving a cab?

(1) Yes (2) No

If yes, how many times would this have happened during 1995 & 1996?

Q15. Have you ever had an accident while driving home after a shift that was at least partly the result of tiredness?

(1) Yes (2) No (3) Don't drive home after shift

Q16. Do you have Sleep Apnea, chronic snoring, or any other major sleeping difficulties?

(1) Yes (2) No

The reason for the qualifier regarding falling asleep on ranks is that feedback on the 1993 survey indicated that some drivers “nod off” for brief periods during quiet times of their shift when the taxi is stationary (and often turned off) while waiting on a taxi rank.

The question included in the optimism scale was the same as reported in Dalziel and Job (1997), that is, Q2 “How able would you be to do the following actions compares to an average taxi driver (same age and sex as yourself): To drive safety when very tired?” The question included in the risk taking scale was Q6 “How often do you: Keep driving even when very tired?”

Other results in this report relevant to fatigue include the R.T.A data presented in chapter 2, and the predictors of accident involvement presented in chapter 4.

3. RESULTS

3.1 Asleep at the wheel and related questions

Of the 151 drivers with sufficient exposure and experience who returned surveys, 35 of them (23%) indicated that they had fallen asleep at the wheel at some stage during their taxi driving career. Of these 35 drivers, 27 had fallen asleep at the wheel more than once, and 14 indicated that they suffered from some form of sleeping disorder. Drivers answering yes to the “asleep at the wheel” question were asked to indicate the total number of times they had ever fallen asleep at the wheel: responses were positively skewed, and ranged from 1 to 30 with a mean of 5. However, almost all of these respondents had been taxi drivers for a considerable period of time, and hence the total number of times asleep at the wheel may be misleading as it does not include any measure of relative frequency. To compensate for this, the total number of times asleep at the wheel was divided by the number of years holding a taxi license. When analysed in this way, the average frequency of asleep at the wheel for these drivers was once every five years, with a range of once every 16 months to once every twenty years. If averaged across the whole sample, the average occurrence of this event is once every twenty five years of taxi driving. There was no significant difference between the “asleep at the wheel” drivers and the rest of the sample on the variables of age, time holding a car or taxi license, or education.

For the question regarding sleeping disorders, 18% of drivers indicated they experienced “sleep apnea, chronic snoring, or other major sleeping difficulties”. Approximately 50% of drivers with sleeping disorders reported falling asleep at the wheel during their careers, whereas only 14% of drivers who did not report a sleeping disorder reported have fallen asleep at the wheel. For the question regarding whether or not drivers had ever had an accident while driving home after work that was at least partially attributable to tiredness, five drivers (3%) indicated that this had occurred, whereas 80% had not experienced this event, and a further 17% indicated that they did not drive home after work. Of these five drivers, four of them reported falling asleep at the wheel at some stage, and two of them indicated that they also suffered from sleeping disorders. When the answers to all three of these questions are combined, 33% of drivers have experienced some form of fatigue-related difficulty.

As noted in chapter 4, there are significant differences in accident rate between “asleep at the wheel” (“asleep”) and non-asleep at the wheel (“non-

asleep”) drivers (mean accident rate for “asleep” = 1.2, “non-asleep” = .7, $F(1,147) = 5.41, p < .05$), but that there are also significant differences for these two groups on both risk-taking (mean risk-taking for “asleep” = 13.1, “non-asleep” = 9.6, $F(1,147) = 8.1, p < .01$) and average hours per shift (mean average shift length for “asleep” = 11.5, “non-asleep” = 10.7, $F(1,144) = 4.47, p < .05$). When entered into the model to predict accident rate, asleep at the wheel did not make a significant contribution once risk-taking and average shift length had been taken into account. The significant difference on the total risk-taking score is not just a byproduct of answers to the particular question concerning driving while very tired (Q6) - the difference remains even if this item is removed, and the data re-analysed using a risk-taking total based on the remaining nine items (“asleep” risk-taking mean = 11.5, “non-asleep” mean = 8.81, $F(1,147) = 6.48, p < .05$). There were no significant differences between the “asleep” and “non-asleep” groups on optimism bias, anger, sensation seeking, average number of breaks or average total break time.

3.2 Fatigue, breaks, and prediction of accidents

In chapter 4, four factors were determined to be predictors of accident involvement: anger, risk-taking, vehicle type and average number of hours per shift. Of these, average number of hours per shift is the only variable directly related to fatigue issues. Average hours per shift was not significantly correlated with any of the variables examined, such as risk-taking, anger, age, time holding a car or taxi license, sensation seeking.

The average number of breaks taken per shift is 2, with a range from 0 to 5 - see figure 16. The average total break time is 41 minutes per shift, with a range from 0 to 160 minutes. The average length of the first break is 22 minutes, followed by 19 minutes for the second, 16 minutes for the third, and 11 minutes each for the fourth and fifth breaks (although only 14 drivers reported taking more than 3 breaks per shift). Where drivers have only one break, this break is significantly longer than the first break of drivers who have three or more breaks (one break mean length = 25 minutes, three or more breaks, 1st break mean length = 16 minutes, $t = 2.9, p < .01$). This indicates that, in general, drivers tend to take one long break or several shorted breaks during their shifts.

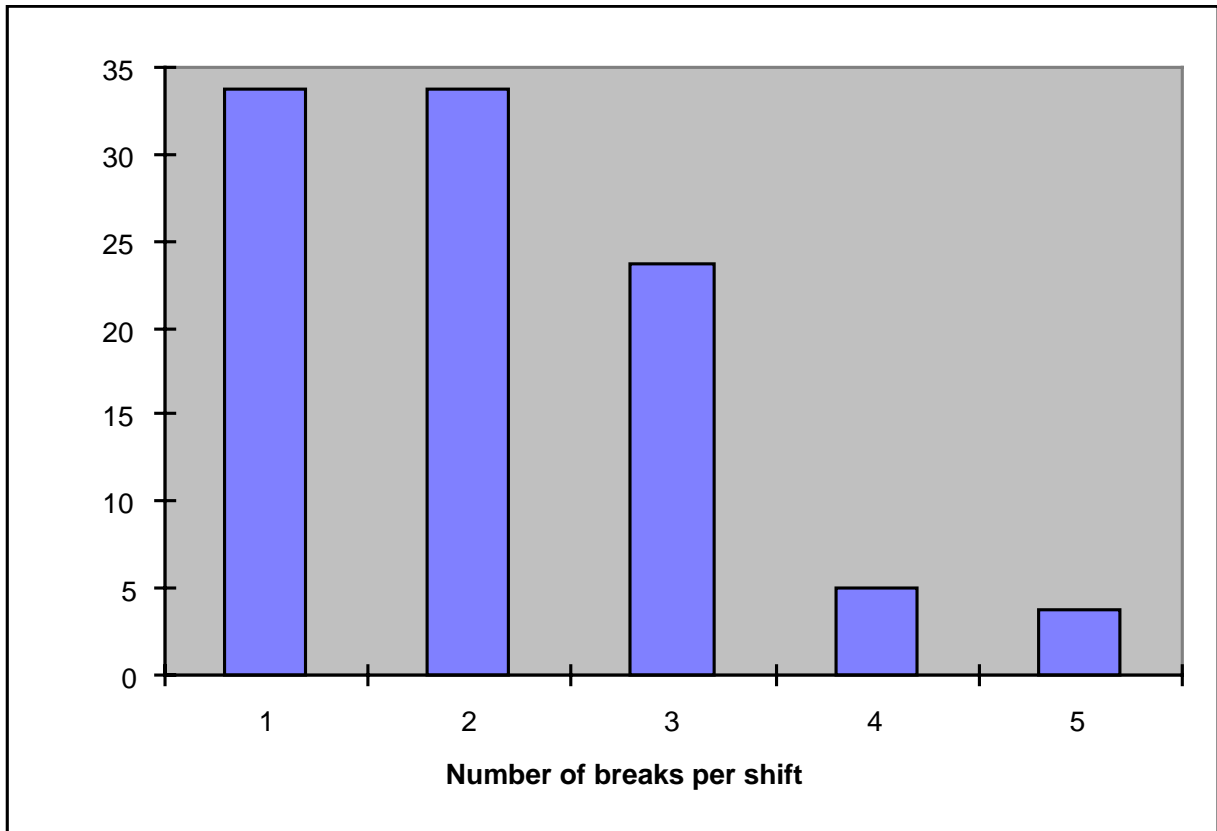


Figure 16: Average number of breaks per shift by percentage of all drivers.

There was no significant correlation between average total break time and accident rate ($r = -.08$, $p > .05$), despite our earlier finding of a correlation between this variable and accident rate (Dalziel & Job, 1997), and it was not a significant predictor in the overall model. There was also no significant difference in average break time by employment type. None of the accidents reported appeared to be due to “driver asleep”, and only two of the accident descriptions provided by drivers mentioned tiredness.

3.3 Optimism bias, risk-taking and fatigue

The average score on the optimism bias question concerning the ability to drive safely when very tired was not significantly different from the designated average value of four (mean = 4.24, $t = 1.58$, $p = .06$, 1 tailed test) indicating that unlike all other questions, taxi drivers as a group do not have an optimistic bias concerning the issue of driving safely when very tired. There was a significant difference between scores on this question and the other optimism bias questions (mean difference = .7, $t = 6.14$, $p < .001$), but this was not due to the fatigue question being a separate construct to the others, as the correlation between

scores on this question and total optimism bias scores was .75. There was no significant difference between asleep at the wheel and non-asleep at the wheel drivers on this question (mean “asleep” = 4.0, mean “non-asleep” = 4.3, $F(1, 143) = .94, p > .05$). None of the other variables examined in this study were significant predictors of scores on this question.

The mean score on the risk-taking questions was 1, with a range of 0 to 5. As above, the fatigue question was not a separate construct to other questions, but rather was correlated with overall scale scores ($r = .59$). Overall risk taking is significantly correlated with a number of variables, including age, time holding a car and taxi license, driving style, aggression, and sensation seeking. The pattern of correlations between the individual fatigue question and these other variables was the same as for the whole scale, with no special exceptions. There was a significant difference between asleep at the wheel and non-asleep at the wheel drivers for this risk-taking item (mean “asleep” = .8, mean “non-asleep” = 1.5, $F(1, 147) = 13.58, p < .001$).

4. DISCUSSION

This findings presented here provide information about the role of fatigue-related variables in the experiences of taxi drivers, and present some new findings concerning the relationship of these variables to road safety. Fatigue is clearly an issue of relevance to taxi drivers, as the results in chapter 2 show, and as the findings here concerning total shift length indicate. However, the results do not simply indicate that fatigue is an independent factor in road safety, but rather that it is part of a complex web of relationships related, in particular, to risk-taking.

The basic data presented here adds to prior work on this topic (Dalziel & Job, 1997). While the percentage of drivers experiencing “asleep at the wheel” is higher than previously noted, the relative infrequency of this event is in keeping with past discussion of the surprising lack of major fatigue problems among taxi drivers (unlike fatigue problems associated with truck drivers or the average motorist taking long trips), even though a third of taxi drivers have experienced some difficulties related to fatigue. This finding supports the suggestion that the “skill” fatigue experienced by taxi drivers is different to the “boredom-induced” fatigue of country driving (Dalziel & Job, 1997). The additional information concerning sleeping disorders and fatigue accidents when driving home after work as a taxi driver help to further expand understanding of the role of fatigue in the experiences of taxi drivers.

The relationship between taxi driver fatigue and accident rate is complex. While drivers who have fallen asleep at the wheel at least once during their careers have higher accident rates than those who have not, fatigue alone does not seem to be the major determinant of this finding, due to the relationship

between this variable and both risk-taking and shift length. Increased shift length, in addition to being an exposure variable, may be considered a fatigue-related variable, for as shift length increases beyond 11-12 hours, even by only small amounts, the risk of involvement in an accident increase considerably (Folkard, 1996), probably due to the effects of exhaustion. This argument is supported by the evidence presented in chapter 2 regarding increased accident rates towards the end of weekend night shifts - traditionally the longest shifts in the taxi driving week. The interesting question that these results suggest is why drivers would put themselves at risk of the effects of fatigue by continuing to drive beyond average shift lengths, and why would drivers with experience of falling asleep at the wheel have higher, rather than lower, levels of risk-taking on both the fatigue question, and the overall risk-taking scale?

The answer to this question may be that the relationship between fatigue and risk-taking is the opposite to that normally assumed. As noted in the introduction, fatigue may lead to greater accident involvement due to the inability of the fatigued individual to realistically assess their performance. However, it is also conceivable that fatigue may be the result of a more general disposition to take more risks when driving. The significantly higher risk-taking levels of drivers who have fallen asleep at the wheel may actually be the cause of falling asleep at the wheel, rather than being unrelated to fatigue incidents. That is, risk-taking while driving may not be related to just specific risky driving manoeuvres such as running a red light, but also to more general behaviours such as continuing to drive in spite of tiredness. If this were the case, drivers who exhibit low levels of risk-taking while driving would be likely to stop driving when they begin to feel the effects of tiredness, while drivers who exhibit high levels of risk-taking while driving may continue to drive despite tiredness. This would explain the finding that overall risk-taking is higher in drivers who have experienced falling asleep at the wheel.

It should be noted, however, that this increased risk-taking is not the product of optimism bias concerning an individual's driving abilities. As demonstrated elsewhere in this report (chapter 6), optimism bias about driving abilities is unrelated to actual risk-taking on the road, disproving the theory that increased optimism bias causes risk-taking, and hence more accidents (at least for experienced drivers). This finding holds for fatigue as well: drivers who are optimistic about their ability to drive safely while very tired are no more likely to continue driving when very tired, or to fall asleep at the wheel than drivers who are not optimistic about this ability. This finding should also be viewed in the light of the overall lack of optimism among taxi drivers concerning this ability, compared to other skills-based abilities.

4.1 Driver education concerning fatigue

One of the more basic findings presented here is that drivers who experience some form of sleeping disorder (such as sleep apnea, chronic snoring or other major sleeping disturbances) are much more likely to have fallen asleep at the wheel than those who do not. Approximately 50% of drivers with sleeping disorders have fallen asleep at the wheel, whereas only 14% of drivers without sleeping disorders have fallen asleep at the wheel. While this 50% is a relatively small number of total drivers (14 of 151), due to the low prevalence of sleeping disorders overall, it indicates that road safety education regarding fatigue could appropriately be targeted at this specific group (drivers with sleeping disorders), due to the fact that half of them have fallen asleep at the wheel at some stage, and that many fall asleep at the wheel a number of times. (Comment: the incidence of sleep disorders here seems high in comparison to the general public, from memory a rate of 4% is quoted generally. This may have something to do with OH&S issues such as body mass index, perhaps we need exercise equipment at taxi ranks?)

The findings concerning the relationship between fatigue incidents and risk-taking is also an important findings for driver education concerning fatigue. In the case of taxi drivers, it appears that most drivers have a realistic (rather than optimistic) assessment of their ability to drive safely when very tired. Even where individual drivers do have an optimistic view of their abilities, this does not appear to be the predictor of fatigue incidents. Rather, drivers who generally take more risks while driving are more likely to experience the effects of fatigue. Thus, in education directed at taxi drivers concerning fatigue, it is not necessary to try and convince drivers that fatigue is a genuine problem that may affect them - taxi drivers seem to already acknowledge this issue (as indicated by the difference in optimism scores between fatigue and other skill-based abilities). However, to attempt to reduce the effects of fatigue on drivers, a more general approach to reducing risk-taking while driving is needed. As argued in chapter 6, this needs to address two potential causes of risk-taking: personality and motivational factors (such as the need for earnings). Each of these appears to contribute to risk-taking among taxi drivers, and hence if the effects of these factors can be reduced, then overall risk-taking may be lowered, which would lead to reduced problems with fatigue. In addition, the major cause of driving behaviours which lead to fatigue (such as continuing to drive while tired) appears to be a general predisposition to risk-taking while driving, and this finding may be of value to all road safety research on fatigue, not just research on taxi drivers.

CHAPTER 8: PERSONALITY

1. INTRODUCTION

One of the earliest reported studies in traffic psychology examined the idea that personality may be a predictor of accident involvement (Tillman & Hobbs, 1949). This study is notable for several reasons: first, it linked motor vehicle accidents to personality, specifically traits related to social deviance (for a more recent discussion of this issue, see West, Elander & French, 1993), second, it was based on the theory of “accident proneness”, and thirdly, it was the first reported study of taxi drivers in the road safety literature. Tillman and Hobbs’ study is of historical and theoretical interest, as it considers drivers to be either “accident prone” or not, rather than the now widely accepted differential accident liability model (Hansen, 1988). While practically all road safety research is based on the theoretical assumption that different measurable factors are predictors of accidents, and hence drivers are differentially at risk based on the influence on these factors, the accident proneness theory does illustrate two important caveats for modern road safety researchers: first, prior accident involvement is often a good predictor of future risk, and second, many of the factors that do predict accidents are still poorly understood, hence giving the impression that an individual may be just “accident prone” without the reasons for this being immediately obvious. This is relevant to this chapter, as personality has been implicated as a predictor of accident involvement, but the specific dimensions of personality that are relevant are not entirely clear.

Prior research has indicated a number of personality traits that may be worthy of study in relation to increased accident rates and risk-taking while driving. Based on a review of the literature in this area, two traits were selected for the current study: aggression and sensation seeking. Aggression has been explored in several studies - particularly in the areas of young male drivers (Donovan, 1993), and the effects of alcohol on driving (Donovan, Marlatt, & Salzberg, 1983). Other studies have noted the relationship between stress and aggression in driving (Hartley & Hassani, 1994), and several scales have been developed to assess these factors and their relationship to driving (for example, Glendon, Dorn, Matthews & Gulian, 1993).

However, scales that examine aggression while driving tend to focus on situations specific to traffic, and hence may not be measures of a general personality trait. For this reason, an independent measure of aggression that was not specific to driving was preferred for the current study so as to establish the importance of general personality traits in taxi driving. The most appropriate instrument for this purpose is Buss and Perry’s (1992) aggression questionnaire, which is a revision of a hostility measure by Buss and Durkee (1957). This scale

includes four subscales: physical aggression, verbal aggression, anger and hostility. It was expected that all of these subscales may be related to accident involvement and risk-taking, particularly the anger subscale, as Buss and Perry note that anger is the component of aggression that represents the immediate emotional response, and that anger appears to be the bridge between other components of aggression, with physical and verbal aggression as a behavioural expression of aggression, and hostility as the remaining cognitive component. When anger is partialled out of the analysis of aggression, there is little relationship left between the other components. Anger is also important as it is the only component of aggression that does not show significant sex differences.

Sensation seeking is a personality trait that relates risk-taking to individual differences, in which high sensation seekers take greater risks due to the pleasurable sensations associated with these experiences (Zuckerman, 1979, 1994). This construct has generally been measured by the sensation seeking scale (SSS - Zuckerman, 1979, 1994), which is divided into four subscales: thrill and adventure seeking (TAS), experience seeking (ES) disinhibition (DS) and boredom susceptibility (BS). SSS scores have been shown to be related to driving behaviour, but not to accident rate (Jonah & Clement, 1984).

Sensation seeking was a central aspect of one of the most important studies of taxi drivers in recent years - Burns and Wilde's 1995 study, which demonstrated that SSS scores were related to another risk-taking scale and to actual driving behaviour (as secretly observed by the experimenters while posing as normal passengers). However, they did not find a relationship between accident involvement and sensation seeking, nor did they find a relationship between actual driving behaviour and accident involvement, although their study was based on a relatively small sample of drivers (51). This study indicates the importance of sensation seeking in actual driving behaviour, and hence SSS scores were expected to be related to the taxi driver risk-taking scale developed here. Considering the comment that 51 drivers may be too few to examine the possible influence of sensation seeking on accident involvement, the current study sought to examine the relationship of sensation seeking to both accident rate and risk-taking while driving with a larger sample size.

In addition to measuring two general personality traits and their relationship to accident involvement, it is also possible to examine the relationship between these two variables. As most scale development studies are based on university students, the current sample provides a considerably different group of subjects for testing of both the internal properties of these scales, and the relationship between them. In addition, the risk-taking and optimism scales developed here (see chapter 6) can also be compared to these measures in the hope that any inter-relationships between them may assist in explaining some of the underlying factors that produce both optimism bias and risk-taking.

2. METHOD

The general methods of this study are discussed in chapter 3. The sensation seeking measure used was Zuckerman's Form V scale. The aggression measure used was Buss & Perry's (1992) aggression scale. Item order for the aggression scale was randomised as suggested, and several items with more positive meaning were included as a "buffer" to the overwhelmingly negative content of the scale, following feedback from pilot testing (see Appendix A, Section 4, Q3, 10, 21, 28). Due to the importance of the anger scale elsewhere in this project, the individual items are presented here: "I flare up quickly but get over it quickly", "When frustrated, I let my irritation show", "I sometimes feel like a powder keg ready to explode", "I am an ever-tempered person" (item scoring reversed), "Some of my friends think I'm a hothead", "Sometimes I fly off the handle for no good reason", and "I have trouble controlling my temper."

3. RESULTS

As a measure of the reliability of the scales used, Cronbach's alpha was calculated in each case, together with the mean and standard deviation. The reliability of the full aggression scale (29 items, 5 point scale) was .86, with a mean total score of 66.1 and a standard deviation of 14.8. The scale data of each subscale was: "Physical Aggression" (9 items), alpha = .65, mean = 19.2, standard deviation = 5.4; "Verbal Aggression" (5 items), alpha = .62, mean = 13.4, standard deviation = 3.6; "Anger" (7 items), alpha = .72, mean = 15.5, standard deviation = 4.8; "Hostility" (8 items), alpha = .68, mean = 18.0, standard deviation = 5.0. These values compare with the following reported in Buss and Perry's (1992) original study of college students (mean and standard deviation for males only reported here): Total Aggression, alpha = .89, mean = 77.8, standard deviation = 16.5; Physical Aggression, alpha = .85, mean = 24.3, standard deviation = 7.7; Verbal Aggression, alpha = .72, mean = 15.2, standard deviation = 3.9; Anger, alpha = .83, mean = 17.0, standard deviation = 5.6; Hostility, alpha = .77, mean = 21.3, standard deviation = 5.5.

For the sensation seeking scale (40 dichotomous items), the total scale alpha was .84, with a mean of 13.8, and a standard deviation of 6.6. This compares with Zuckerman's 1979 student sample with an alpha = .83, a mean of 21.2 and a standard deviation of .83. The reliability of each subscale was: "Thrills and Adventure seeking" (10 items), alpha = .77, mean = 4.8, standard deviation = 2.8; "Experience seeking" (10 items), alpha = .67, mean = 3.7, standard deviation = 2.3; "Disinhibition" (10 items), alpha = .66, mean = 3.2, standard deviation = 2.2; "Boredom susceptibility" (10 items), alpha = .50, mean = 2.2, standard deviation = 1.7. These may be compared with the values obtained for Burns and

Wilde's (1995) study of taxi drivers: Total Sensation Seeking, alpha = .86, mean = 18.6, standard deviation = 7.2; Thrills and Adventure seeking, alpha = .85, mean = 6.1, standard deviation = 3.2; Experience seeking, alpha = .56, mean = 5.2, standard deviation = 1.9; Disinhibition, alpha = .50, mean = 2.9, standard deviation = 1.9; and Boredom susceptibility, alpha = .71, mean = 4.4, standard deviation = 2.5.

As noted in chapter 6, the alpha for the taxi driver risk-taking scale (10 items) was .79, with a mean total score of 10.6. The alpha of the optimism bias scale (5 items - those from the taxi driver comparison group only) was .88, with a mean total score of 23.7. Correlations between scale components for both aggression and sensation seeking can be found in table 20, including their relationship to the taxi driver risk-taking scale. In addition, there is a significant negative correlation between age and the three main scales (aggression, sensation seeking and risk-taking), as well as a negative correlation between time holding a car license and both aggression and risk-taking (see chapter 6). Figure 17 provides a graphical interpretation of the role of personality and risk-taking in taxi accident causation, based on the findings of the correlation matrix and the predictive model presented in chapter 4.

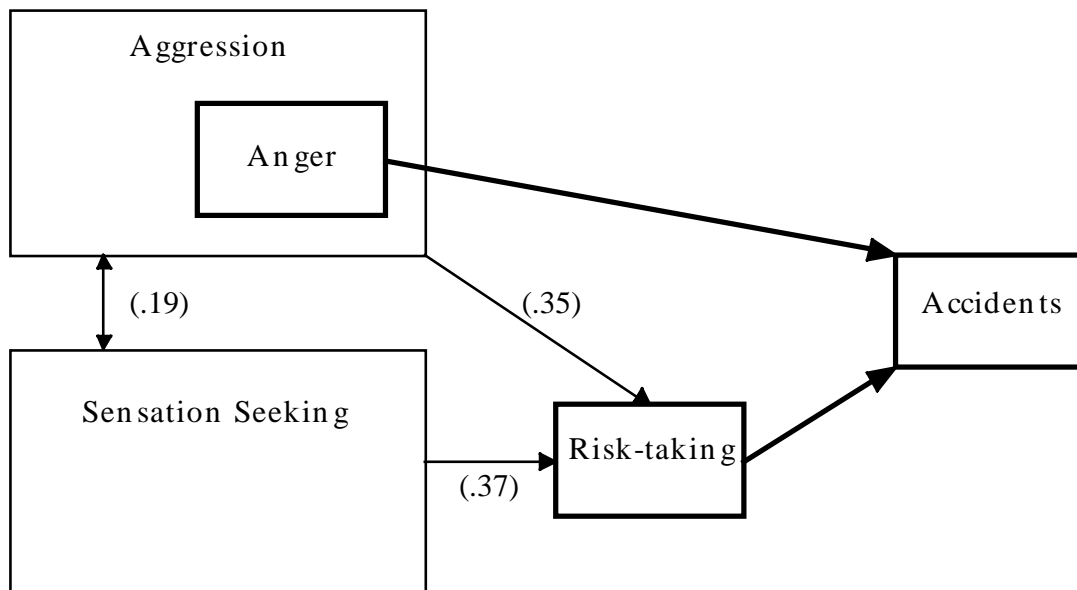


Figure 17: A model of the relationship between personality related factors in the causation of taxi accidents. Thin lines and scores indicate correlations, thick lines are based on the predictive model of chapter 4.

	1	2	3	4	5	6	7	8	9	10	11
1. Physical Aggression		0.41	0.57	0.44	0.80	0.12	0.04	0.16	0.15	0.16	0.26
2. Verbal Aggression			0.54	0.49	0.73	0.11	0.17	0.06	0.26	0.20	0.25
3. Anger				0.51	0.84	0.02	0.09	0.12	0.19	0.13	0.30
4. Hostility					0.78	-0.01	0.15	0.05	0.25	0.13	0.28
5. Total Aggression						0.07	0.13	0.13	0.26	0.19	0.35
6. Thrill and Adventure Seeking							0.50	0.36	0.09	0.75	0.21
7. Experience Seeking								0.49	0.38	0.82	0.30
8. Disinhibition									0.36	0.76	0.33
9. Boredom Susceptibility										0.54	0.26
10. Total Sensation Seeking											0.37
11. Risk-taking scale											

Table 20: Correlation matrix of subscales and totals for Buss & Perry's (1992) Aggression scale and Zuckerman (1994) Sensation Seeking Scale, together with the taxi driver risk-taking scale (see chapter 6). Correlations of .17 or above are significant at alpha = .05.

4. DISCUSSION

The results of this project concerning taxi drivers and road safety clearly indicate a relationship between personality factors and accidents, particularly as presented here and in chapters 4 and 6. Of the four predictive factors in chapter 4, two of these are related to individual differences in driver personality traits. One of these, anger, is argued by Buss & Perry (1992) to be central to the phenomenon of aggression as measured in their scale. The second factor, risk-taking, is strongly related to both overall aggression and to sensation seeking. While the two general personality traits were found to be correlated with each other, each of their contributions to risk-taking appears to be over and above their shared variance, suggesting that taxi driver risk-taking is influenced by both aggression and sensation seeking.

The scale properties of both the aggression and sensation seeking scales are satisfactory, and these scales appear to have acted as valid measuring tools in the current research. The lower values on each scale when compared to the original development studies is probably due to age differences and the fact that the original studies used university students as subjects. Similarly, the risk-taking and optimism bias scales also performed appropriately, and the theoretical findings concerning the role of each of these scales in the road safety issues considered here are underpinned by the good psychometric properties of each scale. While further research will be needed to establish additional psychometric properties of the taxi driver risk-taking and optimism bias scales, such as test-retest reliability, the basic indications regarding the factor structure and scale qualities of these measures are encouraging.

The finding that aggression is related to risk-taking helps to illuminate the possible causes of actual risky driving behaviour, and relates well to previous road safety research on the problem of aggression while driving. West, Elander & French (1993) have already argued that mild social deviance is a determinant of problem driving behaviour, and the current finding adds to this general point by connecting actual risk-taking while driving to the expression of aggression in non-driving situations. This finding is consistent with Buss and Perry's observation of positive correlations between aggression and measures of competitiveness and impulsivity. This is an important finding of the current research, especially given that both risk-taking and the anger subscale were found to be predictors of accident involvement. In addition, it is likely that this pattern of relationships is not specific to taxi drivers alone, but may be a general phenomenon, as general psychological attributes such as the structure of personality and subsequent expression of behaviour are unlikely to be very different between taxi drivers and the general public. Hence, the potential value of including measures of aggression in future road safety research is suggested by the results of this project.

The findings regarding sensation seeking help clarify the importance of this trait to road safety research. Burns and Wilde (1995) demonstrated the relationship between sensation seeking and driving behaviour, but did not find a link to accident rate. In the current study, the taxi driver risk-taking scale, which may be considered an alternative measure to their behavioural assessments, was found to be a predictor of accident rate, but sensation seeking was not. The finding that this new scale was a significant predictor of accident rate, but that the observational measures used by Burns and Wilde was not, may be due to either differences in sample size or that self-assessment of risk-taking behaviour may be more comprehensive than external assessments based on a relatively brief exposure period. The reasonable strong correlation between sensation seeking and risk-taking found here implies that sensation seeking itself may be only very weakly related to accident rate as it is only one of the factors that causes risk-taking, but that general risk-taking while working as a taxi driver is a significant predictor. In other words, sensation seeking is of some relevance to road safety, but through an indirect relationship mediated by risk-taking.

One of the most important road safety issues that arises from the findings of the current project is the cause of risk-taking among taxi drivers. As demonstrated, this is partly due to the personality traits of aggression and sensation seeking. However, there may be an additional factor that is relevant to increased risk-taking which was not directly studied in this project, but which was a theme in discussions with taxi drivers (see chapter 9). This factor is a motivational one, the need for sufficient earnings. Anecdotal evidence suggests that as actual driver earnings fail to match required earnings, some drivers will attempt to compensate for this loss by driving “harder”, that is, taking more risks in order to gain more fares. The picture that emerged from discussion with some drivers was that real income levels are poor and have fallen in recent times, and that at least some drivers have attempted to compensate for this by taking more risks while driving, in order to gain more fares. The wording of some of the taxi driver risk-taking scale items reflects this kind of risk-taking for greater income’s sake, such as “Q1. Cut across traffic to get to someone hailing you even when there is a slight risk of an accident” and “Q4. When you get a job to a quiet area, drive back very fast to get back to where the work is.” Drivers who are seeking greater income would be prone to each of these risk-taking behaviours as a way of maximising their chances of gaining fares, and hence sufficient income. At the same time, however, they also increase their chances of being involved in an accident due to the risks inherent in these actions.

The models developed in chapter 4 indicated that scores of the taxi driver risk-taking scale and the anger subscale are key predictors of accident involvement. Is there anything that can be done to improve taxi driver road safety by addressing the twin problems of anger and risk-taking? In terms of anger, there are two possible ways of minimising the effects of this trait on actual driving behaviour. First, a series of anger-management techniques would be

useful for drivers prone to high levels of anger which they find are expressed in their driving behaviour. Using a cognitive-behavioural strategy, drivers could be assisted to identify situations that provoke anger and learn to modify their thinking in response to these situations - particularly in regards to the behaviour of other motorists. At the same time, drivers could be taught techniques for self-management of anger, including ways of relaxing once anger is aroused.

The second way of minimising the effects of anger is to counter the apparent anonymity of other drivers. Several studies have shown that aggression while driving is more easily expressed towards targets which are perceived as anonymous (Ellison, Govern, Petru & Figler, 1995; Novaco, 1991). Thus, if taxi drivers can be encouraged more to see other drivers as fellow motorists trying to negotiate the difficult task of driving under the same difficult traffic conditions as taxi drivers, rather than (perhaps) as anonymous annoyances, then quick aggressive responses which are based on depersonalising other drivers would be attenuated. It is important to note that this suggestion is not limited to taxi drivers, but may be of value to general road safety education.

Regarding the problem of risk-taking, there are two possible approaches to this as well. First, as risk-taking appears to be due, in part, to the need for greater income, then the income of drivers should be carefully investigated. If driver earnings are inappropriately low, then risk-taking is a likely result. To combat this problem, ways of alleviating low driver income should be considered. In the case of the current project, individual taxi drivers in the Sydney metropolitan area are forced to carry the burden of low earnings due to the "pay-in" system. The problem with this system is that drivers must pay the owner of the taxi vehicle a set amount to rent the taxi for the evening, regardless of actual earnings. If the taxi driver has a poor night in terms of earnings, the cost of the rental of the taxi remains the same, and hence the "take-home" income of the driver may be dramatically reduced. An alternative financial system that mediates the effects of low income on drivers is a percentage system, in which driver earnings are a set percentage of the total shift earnings. In terms of the problem of risk-taking, a percentage system is preferable as it shares the effects of low earnings between both driver and owner, thus reducing the need for risk-taking by the driver in order to compensate for the genuine possibility of extremely low (or non-existent) "take-home" earnings after paying the cost of renting the taxi vehicle under the "pay-in" scheme. While either system may be engineered to either benefit or hinder driver earnings (depending on the actual figures used) the percentage system is inherently preferable as it reduces the impact of low earnings on individual drivers, thus alleviating some of the need to take risks in order to gain income. While the percentage system was available to Sydney taxi drivers in the past, it is unclear why it is no longer available under current legislation. (Comment: It may be interesting to compare the net earnings of a set of high risk drivers with a suitable control group to determine if there is much to be gained by high risk driving; alternatively if we can't get the message

across to drivers, then an appeal to owners/co-operatives on the grounds that the higher insurance and crash costs involved make high risk driving an uneconomical practice may be effective)

Second, as risk-taking is also partly based on driver personality, education concerning the effects of risk-taking (that is, accident involvement) may be a useful countermeasure to its internal causes. Particularly where the penalties for risk-taking outweigh the benefits, such as where the pleasure of driving fast is offset by the cost and likelihood of a speeding fine, the level of risk-taking can potentially be reduced. While it is difficult to change the structure of personality traits such as aggression and sensation seeking, it is possible to make the expression of these traits in particular circumstances (such as on the road) less likely through increased education and the threat of punishment.

In summary, the importance of personality to taxi driver road safety is relatively clear, and the influence of anger and risk-taking on accident rate has been demonstrated by the current study. Potential methods of alleviating the negative effects of these traits include greater driver education, and systems that minimise risk-taking while driving.

Part 3: Taxi driver feedback - Qualitative data

During the course of this study, a great deal of feedback was received from Sydney taxi drivers regarding their working conditions. This feedback, on the whole, was profoundly negative, and suggested considerable problems within this taxi industry. As many of the issues raised may be applicable in other locations due to the industrial structures used and the systemic problems that may arise, this feedback is reported here to allow for comparison between the findings of this study and situations in other locations.

CHAPTER 9: COMMENTS, DISCUSSIONS AND LETTERS

This chapter is based on information concerning Sydney metropolitan taxi drivers, and in some respects is limited to the particular conditions experienced by these drivers. However, much of this information has parallels with the experiences of taxi drivers elsewhere, and where taxi driver working conditions differ substantially from those presented here, this chapter may be useful as a basis for comparison and exploration of the effects of the differences, and as a basis for interpretation of the results presented in this report and their applicability to vastly different taxi industries (such as in the United Kingdom and Japan).

The current project utilised several sources of data in understanding the experiences of drivers. In addition to the quantitative information about work habits derived from the survey (see chapter 5), there are additional sources of qualitative information that were used in the writing of this chapter. The first of these was the recollections and experiences of taxi drivers with whom one of the authors (JD) has spoken over the years in which he has been involved with the industry - both as a driver and as a researcher. This kind of “working” knowledge is invaluable in understanding taxi driver road safety, and it has provided the background to many of the hypotheses and theories developed in this work. The second source of information was answers to the final question on the back page of the survey. Open questions at the end of surveys are often left blank by the majority of respondents (for example, in a study of first year university students at a pre-university transition workshop (Dalziel and Peat, 1997), a one page end-of-workshop evaluation which included a final “any further comments” type question was left blank by over 82% of participants). Particularly where a survey is long, it is uncommon to see a high percentage of respondents answering these questions, and it is even less likely that they will give detailed responses. This was not the case in the current study: over 60% of drivers answered this question, and many of these provided long and detailed commentary on the taxi industry. (Comment: Does this indicate the possibility of sample bias, given the response rate in this survey?)

The final source of information for this section was the comments of taxi drivers on ranks when they were approached to complete the survey. While the majority of drivers accepted surveys, only a minority of these actually returned the survey. However, the general comments of all drivers when accepting a survey, together with the comments of those who did not take a survey are included here. As a result of the three sources of information used in this chapter, its focus is broader than that of chapters 3 to 8, as it is based not only on responses to the survey, but also on comments by drivers who did not return surveys, and on experience with the taxi industry over the past five years.

This chapter is divided into two sections: first, material concerning “typical” working experiences of taxi drivers and the problems they face; and second, a discussion of the major themes arising from driver feedback.

1. TAXI DRIVER WORK PATTERNS

It is not easy to describe a “typical” shift for taxi drivers, as both drivers and shifts vary greatly. The taxi driver who has been driving for thirty years, owns his own taxi, and only drives for a relatively short morning shift (6-8 hours) four or five days a week “to help pay the bills” will experience a very different shift to the young taxi driver, working for a large taxi base in different rented cabs each shift, driving six night shifts per week of at least 12 hours duration in order to earn as much money as possible. A description of a typical shift based on either of these drivers will almost certainly seem relatively foreign to the other. However, there are basic aspects of the job of taxi driving that are poorly known outside of the industry, and it is for this reason that the following discussion provides some detailed qualitative assessments of taxi driver experiences. There are several work patterns that describe a large number of working taxi drivers, and there are also several basic “employment types” and taxi vehicle rental systems which describe most drivers, and hence are described here.

The most basic distinction in work patterns is between day (3am-3pm) and night (3pm-3am) shifts. Day shift average lengths are slightly under 10 hours for each day of the week (this shorter average length is due to most drivers beginning around 5am, rather than 3am, due to lack of work between 3am and 5am), while night shift average lengths vary from around 10 hours on Sunday, Monday and Tuesday nights, through 11 hours on Wednesday, Thursday and Saturday nights, to 12 hours on Friday night (this variation in night shift length results from earlier shift completion times for the quieter nights of the week - starting times would all be around 3pm). Most drivers only drive one type of shift, that is day or night. Typical shift patterns for full time drivers include: for day shifts - Monday to Friday, Tuesday to Saturday and Monday to Saturday; for night shifts - Monday to Friday, Tuesday to Saturday and Wednesday to Sunday. These patterns are partially based on avoidance of those shifts with relatively poor earning potential: Saturday and Sunday day shifts, and Monday and Tuesday night shifts.

One exception to the above that is not uncommon is the inclusion of an occasional “semi-double”, particularly on Sundays, and a small but significant number of drivers only drive semi-doubles. Few drivers (six of the 165 surveyed) regularly drive separate full day and night shifts within the same week, most probably due to the adverse effects of circadian rhythm disruption (Dalziel & Job, 1997; NASA, 1996). In terms of the number of shifts were week, the majority

of full-time taxi drivers work four to six shifts per week, which represents approximately 40-60 hours per week for day drivers, and approximately 44-65 hours per week for night drivers. A smaller number of drivers work shifts referred to as “semi-doubles”, that is, shifts that cut across both day and night shifts. While these shifts may sometimes be short (eg, an 8 hour Sunday shift from 11am-7pm), the majority of them are between 12 and 16 hours long, and occasionally longer. The other major type of shift pattern omitted by the above is the driver who only drives one or two shifts per week. These drivers commonly work on weekends, particularly on Saturday nights, and on Sunday mornings, nights, or as a semi-double.

Shifts generally have both busy and quiet times, as the work is rarely evenly distributed throughout a shift. This means that at some times there are relatively more “fares” than taxis, while at other times there are many more taxis than fares, and drivers may wait for substantial periods between fares. From the comments of drivers, it appears that the latter case is far more common than the former, except for during a few limited time periods, such as the morning rush hour and portions of the Friday and Saturday night shift (especially the around the end of these shifts, ie 3am). There are also yearly variations in work, such as less work during winter and January, and greater work with the approach of Christmas, although these yearly patterns seem to affect night shifts more than day shifts.

Taxi drivers may be described as one of four basic “employment types”, the owner, permanent driver, permanent casual or irregular driver. The owner often works a constant pattern of 4 or 5 shifts per week, more often than not as a day driver. The permanent driver typically drives 4-6 shifts per week either as a day or night driver. Permanent drivers appear to work for taxi bases relatively less often than for single vehicle owners, although permanent drivers still make up a substantial proportion of any taxi base’s drivers. Permanent casuals, that is, drivers who drive a smaller number of shifts (usually one or two) on a regular basis frequently drive on weekends. Irregular drivers, that is, drivers that do not have a work pattern that easily fits the descriptions above, are most common as drivers working for taxi bases, as owners of large fleets are better able to accommodate a number of irregular drivers within their overall worker base than the taxi owner who manages only one or two taxi vehicles, and needs a small number of employees who have stable work patterns.

Taxi drivers who do not own their taxi are generally employed using a “pay-in” system - that is, drivers commit to pay the owner a preset amount of money for the given shift, and in exchange may keep any earnings beyond this amount. Drivers may pay for their own L.P.G. gas and/or washing the vehicle at the end of the shift, and potentially other expenses. In some cases the taxi owner pays for these expenses, and hence the “pay-in” amount is typically higher to reflect any additional costs to the owner. The alternative employment system, which seems to be quite rare in Sydney, is a percentage system, in which the taxi

driver and taxi owner divide the earning for the shift between them according to a set ratio, such as 50:50. The problem with the “pay-in” system, from the driver’s point-of-view, is that when there is little earning potential, this has a considerable impact on “take-home” earnings, as regardless of overall earnings, a set amount must still be given to the owner. For example, if the pay-in is \$100, and a driver makes \$200 total for a shift, then under the pay-in or percentage schemes described above, the driver takes home \$100. However, if there is little earning potential for a given shift, and the driver only makes \$120, then under the pay-in scheme, the driver only makes \$20 for the night’s work, while the owner still makes the full \$100. Under a percentage system, both owner and driver would should the burden of reduced earnings, each receiving \$60.

2. PROBLEMS THAT TAXI DRIVER ENCOUNTER

Some typical problems that taxi drivers encounter while working include problems with passengers, problems with other motorists and problems with other taxi drivers. Problems involving passengers may occur for many reasons. Drivers may be insufficiently courteous, may drive in ways that make passengers uncomfortable, or may take a route to a destination that is not familiar to the passenger. While there are times when each of these will be justifiable criticisms of the taxi driver involved, it is also important to realise that situations can arise in which a taxi driver may be acting in a reasonable manner, but which is not understood as such by a passenger. This may occur when a driver shows insufficient sympathy for the personal problems of a passenger, drives in a manner which is quick and safe but to which the passenger is unaccustomed, or when the driver takes a route to a destination which is quicker than the obvious route which the passenger has assumed the driver will follow. While these problems may be easily solved by open discussion, disputes can escalate quickly when the relationship between taxi driver and passenger becomes adversarial. For example, when a passenger accuses a driver of deliberately taking a longer route to a destination, when the taxi driver has actually chosen the route that is fastest and least expensive due to superior knowledge of prevailing traffic conditions, the response of the taxi driver is unlikely to be positive. These examples illustrate that disputes between drivers and passengers can easily be the result of legitimate differences in points-of-view, and that unless these are dealt with openly and with mutual respect, then these can degenerate into more serious arguments.

Drivers also experience problems with other motorists. While the average driver is on the road to get from one place to another, taxi drivers are on the road attempting to make a living. For this reason, they will at times drive in ways that are not the same as other road users who are not attempting to earn money. For example, when a person suddenly hails a taxi which is not in the lane closest to

the curb, the taxi driver will need to change lanes and come to a stop quickly if the fare is to be obtained. However, this manoeuvre may inconvenience other road users, and it is this aspect of the difference between taxi drivers and other motorists which may be responsible for some of the ill-will of the general public to taxi drivers. (Comment: If a driver doesn't have a fare why wouldn't he be in the left lane unless turning right?) While negative opinions of taxi drivers are less likely to be directly expressed to taxi drivers while on the road (compared to problems with passengers arising within the taxi vehicle), they may be responsible for some of the general attitude of society to taxi drivers. If fares were not so scarce, taxi drivers might not take the risks they currently do to reach potential customers, but due to the fact that a hail is income for a taxi driver, it is difficult to stop this situation from occurring.

Finally, taxi drivers also encounter problems with other taxi drivers. Within the industry, many taxi drivers talk of “cowboys”, that is, taxi drivers who take many risks and drive in an unprofessional way. Problems that arise between taxi drivers typically occur when one taxi driver tries to gain an advantage over another taxi driver while attempting to gain work. Examples of this include queue-jumping at ranks, and in drivers exceeding the speed limit to get ahead of another taxi driver on a busy road (so as to be able to gain any hails that may be waiting further down the road which would have otherwise gone to the driver who was overtaken). (Comment: A system for reporting this type of behaviour might work)

All of these problems are common, and must result in considerable “background” stress on drivers while they work. When one considers the long hours, poor earnings, poor diets and lack of public respect that are the common experiences of taxi drivers, the degree of negative feeling among taxi drivers about their working conditions is understandable. This is not to minimise the problems that occur due to inappropriate behaviour on the part of taxi drivers, but it is to point out that the job of taxi driving is a hard one, and one which is made more difficult by lack of understanding by the general public. Taxi drivers typically do not want any pity, and take a certain pride in their profession and their ability to survive in the face of adversity, but many drivers would appreciate greater community understanding of their job, and some increased respect for the difficult work they do.

3. COMMENTS AND FEEDBACK

As noted in the introduction to this chapter, a large proportion (102 of 165 driver - 62%) of respondents provided comments about taxi driving on the final open question of the survey. Many of these comments contained more than one point, and some were extremely detailed. For the analysis presented below, each discrete point within a driver's comments was identified separately, and points

were then grouped into major categories. This process identified six major themes within driver's responses, and feedback from other sources and experience with the industry confirmed the importance of these. These themes are: driver safety, earnings, working conditions and shift lengths, lack of community respect, criticism of the management of the industry, and taxi driver training. It is important to realise that the percentages reported here are of all drivers making comments to this final question, not the percentage of drivers who answered a question on each specific issue. Hence, the fact that 23% of drivers commented on poor earnings does not mean that only 23% of drivers believe that this is a problem. Rather, the actual rates of problems within the industry are probably much higher than the percentages reported here, as informal feedback has suggested that, for example, a greater percentage of drivers than 23% are concerned about poor earnings.

3.1 Driver safety

The issue that received the greatest number of comments was driver safety. Forty one drivers (40%) commented on this issue in some form, including the comments of the one female driver who responded to this question. Many respondents identified that driver safety was poor and that taxi driving was a dangerous job, but others provided more detailed comments. Where drivers made multiple points in their end of survey comments, they often identified safety as the most important issue. Three drivers noted being robbed at knife point, but two of these indicated that they had not officially reported these incidents. From this comment and other feedback, it seems likely that the official number of attacks on taxi drivers recorded by police records would be an underestimate of their actual prevalence. Several drivers noted that they believed the situation is getting worse. Several drivers also noted that emergency buttons (activated during emergencies to notify the taxi network of an attack on a driver) were sometimes broken due to poor maintenance, but that a driver would only discover this when it was too late.

There were different views on appropriate ways of improving driver safety, and these should be considered in the light of current changes occurring within the industry that include the mandatory introduction of screens to protect drivers. Five drivers noted criticisms of the screens, but four drivers were in favour of them. Alternative safety measures preferred by drivers include the use of a satellite tracking device (four drivers) and the use of video surveillance (four drivers). In particular, the female driver commented that she often tells troublesome passengers that they are being filmed, and noted that this is an effective deterrent. The following comments from drivers provide some insight into this issue:

“Taxi drivers need safety first, not uniforms.”

“I think there are enough laws and regulations to discipline bad taxi drivers, but there is not a single law which can guarantee a safe working environment for taxi drivers . . . we don’t get nasty people often but when we have them, that is enough to destroy the whole working day.”

“I am not keen on protective screens. They provoke more trouble than they save. A friendly intelligent attitude is your best protector.”

“I think that video recorders need to be seriously considered as opposed to safety screens, as we are after deterrence, not encouraging vandalism of the rest of the cab while at the same time destroying conversation and camaraderie.”

3.2 Earnings

Taxi driver earnings was another topic frequently mentioned. While no drivers commented positively on their earnings, twenty four drivers indicated that driver earnings were low, particularly when compared to the number of hours worked per week. Several drivers noted that the “pay-ins” were too high, or that there was not enough work available. Six drivers commented that earnings had fallen due to fewer fares since the introduction of increased fare rates during 1996, noting that many of the smaller fares had been lost because of this change. However, drivers had not received the benefits of increased fares, as shift “pay-ins” had increased at the same time. Four drivers commented that there are too many taxi vehicles on the road, thus reducing the overall earnings potential of all drivers. Several drivers noted that they are forced to drive longer hours and take more risks while driving in order to recoup lost earnings. The following comments from drivers are indicative of the feeling on this issue:

“A driver has to work 12 hour shifts to make a livable income. Some drivers go home with \$40 or \$50 after 10-12hrs. The amount of work is getting less, because the number of cabs on the road is increasing.”

“The main problem is increased fares. This causes higher pay-ins, forcing drivers to driver faster and to take more chances.”

“The recent changes to the fares have caused a lots of problems. The number of passengers has been reduced drastically, the amount of pay-in to the owner has gone up, as well as price of LPG. Therefore you have got to spend more hours on the road, have got to cruise most of the time instead of sitting at the rank, as you are rushing to make the pay in and a few dollars for yourself. You are bound to make some mistakes.”

3.3 Working conditions and shift lengths

Many drivers made negative comments on their working conditions, often in connection with earnings problems. Four drivers commented that taxi driving is really just “slave labour”, and two drivers commented that taxi driving is “just terrible”. In terms of specific issues, shift length received particular attention, with thirteen drivers arguing that shifts are too long, and several drivers noted that the long hours places them at increased risk of accidents due to fatigue. In addition to shift length, several drivers identified other working conditions issues such as lack of sick leave and holiday pay, lack of unionisation, lack of occupational health and safety considerations, and lack of counselling in the event of a violent attack. Four drivers noted that they experience high levels of stress in their day-to-day work. The following comment captures the bleak view that some drivers have.

“Taxi driving is not a rewarding job financially, you end up working 10 to 12 hours and when compared with other jobs you're only getting paid for about 60% of the time you work. Taxi driving is the most insecure, stressing, underpaid and low level job anyone could do.”

3.4 Lack of community respect

Many taxi drivers feel that they are not respected within the community, despite the assistance that taxis provide to society as a whole (eg, as an alternative to drink-driving), the long hours they work, their low earnings they receive, and the dangerous nature of their job. This theme was addressed specifically by twelve drivers, with some comments identifying that lack of community respect seemed to be based on poor community understanding of what it is actually like to drive a taxi, and with one driver suggesting that greater community education was needed. Seven drivers also commented that they do not receive sufficient support from police, and a further three drivers criticised police for fining taxi drivers for very minor offences (such as parking fines). The two comments below illustrate this issue.

“Other motorists do not understand what cabbies have to do in making a living. Especially picking up or dropping people off in the CBD. Drivers are often treated like second class citizens. If the general public only knew what it was like.”

“Some time ago, the R.T.A. had ads on TV about how to use a multi-lane roundabout. How about teaching the public about where they can and can't catch a taxi and how unfair it is to book a cab and not to wait for it, and that this is the reason a lot of bookings never get picked up.”

3.5 Criticism of management of the taxi industry

Many taxi drivers are not happy with the way that their industry is managed. In total, twenty-four drivers commented on this issue, but criticisms were directed at a number of different groups. Twelve drivers were critical of taxi fleet owners and taxi bases for their handling of the industry, including two criticisms of the quality of the maintenance of vehicles. Six drivers were critical of the N.S.W. Roads and Traffic Authority for regulations and road design issues, and a further three drivers said there were “just too many rules and regulations”. A further five drivers were critical of the State Government’s handling of issues related to taxi drivers. Several drivers identified the lack of driver unionisation as a problem, and several drivers argued that industry bodies such as the Taxi Council were not representative of the average driver. In addition to all of the comments above, a further six drivers argued that the management of the industry should be investigated.

3.6 Taxi driver training

Finally, twelve drivers commented that greater taxi driver training was needed. These comments noted the need for greater knowledge of the Sydney area and for improved English language skills. In addition, seven drivers made comments that were critical of other taxi drivers, and some suggested that a “code of conduct” would be appropriate for the industry.

3.7 Summary of driver comments

As can be seen by the above discussion, taxi drivers are overwhelmingly negative about the state of the industry in New South Wales, and feel that many issues need to be addressed. These problems do not appear to be just generic difficulties faced by any taxi industry, but the comments made identify systemic management problems and structural failures within the industry, particularly in the areas of occupational health and safety and in the earnings of average drivers. While not all drivers have a negative view of their profession - indeed many take pride in their ability to work in such difficult circumstances, there are many issues that need to be addressed. This is particularly true if the State Government wishes taxi drivers to present a positive image to tourists (especially for the approaching Olympic games). On the 28th of June, 1997, the Sydney Morning Herald reported the following:

“Use inducements, blackmail, threats of terror, massive reprisals, happy persuasion, any devices you need.”

Premier Bob Carr, joking with Transport Minister Brian Langton about how to turn Sydney cabbies into happy ambassadors for the city.

On the basis of the material presented here, it appears that the government has much to do itself to improve the attitude of drivers through reforms to the industry which address the concerns of drivers raised here. The following quote summarises the negative feeling among many Sydney taxi drivers, and should be taken seriously by government and industry bodies who wish to address the problems within the industry:

“I feel angry and frustrated with this industry. On the quiet nights when we make next to nothing, I get so stressed. On the busy nights I leave the cab exhausted, hyped and disoriented. Lately I’m so fatigued I feel everything is an effort. If I stop for a break, I get anxious because I can't afford the time off the road. We non-owner drivers carry the burdens of the industry with our efforts and sometimes our lives. I am sickened by the lack of concern that the industry and society show towards people who work so hard for what is really a pittance.”

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GLOSSARY

Accident involvement: Involvement in any accident, including involvement in more than one accident for the time period examined.

Accident Rate: The number of accidents for a given period (eg 2 years).

Day Shift: The taxi shift from 3am to 3pm

Hail: A fare obtained by a person waiting by the side of the road and “waving” down the next vacant taxi to pass by.

Hunting for hails: When a taxi driver deliberately drives along roads in busy areas in the hope of a hail. This may involve driving in circles around a busy area.

Night Shift: The taxi shift from 3pm to 3am

Optimism bias: A systemic error in perception of individual standing relative to a group in which positive events are seen as more likely to occur to the individuals than average, and negative events are less likely to occur.

Risk-taking: In this report, risk taking is used only in the specific sense of risk-taking while driving, not as a general personality predisposition.

Semi-double: A taxi shift that involves part of one shift and part of a second, such as from 9am to 9pm (which involves half a day shift and half a night shift - hence “semi-double) shift. semi doubles may be longer than 12 hours.

Sensations seeking: A personality trait in which those who score highly on sensation seeking seek out dangerous and exciting situations because of the pleasurable effects of these experiences on the individual.

APPENDIX A: SURVEY INSTRUMENT

Section 1: Work Details

Q1. How long have you had a license to drive a car?.....years

Q2. How long have you had a license to drive a taxi?.....years

For the following questions, please give details of your employment as a taxi driver during 1995 & 1996. If you have changed your work pattern or have worked irregular shifts during the past two years, please provide details for your most regular situation, with details of differences at the end of Q.5.

Q3. What was your employment status during 1995 & 1996?

(1) Owner (2) Permanent Driver (3) Permanent Casual (4) Irregular

Q4. How many weeks of the year did you drive in 1995?.....

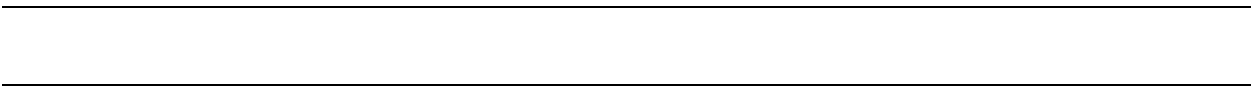
How many weeks of the year did you drive in 1996?.....

Overall, what was your average number of shifts per week?.....

Q5. Please describe your normal weekly work pattern for 1995/1996.

	(please tick)				(please write number)	
	Did not drive	Day Shift	Night Shift	Semi-double	Average hours on road	Average km driven
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						

Please describe any major variations to the above here: _____



Q6. Do you do any other type of work or study in addition to cab driving?

- (1) Yes (2) No

If yes, how many hours a week (on average) does this involve.....

Q7. How many breaks do you normally take during a shift (for gas, a meal, etc.), and how long are each of these?

- (1) One (2) Two (3) Three (4) Four (5) Five

Duration: 1st.....2nd.....3rd.....4th.....5th.....

Q8. What type of car did you usually drive during 1995 & 1996?

- (1) Sedan (2) Wagon (3) Special Vehicle/Other

Q9. How well maintained was the taxi you usually drove?

- (1) Very well (2) Well (3) Satisfactory (4) Poor (5) Very Poor

Q10. Where was the computer located in the taxi that you usually drove?

- (1) Centre, on top of dashboard (4) Other
(2) Centre, level with steering wheel (5) No computer
(3) Right hand side, on top of dashboard

Q11. When driving, do you normally sit on ranks or hunt for hails:

- (1) Sit on ranks (2) Hunt for hails (3) About equal

Q12. Where do you spend most of your time driving?

- (1) In the city/CBD (2) In the suburbs (3) About equal

Q13. Consider your style of taxi driving, are you a “hard driver” or a relaxed driver?

- (1) I drive in a very “hard” way (3) I drive in a moderately relaxed way
(2) I drive in a moderately “hard” way (4) I drive in a very relaxed way

Q14. Apart from when you are stationary at a rank, have you ever fallen asleep at the wheel (even just for a few seconds) while driving a cab?

- (1) Yes(2) No

If yes, how many times would this have happened during 1995 & 1996?.....

Q15. Have you ever had an accident while driving home after a shift that was at least partly the result of tiredness?

- (1) Yes(2) No (3) Don't drive home after shift

Q16. Do you have Sleep Apnea, chronic snoring, or any other major sleeping difficulties?

- (1) Yes(2) No

Section 2: Attitudes to Future Events & Driving

In this section, you are asked to rate the chances of future possible life events, relative to other taxi drivers.

PART 1: Compared with an average taxi driver, of the same age and sex as yourself, what are the chances that the following events will happen to you in the future? Please circle the number that best represents your relative chances.

1. Stay healthy during next winter
2. Develop a mental illness
3. Win a large sum of money
4. Be a victim of burglary
5. Develop cancer
6. Have a drinking problem
7. Attempt suicide
8. Injured in a road accident, as a driver
9. Injured in a road accident, as a passenger
10. Booked for an illegal U-turn
11. Booked for speeding
12. Booked for running a red light
13. Have an accident while taxi driving during the next 2 years
14. Have an accident (but not be injured) because **you** failed to give way
15. Have an accident (but not be injured) because **someone else** failed to give way

1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7

The next set of questions ask you to compare your own driving abilities with others (both taxi drivers & the average motorist). Please rate your ability compared with the ability of the given group.

PART 2: How able would you be to do the following actions compares to an average taxi driver (same age and sex as yourself).

1. To drive safely at high speeds
2. To drive safely when very tired
3. To regain control in an out-of-control skid

1	2	3	4	5	6	7
1	2	3	4	5	6	7
1	2	3	4	5	6	7

4. To swerve around a sudden road hazard

5. To minimise injury to self in an unavoidable accident

1	2	3	4	5	6	7
1	2	3	4	5	6	7

your current position, and which you will
have to drive fast to get to on time

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Section 3: Infringements & Accidents

The following questions are about any traffic infringements (other than parking fines) which you may have had while driving a taxi during 1995 & 1996.

- Q1.** How many **Speeding** fines have you had during 1995/6?.....
- Q2.** How many **Red light** fines have you had during 1995/6?.....
- Q3.** How many **Illegal U-Turn** fines have you had during 1995/6?.....
- Q4.** How many fines **in total** have you had during 1995/6? (including all of the above, and also failure to give way, negligent driving, failure to stop at stop sign, etc. - any fines except for parking tickets).....

The next section asks details of any accident involvement. Please answer as best as you can remember for all accidents. This information may be checked with your records to ensure accuracy for difficult to remember details, such as dates (provided that permission has been given on page 2). All material will be kept strictly confidential, and used only for research purposes.

- Q5.** How many accidents of any type (include collisions with stationary objects, pedestrians, etc) were you involved in while driving a taxi during 1995 & 1996?.....

Accident 1:

- 1. Date..... 2. Day of week..... 3. Time.....am/pm
- 4. Number of cars?..... 5. Were you stationary at the time of impact? Yes / No
- 6. Please describe the location of the accident.....

7. Please give a brief description of the accident

.....

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.....

- 11. Was the total repair cost \$2,000 or more? (guess if unsure) Yes / No
- 12. Were any of the cars involved towed away? Yes / No
- 13. Were there any injuries? Yes - serious / Yes - minor / No

Accident 2:

- 1. Date..... 2. Day of week..... 3. Time.....am/pm
- 4. Number of cars?..... 5. Were you stationary at the time of impact? Yes / No
- 6. Please describe the location of the accident.....

7. Please give a brief description of the accident

.....

.....

.....

.....

.....

- 11. Was the total repair cost \$2,000 or more? (guess if unsure) Yes / No
- 12. Were any of the cars involved towed away? Yes / No
- 13. Were there any injuries? Yes - serious / Yes - minor / No

Accident 3:

- 1. Date..... 2. Day of week..... 3. Time.....am/pm
- 4. Number of cars?..... 5. Were you stationary at the time of impact? Yes / No
- 6. Please describe the location of the accident.....

7. Please give a brief description of the accident

.....

.....

.....

.....

.....

- 11. Was the total repair cost \$2,000 or more? (guess if unsure) Yes / No
- 12. Were any of the cars involved towed away? Yes / No
- 13. Were there any injuries? Yes - serious / Yes - minor / No

Accident 4:

- 1. Date..... 2. Day of week..... 3. Time.....am/pm
- 4. Number of cars?..... 5. Were you stationary at the time of impact? Yes / No
- 6. Please describe the location of the accident.....

7. Please give a brief description of the accident

.....

.....

.....

.....

.....

- 11. Was the total repair cost \$2,000 or more? (guess if unsure) Yes / No
- 12. Were any of the cars involved towed away? Yes / No
- 13. Were there any injuries? Yes - serious / Yes - minor / No

If you have had more than 4 accidents, please describe additional accidents on a separate page and attach to survey.

Section 4: Your Approach to Life

The following questions are about aspects of your general approach to life, not just about taxi driving. There are no right or wrong answers - just try to answer each question honestly for yourself. Answer with the first response that comes to you, and try not to linger on any one question.

Please rate the following statements from 1 to 5 where:

(1) = extremely unlike me - to - (5) = extremely like me

	extremely unlike me		----->		extremely like me
1. I am suspicious of overly friendly strangers	1	2	3	4	5
2. I tell my friends openly when I disagree with them.	1	2	3	4	5
3. I am sensitive to the feelings of those around me	1	2	3	4	5
4. Given enough provocation, I may hit another person.	1	2	3	4	5
5. I flare up quickly but get over it quickly.	1	2	3	4	5
6. I am an even tempered person.	1	2	3	4	5
7. I am sometimes eaten up with jealousy.	1	2	3	4	5
8. I get into fights more than the average person.	1	2	3	4	5
9. I often find myself disagreeing with people.	1	2	3	4	5
10. If someone is in genuine need, I'll try to help	1	2	3	4	5
11. If I have to resort to violence to protect my rights, I will.	1	2	3	4	5
12. When frustrated, I let my irritation show.	1	2	3	4	5
13. When people are especially nice, I wonder what they want.	1	2	3	4	5
14. At times I feel I have gotten a raw deal out of life.	1	2	3	4	5
15. I can think of no good reason for ever hitting a person.	1	2	3	4	5
16. When people annoy me, I may tell them what I think of them.	1	2	3	4	5
17. I have threatened people I know.	1	2	3	4	5
18. I sometimes feel like a powder keg ready to explode.	1	2	3	4	5
19. Other people always seem to get the breaks.	1	2	3	4	5
20. I have become so mad I have broken things.	1	2	3	4	5
21. I like to help people if I can	1	2	3	4	5
22. I can't help getting into arguments when people disagree with me.	1	2	3	4	5
23. If somebody hits me I hit back.	1	2	3	4	5
24. My friends say that I'm somewhat argumentative.	1	2	3	4	5
25. I wonder why sometimes I feel so bitter about things.	1	2	3	4	5
26. Some of my friends think that I'm a hothead.	1	2	3	4	5
27. I know that my "friends" talk about me behind my back.	1	2	3	4	5
28. I feel that "mateship" is important	1	2	3	4	5
29. Sometimes I fly off the handle for no good reason.	1	2	3	4	5
30. Once in a while I can't control the urge to strike another person.	1	2	3	4	5
31. I have trouble controlling my temper.	1	2	3	4	5
32. I sometimes feel that people are laughing at me behind my back.	1	2	3	4	5
33. There are people who pushed me so far that we came to	1	2	3	4	5

blows.

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Each of the items below contains two choices, A and B. Please indicate the statement (either A or B) which best describes your likes or the way you feel. If you do not like either statement, choose the one you dislike least. Please choose one statement for each question, and do not leave any items blank. Again, try not to get stuck on any one item.

1. A. I like "wild" uninhibited parties.
B. I prefer quiet parties with good conversation.
2. A. There are some movies I enjoy seeing a second or even third time.
B. I can't stand watching a movie I've seen before.
3. A. I often wish I could be a mountain climber.
B. I can't understand people who risk their necks climbing mountains.
4. A. I dislike all body odours.
B. I like some of the earthy body smells.
5. A. I get bored seeing the same faces.
B. I like the comfortable familiarity of everyday friends.
6. A. I like to explore a strange city or section of town by myself, even if it means getting lost.
B. I prefer a guide when I am in a place I don't know well.
7. A. I dislike people who do or say things just to shock or upset others.
B. When you can predict almost everything a person will do or say he or she must be a bore.
8. A. I usually don't enjoy a movie or play where I can predict what will happen in advance.
B. I don't mind a movie or a play where I can predict what will happen in advance.
9. A. I would like to smoke marijuana.
B. I would never smoke marijuana.
- 10.A. I would not like to try any drug which might produce strange and dangerous effects on me.
B. I would like to try some of the drugs that produce hallucinations.
- 11.A. A sensible person avoids activities that are dangerous.
B. I sometimes like to do things that are a little frightening.
- 12.A. I dislike "swingers" (people who are uninhibited and free about sex).
B. I enjoy the company of real swingers.
- 13.A. I find that stimulants make me uncomfortable.
B. I often like to get high (drinking liquor or smoking marijuana).
- 14.A. I like to try new foods that I have never tasted before.
B. I order the dishes with which I am familiar with so as to avoid disappointment and unpleasantness.
- 15.A. I enjoy looking at home movies, videos, or travel slides.
B. Looking at somebody's home movies, videos, or travel slides bores me tremendously.
- 16.A. I would like to take up the sport of water skiing.
B. I would not like to take up water skiing.
- 17.A. I would like to try surfboard riding.
B. I would not like to try surfboard riding.
- 18.A. I would like to take off on a trip with no preplanned or definite routes, or timetables
B. When I go on a trip I like to plan my route and timetable fairly carefully.

- 19.A. I prefer the “down to earth” kinds of people as friends.
B. I would like to make friends in some of the “far-out” groups like artists or punks.
- 20.A. I would not like to learn to fly an airplane.
B. I would like to learn to fly an airplane.
- 21.A. I prefer the surface of the water to the depths.
B. I would like to go scuba diving.
- 22.A. I would like to meet some persons who are homosexual (men or women).
B. I stay away from anyone I suspect of being “gay” or “lesbian”.
- 23.A. I would like to try parachute jumping.
B. I would never want to try jumping out of a plane, with or without a parachute.
- 24.A. I prefer friends who are excitingly unpredictable.
B. I prefer friends who are reliable and predictable.
- 25.A. I am not interested in experience for its own sake.
B. I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional, or illegal.
- 26.A. The essence of good art is in its clarity, symmetry of form, and harmony of colours.
B. I often find beauty in the clashing colours and irregular forms of modern paintings.
- 27.A. I enjoy spending time in the familiar surroundings of home.
B. I get very restless if I have to stay at home for any length of time.
- 28.A. I like to dive off the high board.
B. I don't like the feeling I get standing on the high board (or I don't go near it at all).
- 29.A. I like to date persons who are physically exciting.
B. I like to date persons who share my values.
- 30.A. Heavy drinking usually ruins a party because some people get loud and boisterous.
B. Keeping the drinks full is the key to a good party.
- 31.A. The worst social sin is to be rude.
B. The worst social sin is to be a bore.
- 32.A. A person should have considerable sexual experience before marriage.
B. It's better if two married persons begin their sexual experiences with each other.
- 33.A. Even if I had the money, I would not care to associate with flighty rich persons in the “jet set”.
B. I could conceive of myself seeking pleasures around the world with the “jet set”.
- 34.A. I like people who are sharp and witty even if they do sometimes insult others.
B. I dislike people who have their fun at the expense of hurting the feelings of others.
- 35.A. There is altogether too much portrayal of sex in the movies.
B. I enjoy watching many of the “sexy” scenes in movies.
- 36.A. I feel best after taking a couple of drinks.
B. Something is wrong with people who need liquor to feel good.
- 37.A. People should dress according to some standard of taste, neatness, and style.
B. People should dress in individual ways even if the effects are sometimes strange.
- 38.A. Sailing long distances in small sailing crafts is foolhardy.
B. I would like to sail a long distance in a small but seaworthy sailing craft.

39.A. I have no patience with dull or boring persons.

B. I find something interesting in almost every person I talk to.

40.A. Skiing down a high mountain slope is a good way to end up on crutches.

B. I think I would enjoy the sensations of skiing very fast down a high mountain slope.

Conclusion

There may be additional research beyond this project, depending on interest and funding. If you are willing to be involved in further paid research (such as a followup survey), please indicate this below.

- (1) Yes, I would be interested in further paid research
- (2) No, this will do thanks.

Did you do this survey in order?

- (1) Yes
- (2) No

Finally, the space below has been left open to allow you to express any additional comments or concerns you have. These may be about changes to the industry, safety, problems you encounter while trying to do your job, etc.

Thank you for taking the time to complete this survey. Please return it in the envelope provided. On receipt of your survey, a cabcharge docket for \$10, together with letter about the study will be sent to you.

Alternatives for Survey B

14. Killed in an accident because **you** failed to give way

15. Killed in an accident because **someone else** failed to give way

Reverse Sections 2 & 3

Much less chance

Less chance

Slightly less chance

Average chance

Slightly more chance

More chance

Much more chance

Never

Hardly ever

Occasionally

Quite often

Frequently

Nearly all the time

Much less able

Less able

Slightly less able

Average ability

Slightly more able

More able

Much more able

Much less able

Less able

Slightly less able

Average ability

Slightly more able

More able

Much more able