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CHAPTER 1 AN INTRODUCTION OF THE YOUNG DRIVER

1.1 Introduction

"Young drivers", defined here as those drivers aged 16 to 24 years, have received a significant level of interest within international road safety literature. Much attention has been levelled at young drivers primarily due to the fact that young drivers represent only a minor proportion of the licensed driving population, yet they are substantially more likely to be involved in fatal and injury crashes than older, more experienced drivers. This phenomenon has been observed in Australia and developed countries worldwide.

Young driver research suggests that the cause of young driver crashes is essentially due to a combination of insufficient driving skills due to inexperience, and intentional risk-taking associated with youthfulness or age. However, as to which of these factors is the primary cause of young driver crashes, and therefore the main target of interventions, is still hotly debated within the literature. Regardless of which factor is more important, there is a need to move beyond this debate and address these issues to reduce young driver crashes. This thesis is chiefly concerned with age-related factors.

Even though young drivers are over-represented in crashes, clearly not all young drivers are crash involved. Research has found evidence among all road users of a smaller subgroup of drivers known to commit traffic offences and be responsible for many crashes. Therefore, it seems plausible that a similar subgroup of *young* drivers might exist. In fact, there is increasing evidence within road safety literature suggesting the existence of a subgroup of "problem young drivers" with an elevated crash risk. Identifying young drivers at a higher risk of crashing before a crash occurs is very valuable as it can prevent injury to road users and reduce social costs to the community.

Generally, attempts to identify drivers at a higher risk of crashing have relied heavily on past driving behaviour, evident in crash and traffic offence records. These studies have reported modest associations at best. However, driver records may be more valuable in identifying drivers at a higher risk of crashing if these high-risk drivers are defined as drivers deemed culpable for a crash, that is, drivers engaging in behaviour that caused the crash rather than drivers who may be involved in a crash due to driving exposure. Therefore, based on this premise that drivers culpable for a crash are a subset of high-risk drivers, it is plausible that high-risk *young* drivers might then be identified by their past driving behaviour. Few studies have investigated this possibility.

More recently, a small number of studies have attempted to identify young high-risk drivers by identifying specific subtypes of drivers based on combinations of certain personality characteristics, motivations, and driving-related attitudes. These studies show some promise as similar characteristics were identified in high-risk young driver subtypes. However, further validation of these young driver subtypes is needed in different populations of young drivers. The identification and validation of young driver subtypes would assist in tailoring interventions and road safety campaigns to the needs of specific subgroups of young drivers who are at a higher risk of crash involvement.

This thesis examined characteristics of young drivers that identify those with an elevated risk of crash involvement. Firstly, this thesis examined the ability of previous driving behaviour, reflected in driving records, to identify high-risk drivers, that is, drivers culpable for a fatal crash. Secondly, individual personality characteristics, motivations, and driving related attitudes and behaviours were examined to ascertain whether they could differentiate young traffic offenders from other young drivers. Considering that young drivers are not a homogenous group, this thesis also examined whether individual personality characteristics and driving related

attitudes could identify different subtypes of young drivers, specifically subtypes of young drivers that might have an elevated risk of crashing.

This thesis begins by reviewing literature describing the young driver problem, examining the risk factors associated with young drivers, and investigating the possibility of a subgroup of young problem drivers. This chapter is followed by a review of studies that have used driver records to identify problem or high-risk drivers, particularly high-risk young drivers (Chapter 2). Chapter 3 compares the driving records (i.e., crashes and traffic offences) of culpable and non-culpable drivers involved in a multiple vehicle fatal crash to determine whether high-risk drivers, or drivers culpable for the fatal crash, could be identified by their prior driving behaviour. The analysis was repeated for young drivers involved in a multiple vehicle fatal crash during the same period.

Chapter 4 summarises research on selected personality characteristics, motivations, and attitudes of drivers associated with an elevated crash risk. Chapter 5 provides a detailed profile of young traffic offenders in relation to a comparison group of young drivers (i.e., university students). This profile is based on a wide variety of personality characteristics, hostility measures, and driving related attitudes and behaviours associated with young driver crash risk (see Chapter 4). The results from analyses of driving records prior to, and one year following questionnaire administration are also presented.

The following two chapters attempt to identify and validate the presence of driver subtypes in two different groups of young drivers. These subtypes are based on questionnaire measures of personality characteristics, motivations and driving related attitudes found to be associated with elevated crash risk in Chapter 4, and used in a previous study that identified novice driver subtypes. The existence of high-risk subtypes among a sample of young drivers (university students) is examined in Chapter 6 and among a sample of young traffic offenders in Chapter 7.

Finally, Chapter 8 provides a summary and synthesis of the findings of the previous chapters and presents the overall conclusions of the thesis.

To provide background to the current interest in young drivers, this chapter provides details about young driver crash involvement (section 1.2), both in Australia and worldwide, and describes the major factors contributing to young driver crash involvement (section 1.3). The concept of a subgroup of young problem, or high-risk drivers is also examined (section 1.4) and the means of identifying such a subgroup is discussed (section 1.5).

1.2 The Young Driver Problem

There is wide variation in the definition of young drivers in the literature. Some studies include all drivers aged 16 to 24 years while others restrict the age range to 16 to 19 years or 18 to 25 years (Jonah, 1986). The variation is partially attributable to the difference between states and countries in the legal age at which a driver may first obtain a driver's licence. For example, in the state of South Australia, one may apply for a driver's licence at 16 years while in the state of Victoria; a driver's licence can be obtained at 18 years. Considering that this study was conducted in South Australia, young drivers were defined as drivers aged 16 to 24 years.

To give some idea of the magnitude of the "young driver problem", the following sections describe crash statistics for young drivers, any sex differences among these statistics, and crash rate patterns, particularly during the first year of driving.

1.2.1 Crash Statistics

According to the Australian Bureau of Statistics (*Deaths from external causes 1998 to 2002*, 2004), "transport accidents" were the leading external cause (i.e., accidents and injury) of death of young Australians aged 15 to 24 years from 1998 to 2002. Transport accidents constituted 31 per cent of all deaths in this age group.

Moreover, during the same five year period, those aged 15 to 24 years reported an age specific death rate from transport accidents (20 deaths per 100,000 people) twice as high as the total population (10 per 100,000 people) (*Deaths from external causes 1998 to 2002*, 2004).

Other statistics demonstrate that young drivers are significantly over-represented among those injured or killed in a road traffic crash (e.g., Legge *et al.*, 2000; Smart *et al.*, 2005). For example, in South Australia from 1999 to 2002, young adults aged 16 to 24 years comprised around 14 per cent of licensed drivers, yet accounted for 24 per cent of all drivers killed and 30 per cent of drivers injured in a casualty crash (*Road crashes in South Australia, 1999*, 2001, *Road crashes in South Australia, 2000*, 2002, *Road crashes in South Australia, 2001*, 2003). This trend of an elevated level of crash involvement among young drivers has been observed in other industrialised countries such as New Zealand, the United Kingdom, the United States, and Europe (Begg & Langley, 2001; Clarke *et al.*, 2002; Engström *et al.*, 2003; Laapotti *et al.*, 2001; Shope *et al.*, 2001b).

Statistics indicate that not only are young drivers over-represented in crashes, they also have the highest level of crash involvement based on population rates. For example, Baldock and colleagues (2002) analysed the crash involvement of drivers in South Australia from 1994 to 1998 per head of population by age group, and showed that crash involvement decreased with age. Almost 40 per cent of the population aged 16 to 24 years had been involved in a crash, in comparison to 26 per cent of people aged 25 to 34 years.

Many young adults might not have a drivers licence, therefore, crash rates adjusting for licensure might be more appropriate than population based rates. Baldock et al's (2002) study indicated that the greatest percentage of crash involved licensed South Australian drivers were aged 16 to 24 years (57%), followed by licensed drivers aged 25 to 34 years (32%). In Western Australia, Ryan and

colleagues (1998) reported that the highest crash involvement rate per 1000 licensed drivers per year was for the youngest drivers aged 17 to 19 years (123.9). Similar to Australia, statistics for fatal and injury crashes in the United States, Great Britain, Spain and the Netherlands have all shown that drivers in the youngest age groups had the highest crash rate per licensed driver (Lyman *et al.*, 2002; OECD, 2001).

There is a common misconception that young drivers have more crashes because they drive more than other age groups (i.e., greater driving exposure). Young drivers, particularly those aged 16 to 19 years, actually have a lower annual mileage than middle-aged drivers (25 to 45 years) but a higher annual mileage than older drivers aged 65 years and over (Massie *et al.*, 1995). Therefore, it is not that surprising that analyses of crash rates per kilometre have consistently reported a "U-shaped curve" of crash risk by age; that is, the youngest and oldest drivers have an increased risk of crashing per kilometre driven relative to middle-aged drivers. Most notably, the youngest drivers reported the highest crash rates per distance driven of all age groups; findings that have been reported for injury and fatal crashes both in Australia (Drummond & Yeo, 1992) and other industrialised countries (e.g., Frith, 2002; Lyman et al., 2002; Massie et al., 1995). Within South Australia, Baldock et al. (2002) found drivers aged less than 25 years had the highest crash rates per distance driven: 15 crashes per million kilometres driven. In comparison, drivers aged 75 to 84 years had the second highest rate of 10 crashes per million kilometres driven.

Janke (1991) argued that using crashes per distance driven as a measure of risk exaggerates the apparent risk of low mileage groups such as young and elderly drivers. Drivers with low mileage tend to drive on congested city streets with two-way traffic while drivers with high mileage accumulate their mileage mostly on relatively safe freeways with separated lanes. The driving task is less complex on freeways and, therefore, the crash rate per distance driven is much lower. However, a study examining the crash rates of Dutch drivers found that in each class of annual mileage,

not just the low mileage class, the youngest drivers had the highest crash rate (Lourens *et al.*, 1999).

1.2.2 Sex Differences

Crash statistics indicate that males are significantly over-represented in fatal and injury crashes. From 1998 to 2002, Australian males aged 15 to 24 years were much more likely to be killed in transport related crashes (77%) than females in the same age group (23%) (*Deaths from external causes 1998 to 2002*, 2004). A study in Sweden also reported a similar proportion of over-involvement for male drivers in injury crashes that occurred during the first two years after licensing (Gregersen & Nyberg, 2002).

However, males tend to drive more often than females (Kweon & Kockelman, 2003). A study conducted in Western Australia found that females aged 17 to 19 years had fewer crashes and a lower crash rate per head of population than male drivers of the same age (Ryan *et al.*, 1998). Consequently, when driving exposure was taken into account, the difference in risk per 100 million kilometres driven was the same for males and females. In the United States, Williams (2003) showed that females had slightly higher rates of crash involvement per mile driven than males at most ages, an exception was at the youngest age of licensing (16 years). Together, these findings suggest that the higher crash rate of young males might be attributed to increased driving exposure.

1.2.3 Crash Rate Patterns for the First Years after Licensure

Driving during the learner stage is low risk for all drivers, mainly because driving during this stage is supervised (Mayhew *et al.*, 2003). However, studies from a number of different countries examining crash rates after licensure (i.e., when driving is no longer supervised) have shown that young driver crash involvement is highest in the first month of driving. Research based on data from four US states

found that the likelihood of the first crash or first traffic offence during the first month was greater than during any of the succeeding 11 months (McCartt *et al.*, 2003). After the initial high level, crash rates decreased rapidly during the next six to eight months of driving and then continued to slowly decline. For example, in Nova Scotia, Mayhew et al. (2003) reported a crash reduction of 41 per cent during the first seven months for novice drivers. Similar crash patterns have been reported in Quebec (Laberge-Nadeau, 1998), where provisional licensure is allowed at 16 years of age, and in Sweden (Gregerson *et al.*, 2000) and Norway (Sagberg, 1998) where licensing is permitted at 18 years of age (crash reduction of about 50% during the first 8 months).

Waller and colleagues (2001) followed the traffic offence and crash patterns of a large cohort of young Michigan drivers and found that the greatest decrease in crash risk was during the first year of driving. A different pattern was apparent for the risk of apprehension for traffic offences. A rise in the risk of traffic offences was reported in the second and third year of licensure with about a 30 per cent increase in odds over the initial year. After the third year, the risk steadily declined. These traffic offence patterns after first licensure are congruent with earlier studies (Ferdun *et al.*, 1967; Harrington, 1972; Pelz & Schuman, 1971).

McCartt et al. (2003) found that in the first year of driving, the crash risk for young novice drivers was higher than the risk of incurring a traffic conviction. Moreover, when examining the distance driven, the risk of a first crash during the first 500 miles driven was much higher than the risk of first traffic offence.

It is clear from these statistics and crash rate patterns that young novice drivers are at a much higher risk of crashing than their older, more experienced counterparts. The following section explores the factors contributing to young drivers' increased crash risk including age, inexperience, and exposure to risk.

1.3 Factors Contributing to Young Driver Crash Involvement

Within the group typically referred to as young drivers (16 to 24 years), considerable attention has been devoted to understanding the wide range of factors that are likely to contribute to their increased risk of crash involvement. These factors can be broadly grouped under three headings: age-related or motivational factors; inexperience and driving skill deficits; and, exposure to risk.

Note that the distinction between age and experience corresponds to what some authors (e.g., Deery & Love, 1996; Elander *et al.*, 1993; Simpson, 1987) have referred to as "driving style" and "driving skill", respectively. This dichotomy also corresponds to what Evans (1991) labelled "driving behaviour" and "driving performance". Driving skill is concerned with performance limitations on aspects of the driving task, such as time taken to detect and respond to hazards. Driving skill is expected to improve with practice and/or training. Conversely, driving style essentially "concerns the way individuals choose to drive or driving habits that have become established over a period of years" (Elander et al., 1993, p. 297). This decision-making aspect of driving may include the choice of driving speed, following distances, overtaking behaviour and the propensity to commit traffic offences.

The main factors known to contribute to young driver crash involvement are described in the following subsections. Following this, studies examining the relative effects of youth and inexperience, while accounting for driving exposure, are discussed. The difficulty in disentangling the relative effects of age and experience is acknowledged.

Note that this is not an exhaustive review of the literature but an overview of current research conducted in Australia and internationally, investigating the role of each of these factors in relation to the young driver crash problem.

1.3.1 Age

Age-related factors are one of the main contributors to the high crash involvement among young drivers. The influence of age at first licensing is most

evident in studies that compare the crash rates of newly licensed drivers in regions where the age of first licensing varies markedly. One such study from the United States showed a clear relationship between age of licensing and crash involvement; the youngest drivers had the highest crash risk (Ferguson *et al.*, 1996). Furthermore, young driver crash rates have shown a reduction with increasing age, with the greatest reductions for the youngest drivers (e.g., Mayhew et al., 2003) (see section 1.2.3).

For most young drivers, the age at which they commence driving, typically around 16 to 17 years in South Australia, often occurs at a time when they are gaining independence from their parents and attempting to find their own identity. At this developmental stage, conformity with social norms is important. Social norms refer to the individual's perception (subjective, not actual norms) of social pressure to perform or not perform a particular behaviour (Ajzen, 1988). If significant others approve of the behaviour, individuals are more likely to perform the behaviour. In the case of young drivers, social norms play an important role as social pressure from friends or peer group are more important to younger drivers than to older drivers (e.g., Gregersen & Berg, 1994; Jessor, 1987; Parker *et al.*, 1992). For example, Parker et al. (1992) found that young drivers experienced greater peer pressure to commit traffic offences such as speeding, driving after drinking alcohol, and dangerous overtaking than older drivers.

The influence of social norms and peer pressure are often expressed through passenger influence on driving behaviour. It is thought that passengers encourage risky driving through social facilitation and peer pressure (Arnett, 2002), although the exact mechanism of passenger influence is unclear (Williams, 2003). The influence of peer passengers is discussed in greater detail in section 1.3.3.3.

Age-related or developmental change has also been associated with changes in risky attitudes and behaviour. It is well known that many young drivers display risky driving behaviour; that is, they have a driving style that heightens their risk of crash

involvement (Williams, 1998). Young drivers are more likely to drive at a faster speed (Baxter *et al.*, 1990; Galin, 1981), leave smaller following distances from the vehicle in front (Baxter et al., 1990; Evans & Wasielewski, 1983), accept narrower gaps in traffic when pulling away from an intersection (Bottom & Ashworth, 1978), and exhibit more risky manoeuvres (Baxter et al., 1990; French *et al.*, 1993; Reason *et al.*, 1990). Males have also been found to have a riskier driving style than females; males report faster driving speeds (Baxter et al., 1990), shorter headways (Evans & Wasielewski, 1983), and display more risky driving manoeuvres (Baxter et al., 1990; French et al., 1993; Reason et al., 1990). It is thought that young drivers' risky driving style serves purposes associated with adolescent development such as opposing authority, asserting independence, and impressing peers (Jessor *et al.*, 1997).

However, not all young drivers who demonstrate risky driving do so intentionally. Therefore, it is important to distinguish risky driving from risk-taking. Simpson (1988) argued that risk-taking implies that the behaviour is purposeful and deliberate; that is, risk-taking describes engaging in behaviour for the purpose of experiencing danger, thrills or sensations. Thus, some risky driving behaviour is motivated by risk-taking. For example, risk-taking, measured by sensation seeking, has been found to be associated with intentional risky driving behaviour (e.g., Rimmö & Aberg, 1999). Furthermore, intentional risky driving behaviour has been found to be related to higher crash rates (Parker *et al.*, 1995) but not unintentional risky driving. However, Simpson (1988) makes the point that the concept of risk-taking is independent from that of risky driving. Driving behaviours considered to be risky are not always motivated by risk-taking, and risk-taking may not always result in risky driving. In the former case, the driver may not be aware that the behaviour is risky.

With respect to attitudes, an increase in risky attitudes has been observed during the period of adolescent development. For example, Harre, Brandt and Dawe (2000) noted an increase in risky attitudes to driving from the ages of 14-15 years to

16-17 years, particularly among males. In general, a weaker road safety orientation has been reported for younger drivers in comparison to older drivers. One study reported that younger drivers (17 – 20 years) rated themselves as lower on safety-mindedness (i.e., driving carefully, showing consideration, being tolerant of other drivers errors) than older drivers (Stradling & Meadows, 2000). More specifically, tolerance of risky driving behaviour, that is, positive attitudes towards speeding, drink driving, aggressive driving, and restraint non-use have been associated with traffic offences and the crash involvement of younger drivers (Beirness & Simpson, 1988; Sarkar & Andreas, 2004; Ulleberg & Rundmo, 2002). For example, Sarkar and Andreas (2004) found that young traffic violators viewed speeding less seriously than high school students did.

Yagil (1998) conducted an interesting study that examined differences in the nature of the motivation to drive safely between young and older male Israeli drivers. An obligation to obey rules and the perceived fairness of punishment motivated young drivers. In contrast, older drivers' motivation centred on the perceived negative outcome of the behaviour.

In summary, the high crash involvement among young drivers is partly an effect of age-related factors such as immaturity, the influence of social norms and peer pressure, and an adolescent developmental stage associated with risky driving attitudes and behaviours. Risk-taking, as part of a risky lifestyle, is another age-related factor associated with young driver crashes that is discussed in section 1.4.1.

1.3.2 Inexperience

Limited or inadequate driving experience is also very important in explaining young drivers' over involvement in crashes. In support of this claim, studies indicate that increases in time since licensure are associated with decreasing crash rates and novice drivers report the highest crash rates in their first year of driving (e.g., Williams, 2003). For example, research from Western Australia showed that drivers

in their first year of driving had a crash rate 2.6 and 3.5 times greater than drivers licensed for five and ten years, respectively (Palamara *et al.*, 2002).

Clearly driving experience is related to a lack of driving skill, as it is through practice (i.e., driving experience), that skills develop. The benefits of increased driving experience have been shown in an evaluation of the effect of lowering the age (17.5 to 16 years) at which Swedish drivers could practice driving before obtaining a driver licence (Gregerson et al., 2000). The evaluation found a 15 per cent reduction in novice driver crash risk that was attributed to 18 months of extra driving experience but also a reduction in the number of young licence holders.

A wide range of driving skills is required to safely complete the driving task: psychomotor skills (i.e., vehicle control, attention allocation), perceptual skills (i.e., hazard perception, visual search), and cognitive skills (i.e., decision making, risk assessment). Novice driver skill deficits in each of these three categories are described briefly here; the reader is referred to Mayhew and Simpson (1995) for a comprehensive review.

In terms of psychomotor or vehicle control skills, novice drivers, relative to experienced drivers, are less proficient in speed and steering control, skill deficits associated with greater crash risk (Mayhew & Simpson, 1995). Furthermore, novice drivers report deficiencies in integrating vehicle control skills, particularly when the driving task is more demanding. Novices have problems dividing attention between competing driving tasks, a problem that has been attributed to inefficient cognitive strategies (Catchpole *et al.*, 1998; Mayhew & Simpson, 1995). Experienced drivers, develop short cuts to decision making in cognitively demanding situations, process information at a more automatic level, and divide attention between tasks more efficiently (Patten *et al.*, 2006; Rumar, 1985).

In addition to decision-making, assessment of personal risk is another major cognitive skill in which inexperienced drivers demonstrate less proficiency than more

experienced drivers. There is evidence from numerous studies that young drivers, perceive less risk when engaging in risky driving behaviour and committing traffic offences (DeJoy, 1992; Finn & Bragg, 1986; Trankle *et al.*, 1990; Yagil, 1998). Trankle (1990) also observed that male ratings of crash risk in traffic situations were lower than those of their female counterparts and younger males gave lower crash risk ratings than middle-aged male drivers. McKenna (1993) examined the mechanisms behind a drivers' underestimation of the risk of involvement in a negative event such as a crash. He drew the conclusion that there was support for an "illusion of control" over the ability to handle the vehicle, rather than unrealistic optimism.

Other research has shown that young drivers assess their level of driving skill as higher than other young drivers (DeJoy, 1992; Matthews & Moran, 1986), as well as drivers of other age groups (DeJoy, 1992; Groeger & Brown, 1989; Svensson, 1981). DeJoy (1992) reported that overestimation of skill was more pronounced in young males than young females. Thus, inexperienced drivers, particularly young males, tend to underestimate the risks associated with dangerous driving situations yet overestimate their own ability or driving skills to deal with the situation. As a result, inappropriate demands are placed on their limited vehicle control skills (Brown, 1982; Deery, 1999).

A noteworthy study by Lajunen and Summala (1995) examined driver skill and safety motivation among Finnish university students. They found that a higher level of perceived driving skill was significantly correlated with self-reported crashes (r=0.26) but a lack of respect for driving safety was not. Of interest, greater driving experience increased driver's perceived skill orientation, but decreased safety motivation.

With regard to perceptual skills, several studies have noted that inexperienced drivers detect hazards less quickly and efficiently than experienced drivers, and take longer to respond to hazards (Finn & Bragg, 1986; Mayhew & Simpson, 1995;

McKenna & Crick, 1994; Quimby & Watts, 1981; Renge, 1998). Difficulties with hazard perception are thought to be related to novice drivers adopting less efficient information gathering strategies (Deery, 1999). Inexperienced drivers have less flexible visual search patterns than more experienced drivers and they have been shown to: confine their visual search to a smaller area, look more to the front of the vehicle, check the rear view mirror less frequently, move their point of focus more frequently, and utilise peripheral vision less efficiently than experienced drivers (e.g., Crundall & Underwood, 1998; Falkmer & Gregersen, 2001; Mourant & Rockwell, 1972).

Interestingly, vehicle control skills appear to increase rapidly with experience while cognitive and perceptual skills take more time to develop. For example, Catchpole et al. (1998) analysed casualty crash data and found drivers aged 18 to 20 years were more likely to be over-represented in single vehicle “off path” crashes (i.e., loss of control) than those aged 21 to 25 years. However, there was no difference between the age groups for crashes involving conflicts created by the unexpected actions of other road users (i.e., crashes resulting from poor hazard perception and detection). Hall and West (1996) suggested that vehicle control skills can be learnt after only 15 hours of driving.

Most studies examining inexperience in relation to crash risk define experience as the length of time that a driver’s licence is held. Recognition must be given to the fact that measuring driving experience by the elapsed time since a driver licence is obtained does not necessarily guarantee driving is occurring. Therefore, it is also important to measure driving exposure, that is, the actual time spent driving, either by total distance driven or the total time spent driving since licensure (Catchpole *et al.*, 1994a). These measures allow for individual variability in driving exposure.

However, driving experience and exposure to risk are often confounded. To gain experience, novice drivers must spend time driving, but in doing so, they increase their likelihood of crashing due to their inexperience. This dilemma has been referred to as the "young driver paradox" (Warren and Simpson, 1976). Exposure to risk is discussed in the following section.

1.3.3 Exposure to Risk

Intuitively, one might think that young drivers have an elevated crash risk because they drive more than other drivers, that is, they have greater driving exposure. However, as noted previously, young drivers actually drive a shorter distance per annum than middle-aged drivers (Massie et al., 1995). Thus, the elevated crash risk of young drivers is not from greater driving exposure but may be from greater risk per unit of exposure (Catchpole *et al.*, 1994b).

To account for the elevated crash risk of young drivers, it has been hypothesised that young driver's lifestyle exposes them to more driving risks than other drivers (Laapotti et al., 2001). Factors associated with young drivers' lifestyle that have been linked to increased young driver exposure to risk include: night driving, alcohol use, influence of peer passengers, and use of older and smaller vehicles. These factors are described in the following subsections.

1.3.3.1 Night driving

Young drivers are known to be over-represented in crashes at night and on weekends (Chen *et al.*, 2000; Clarke et al., 2002; Gregersen & Nyberg, 2002). Although all drivers have an elevated crash risk at these times, young driver crash risk has been found to be disproportionately higher (Cvijanovich *et al.*, 2001; Stewart & Sanderson, 1984; Twisk, 1995).

Clarke and colleagues (2006) investigation of over 3000 crashes involving young drivers found that of the different crash types examined, crashes in darkness

were particularly problematic for younger drivers. Moreover, crashes in darkness were not a result of poor visibility but a consequence of how young drivers used the roads at night (i.e., driving for recreational purposes).

As young drivers are more likely than other drivers to drive at night and on weekends, it was thought that driving at these high-risk times (i.e., when exposed to increased risk) contributed to their increased crash risk. However, studies accounting for the amount of driving at night showed that young drivers still had an elevated risk of crash involvement per distance driven at night, especially on weekends and weekend nights (Crettenden *et al.*, 1994; Williams, 1985). Thus, driving at high-risk times is not sufficient to explain young drivers' elevated crash risk.

1.3.3.2 Alcohol use

A large body of literature clearly demonstrates that alcohol consumption impairs driving performance and increases the risk of crash involvement, a risk that increases exponentially with rising blood alcohol concentration (BAC) (e.g., Borkenstein *et al.*, 1964; McLean & Holubowycz, 1981). Research has shown that young drivers are less likely than other drivers to be drinking and driving, and of those drivers who have been drinking, young drivers record lower BAC levels (e.g., Williams, 2003). Younger crash involved drivers have also been found to have lower BAC levels than older crash involved drivers (Macdonald, 1994). However, young drivers are over-represented in alcohol related crashes, and have a higher risk of a crash at all BAC levels compared to other drivers, even when controlling for driving exposure (Keal *et al.*, 2004; Perrine *et al.*, 1989). For example, New Zealand research showed that at all BAC levels, drivers aged 15 to 19 years had more than five times the fatal crash risk of drivers aged over 30 years (Keal et al., 2004). Moreover, this risk was inflated at night and with additional passengers. Young driver's greater deterioration of driving after drinking has been attributed to the combination of

inexperience with driving and inexperience in coping with the effects of alcohol (Catchpole et al., 1998; Williams, 2003).

1.3.3.3 Influence of peer passengers

Research indicates that young driver's crash risk increases when carrying passengers and increases with a greater number of passengers (Chen et al., 2000; Preusser *et al.*, 1998; Williams, 2000). Moreover, the increase in crash risk associated with carrying passengers is unique to young drivers (Williams, 2003). For example, using fatal crash data, Chen and colleagues (2000) found that the risk of fatal injury for young novice drivers (16-17 years) increased with the number of passengers while the risk for older drivers (30-59 years) decreased with passengers in the vehicle. In comparison to drivers of the same age without passengers, the fatal crash risk for a driver aged 16 years with one passenger was 1.9 times higher, 2.6 times higher with two passengers, and 3.1 times higher with three passengers. Similarly, Williams (2000) reported that the crash risk among drivers aged 16 and 17 years was four times higher with three passengers than no passengers.

The characteristics of the passenger also appear to influence young driver behaviour. Carrying young passengers or peers has been associated with increases in young driver travelling speeds (Baxter et al., 1990; McKenna & Crick, 1994) and fatal crash risk (Chen et al., 2000; Preusser et al., 1998). Moreover, young male passengers have been associated with the greatest increases in crash risk (Baxter et al., 1990; McKenna & Crick, 1994; Williams, 2003).

Several explanations have been offered to understand the adverse influence of passengers on young drivers. It has been suggested that passengers are distracting and this can lead to driving errors and increased crash risk for the young driver (Preusser et al., 1998). Alternatively, social psychological models postulate that young drivers are more susceptible to peer and social influences and will conform to the social

norms of the group, leading to more risk-taking driving behaviour (Parker et al., 1992).

However, some studies have found contradictory results. Ballesteros and colleagues (2000) reported that passengers did not increase young driver crash risk. Of the 16 year-old drivers involved in a crash, 75.9 per cent without passengers were deemed culpable, compared to 73.7 per cent with one passenger and 74.2 per cent with more than one passenger. However, the authors warn that this study is not directly comparable to other studies as they did not determine how often young drivers generally drive with and without passengers. In contrast to most studies, Vollrath, Meilinger and Kruger (2002) reported a protective effect of passengers on crash risk among young drivers (18-24 years). However, the reduction in crash risk was less for young drivers, relative to other drivers.

As young drivers tend to be more likely to carry passengers when driving (Lam, 2003), it has been suggested that the higher vehicle occupancy increases young drivers' exposure to risk. Williams (2003) disagrees; he argues that studies based on crash involvement showed that there was still an increased risk for young drivers when carrying passengers, and increased exposure was not a factor.

1.3.3.4 Older and smaller vehicles

There is evidence that young drivers tend to drive older and smaller vehicles (Cammisa *et al.*, 1999), and young drivers are over represented in crashes with older and smaller vehicles (Engström et al., 2003; Williams *et al.*, 2006). For example, young Swedish drivers were found to be over-represented in crashes with vehicles in which the model was 1986 or earlier (Engström et al., 2003). Analysis of fatal crashes in the United States during 2003 revealed that 35 percent of drivers aged 16 to 17 years involved in a fatal crash were driving small passenger vehicles compared to 22 per cent of drivers aged 20 to 49 years (Williams et al., 2006). Similarly, 55 per cent of drivers aged 16 to 17 years were driving vehicles manufactured in 1995 or earlier

in comparison with 46 per cent of drivers aged 20 to 49 years. The older vehicles may be in poor condition and offer less safety features than more modern vehicles, and smaller vehicles offer less crash protection than larger vehicles. As young drivers are more likely to drive older and smaller vehicles, they are more likely to be exposed to the risk of serious injury if crash involved (Engström et al., 2003; Williams et al., 2006).

In summary, although some of the factors reviewed contribute to an increased exposure to risk for young drivers, they do not account entirely for young drivers' elevated crash risk. After reviewing the evidence, Jonah (1986) concluded that "even when one controls for the quantity and quality of exposure to risk, young drivers are still at greatest risk of casualty accident involvement" (p. 257).

1.3.4 Youth versus Inexperience

One of the most contested questions in young driver research has been whether age-related factors or inexperience factors make the greatest contribution to young drivers' over-representation in crashes. This question is particularly important when developing countermeasures to address the young driver problem. However, the problem with attempting to define the effects of age and years of driving experience is that they are highly correlated. Younger drivers are inexperienced and older drivers are usually more experienced. This problem is particularly relevant to South Australia where individuals are able to apply for a driver's licence at a younger age (16 years) than in other Australian states (e.g., Victoria, 18 years). Given that age and experience are confounded, it is very difficult to determine which is more closely associated with younger driver crash involvement.

Several studies from Canada have suggested age or maturational factors are more important than experience. Laberge-Nadeau, Maag and Bourbeau (1992) showed that crash rates decreased with age for both experienced and inexperienced drivers. This effect was stronger among males than females. Mayhew et al. (2003)

found evidence of both age and inexperience effects. They demonstrated that at all ages, novice driver crash rates decreased with increasing experience, that is, time since licensure. However, the decrease was greatest among the youngest drivers, particularly drivers in the first year after licensing; a finding that may be partially attributable to the low starting level of crashes for older novice drivers. These findings were consistent with results from a study of novice drivers aged 16 to 55 years (Cooper *et al.*, 1995). Initial risk for crashes in which the driver was deemed responsible or culpable was higher for novice drivers than their more experienced counterparts, but highest for the youngest novice drivers aged 16 years.

Maycock et al. (1991) examined novice drivers in the United Kingdom where the youngest age a licence could be acquired was 17 years, although many were known to wait until they were older. Consistent with the previous studies, age appeared to be a factor with the youngest novice drivers having a higher crash risk than older novice drivers. Moreover, postponement of licensure from age 17 to 18 was associated with a six per cent decrease in crash risk, and a delay from age 18 to 19 lead to an additional six per cent decrease. However, experience appeared to be an even more important factor than age. At all ages, a 30 per cent decrease in crash risk was noted after the first year of licensure, followed by an additional reduction of 17 per cent in the second year. Maycock and colleagues (1991) concluded that crash risk during the first eight years of driving decreased by 59 per cent due to inexperience, and 31 per cent due to age factors, although age factors were shown to be more important at younger ages.

Other research suggests that inexperience plays a greater role in young driver crash risk than age-related factors. Catchpole, Macdonald and Bowland (1994b) studied the personal characteristics, travel patterns and crash history of drivers aged 16 to 29 years. They found that driving experience and “recklessness”, a factor strongly correlated with age, predicted young driver crash risk when driving exposure

was held constant. While experience was found to be a more important determinant than age, the authors stated that these findings should be regarded as “indicative rather than conclusive” due to the high correlation between age and experience, and possible effects from self-selection of age of licensure (i.e., those who delay licensure may differ significantly by factors other than age). Clearly, these limitations apply to most research examining the relative effects of age and experience on young driver crash risk.

Catchpole and colleagues (1994b) also stressed the importance of examining crash rates per distance driven without statistically removing the effect of annual driving exposure: “due to the correlation between experience and exposure, controlling for exposure removes a large part of any experience effect which may be present, thus weakening the effect of the nominal ‘experience’ variable and biasing the study towards finding that age effects predominate” (p. 16).

Waller and colleagues (2001) followed the crash and traffic offence records of a large cohort of young Michigan drivers for seven years from first licensure. They demonstrated that both age and experience factors were important among young drivers, but experience contributed to a greater decline in crash risk. They found that the odds of crashing decreased by about five per cent for each additional year of *age* at the time of licensing, but decreased at a higher rate, 17 per cent, per *year* of licensing across age and gender. The decrease in crash risk was greater during the first year of licensure (22% in the first year and 19% in the second year) than the following years. The decrease in crash risk during the first year was lower than the 30 per cent reduction reported by Maycock et al. (1991) in the United Kingdom. However, unlike Maycock et al. (1991), Waller and colleagues (2001) did not include estimates of mileage as a variable in their model. Annual mileage has been shown to increase during the first few years of driving (Massie et al., 1995). If the increased driving exposure were taken into account, the decrease in crash rates would be even greater.

Interestingly, Waller et al. (2001) also examined culpable crashes (i.e., at fault) and found that they decreased by approximately 20 per cent per year of licensing, a slightly greater reduction than the rate for all crashes (i.e., 17%). Age at the time of licensure was positively associated with culpable crashes and serious traffic offences (i.e., driving incidents associated with more risky driving); older novice drivers were at a higher risk of crash culpability and detection for traffic offences. These findings suggest that risky driving did not decline as a function of age. However, these results should be interpreted cautiously because the upper age range of novice drivers in this study was limited to 19 years, an age at which drivers are still considered relatively young.

A study from the United States took a different approach to examine the effects of age and inexperience on young driver crash involvement. McKnight and McKnight (2003) examined more than 2000 non-fatal crashes involving drivers aged 16 to 19 years and found that the majority of crashes resulted from inexperience including errors in attention, visual search, speed relative to conditions, hazard recognition, and emergency manoeuvres. Few crashes were attributable to intentional risk-taking behaviour. However, this study did not examine crashes with the most severe outcome, fatal injury crashes. Conversely, a study from the United Kingdom that examined a large number of young driver crashes reported to police, found that crashes of all types were found to be frequently the result of risk-taking factors rather than driving skill deficits (Clarke *et al.*, 2005).

While similar methodologies were employed, there were a number of factors that may have contributed to the contradictory conclusions drawn by each study. The United Kingdom study examined drivers aged 17 to 25 years while the United States study examined younger novice drivers, aged 16-19 years. In addition to age differences, there were also differences in driving experience and details available in

crash reports. Moreover, the subjective nature of the research may have also contributed to the different findings (i.e., determination of crash causation).

In summary, studies from all around the world demonstrate that both age (i.e., risky driving style) and inexperience (i.e., lesser ability to recognise and respond to hazards) contribute to the high level of young driver crash involvement. However, studies have varied in their conclusions about the relative contribution of age and inexperience. After reviewing studies examining the contribution of age and experience, Engström and colleagues (2003) concluded "age-related factors account for about 30-50% of accident reduction while experience accounts for 50-70%" (p. 30). However, age factors appear to be more important at younger ages, particularly less than 17 years. For example, age-related factors appear to be of higher significance in American studies because the age limit for obtaining a licence is lower (Engström et al., 2003). Clearly, the high correlation between age and inexperience makes it difficult to separate the relative contribution of the two factors.

Regardless of which factor is more important, there is a need to move beyond this debate and address each of these factors to reduce young driver crashes. This thesis focuses on age-related factors. Consequently, the following section concentrates on risk-taking associated with adolescent development, that is, "the problem young driver".

1.4 The Problem Young Driver

It has been argued that the higher risk of crash involvement for young drivers is not necessarily a problem for all young drivers, but a problem associated with a smaller, specific group of young drivers. In other words, it is not so much a young driver problem, but certain problem young drivers. There is evidence that these problem young drivers intentionally engage in risky driving (i.e., risk-taking) and are also likely to engage in other risky behaviours as part of a risky lifestyle. These factors, related to adolescent development, are discussed with reference to the

theoretical framework provided by Problem Behaviour Theory in the following sections.

1.4.1 A Risky Lifestyle?

It appears that the majority of young drivers do not intentionally engage in risky driving. Moreover, the unsafe driving styles of these young drivers are thought to be the result of a tendency to underestimate the risk in driving situations and overestimate their own driving ability or skill; factors related to inexperience (Elander et al., 1993). It has been proposed that a smaller group of young drivers deliberately participate in risky driving and are motivated by risk-taking tendencies, that is, they are motivated for the purpose of experiencing danger or seeking thrills. Research suggests that risk-taking in the driving context, among other risky behaviours, serves to fulfil functions associated with adolescent development (i.e., oppose authority, assert independence, impress peers) (Jessor et al., 1997). This notion is discussed in detail in the next section (1.4.2).

There is evidence from a number of studies that individuals displaying risky driving practices also engage in other risky, problematic or health compromising behaviours in other areas of their life. Essentially, as Tillman and Hobbs (1949) first noted, “we drive as we live” (p329). The link between lifestyle, risky driving and crash involvement of young drivers has been shown in a number of studies (Berg & Gregersen, 1994; Bina *et al.*, 2006; Schulze, 1990). For example, Bina et al. (2006) reported that male Italian adolescents (aged 14 - 17 years) exhibiting risky driving behaviours were more likely to engage in anti-social behaviour, smoke tobacco, eat for comfort, and spend time in non-organised activities with friends. Female adolescents reporting risky driving were more likely to participate in antisocial behaviour, other risk-taking behaviours for sensation seeking purposes, and drug use. A Swedish study defined high and low crash risk groups in relation to their lifestyle (Berg & Gregersen, 1994). The high-risk group was characterised by low participation

in sports activities, consumed alcohol with the intention to get intoxicated, driving for reasons other than transportation, and an interest in cars. In addition, they frequently visited licensed premises, reported a busy social life, and were predominantly male.

Problem Behaviour Theory (PBT) (Jessor & Jessor, 1977) provides a theoretic framework to understand young drivers' risky lifestyle in terms of adolescent development and the fulfilment of certain goals; PBT is discussed in the next section.

1.4.2 Problem Behaviour Theory

In the context of younger drivers, the premise that crash involvement represents part of a risky lifestyle is consistent with Problem Behaviour Theory (PBT) (Jessor & Jessor, 1977). Jessor and Jessor (1977) originally developed PBT to provide a psychosocial explanation of adolescent problem behaviour from the perspective of adolescent development and to evaluate the influence of lifestyle factors. A significant advancement occurred when PBT was extended to include risky driving as another adolescent problem behaviour (Jessor, 1987). PBT postulates that many problem behaviours, including risky driving, are interrelated and reflect a common underlying propensity for problem behaviour or a deviant lifestyle among young adults (Jessor, 1987; Jessor & Jessor, 1977). According to this theory, the likelihood that problem behaviour will occur is determined by a number of psychosocial risk factors within the Personality System (i.e., an individuals' values, opinions, feelings), the Perceived Environment System (i.e., approval of peer, family and school contexts), and the Behaviour System (i.e., problematic and conventional behaviours). Problem behaviour is considered to be a learned behaviour that serves an important purpose for individuals specific to developmental tasks and is instrumental towards the attainment of goals (Jessor, 1987). Risky driving, and other risky behaviours, may serve to fulfil the following functions: express opposition to adult authority, cope with anxiety and frustration, satisfy a need for thrills or sensations, demonstrate adulthood, gain peer

approval or acceptance, and overcome one's own limits and assert independence (Jessor et al., 1997).

Consistent with PBT, studies conducted in a variety of countries have demonstrated that risky driving is part of a cluster of problem behaviours, or risky lifestyle, in young adults. Risky driving has been shown to be associated with high alcohol consumption, illicit drug use, and antisocial behaviour (e.g., Donovan, 1993; Jessor, 1987; Wilson & Jonah, 1988). Beirness and Simpson (1988, 1991) conducted one of the first longitudinal studies examining aspects of young driver lifestyle by comparing crash and non-crash involved young Canadian drivers. Their findings supported PBT; they concluded that young driver crashes were associated with a more comprehensive pattern of behaviours that included other risky behaviours such as driving after drinking, not using seat belts, and intentionally taking risks while driving. Also in support of PBT, a longitudinal study of drivers aged 21 years from New Zealand found that drivers most likely to engage in risky driving in the last three years reported alcohol or cannabis abuse in adolescence, were involved in violent or property crime, and were associated with delinquent or substance using peers (Fergusson *et al.*, 2003). A strong relationship was also found between risky driving behaviour and crash risk.

Shope and colleagues (2001b) analysed official driver records in combination with high school questionnaire data for a large number of young adults in Michigan, United States. Poisson regression models were used to identify characteristics predicting subsequent high-risk driving of young drivers aged 23 and 24 years. Substance use (cigarettes, marijuana, and alcohol) reported at age 15 was shown to be an important predictor of the subsequent risk of serious traffic offences and serious crashes for both males and females.

Other evidence of a pattern of risky behaviours among young drivers comes from a recent Australian longitudinal study investigating the correlates of risky

driving behaviour, crash involvement and speeding offences (Smart et al., 2005). This research was based on a large cohort of young adults aged 19 to 20 years at the most recent time of data collection. Young drivers were categorised according to the prevalence of each behaviour. The risky driving group, the multiple crash group, and the multiple speeding offence group reported more frequently engaging in multiple substance use and anti-social behaviour than the other driver groups. Of interest, these differences were observed in the cohort from mid/late adolescence (15-18 years).

In contrast to the previous studies, a longitudinal study of a cohort of young New Zealand drivers found few lifestyle factors were important predictors of crash outcomes (Begg *et al.*, 1999). Begg and colleagues (1999) found significant but weak odds-ratio relationships. Furthermore, few lifestyle predictors were common to both males and females. They warned that altering the lifestyles of young drivers would have little effect in reducing the risk of crash involvement. Engstrom et al. (2003) also remarked that many of the correlations between lifestyle factors and crash involvement found in studies have been weak.

Two aspects of young drivers' lifestyle associated with increased crash risk have received much attention in the literature and deserve some discussion in greater detail, antisocial behaviour or social deviance, and alcohol consumption. A relatively strong relationship between crash involvement and anti-social behaviour or social deviance has been reported in research from the Netherlands, United Kingdom, Canada, and the United States (Hansen, 1988; Junger *et al.*, 1995; Junger *et al.*, 2001; Lawton et al., 1997b; Sivac, 1983; Tillman & Hobbs, 1949; West *et al.*, 1993; West & Hall, 1997). For example, a Dutch study found that 28 per cent of non-delinquent children reported crash involvement compared to 72 per cent for the most delinquent children (Junger et al., 1995). This association persisted even after controlling for age, gender and the different types of criminal behaviour committed. A more recent study using driver records indicated that if an individual was involved in crime, it more than

doubled the likelihood they would be involved in a crash preceded by risky driving behaviour (Junger et al., 2001).

West et al. (1993) developed the Social Motivation Questionnaire to measure mild social deviance, a construct examining antisocial motivation within the normal range, that is, behaviours whose motive was not to harm others but harm to others may be a likely consequence. The authors found an association between mild social deviance and crash involvement. A subsequent study that used the same measure of mild social deviance reported that the effects of social deviance, mileage and gender on crash involvement were mediated by the tendency to commit traffic offences (Lawton et al., 1997b). The authors concluded that one of the ways mild social deviance manifests itself in the driving context is through committing traffic offences. Meadows (1998) reported a relationship between extreme social deviance and crash involvement in a sample of young offenders from a reform centre in the United Kingdom. Similar to Lawton et al's (Lawton et al., 1997b) findings, this association was mediated by traffic offences.

Consumption of large amounts of alcohol has also been considered part of a general risk-taking propensity related to the lifestyle of problem young drivers (Gregersen & Berg, 1994; Jonah, 1986). For example, Horwood and Fergusson (2000) found that young drivers who reported drinking and driving were also more likely to report high rates of other unsafe driving behaviours (e.g., speeding, unsafe overtaking, running red lights). Controlling for these factors substantially reduced the association between drink driving and crashes.

Alcohol consumption patterns have also been used to predict the crash involvement and drink driving behaviour of young drivers, sometimes as early as mid adolescence (Beirness & Simpson, 1988; Deery & Love, 1996; Gregersen & Berg, 1994; Lang *et al.*, 1996). For example, a longitudinal study of high school students found attitudes towards alcohol and alcohol consumption were associated with young

driver crash involvement (Beirness & Simpson, 1988). Young drivers involved in a crash were more likely to: drink alcohol, drink more frequently, consume greater quantities of alcohol, report more frequent alcohol use, and begin drinking at a younger age.

In summary, there appears to be substantial evidence of relationships between crash involvement and risky driving behaviour, and other risky behaviours associated with young drivers' lifestyle such as antisocial behaviour and alcohol involvement.

1.5 Identifying Problem or High-Risk Young Drivers

It has been argued that the higher risk of crash involvement is not necessarily a problem for all young drivers, but a problem associated with a smaller, specific group of young drivers (e.g., Williams, 1998). Moreover, these problem young drivers who intentionally engage in risky driving are likely to engage in other risky behaviours. The identification of young drivers with a higher risk of crash involvement is obviously important for the targeting of interventions and countermeasures aimed at reducing crash risk among young drivers.

Traditionally, studies have attempted to identify problem or high-risk drivers by demographic information and examining their history of crash involvement and traffic offences. Any relationships found have been modest at best. This approach has also been used, to a limited extent, to identify young high-risk drivers and predict subsequent crash involvement. For example, Crettenden and Drummond (1994) reviewed evidence for a problem or high-risk young driver subgroup from the literature and mass crash data analyses. They acknowledged the heterogeneity of crash risk among young drivers and concluded that there was evidence supporting such a subgroup if "problem driving" was defined as involvement in multiple crashes. However, the authors recognised that there are many ways of defining problem driving apart from involvement in multiple crashes and emphasized that their problem young driver subgroup comprised a very small proportion of young driver crash

involvement. Furthermore, Crettenden and Drummond (1994) stated that “there is no agreed definition of a young problem driver and even very good, current identification procedures using crash, violation and demographic information are very inefficient” (p. 42).

It is possible that the identification of high-risk young drivers, on the basis of driver records, might improve if high-risk young drivers are defined as engaging in unsafe driving behaviour that leads to crash involvement. In other words, driver records may be more valuable in identifying young drivers *culpable* for a crash, rather than young drivers who are crash involved primarily due to driving exposure. There is a clear need for research to address this deficit. Nonetheless, there is also a need for more efficient means, other than driver records, of identifying young drivers at a higher risk of crash involvement.

Given that there is a subgroup of young drivers at a higher risk of crashing, it is of importance for research to ascertain exactly which characteristics or attributes (i.e., personality, motivations, attitudes) define high-risk young drivers and to confirm the existence of high-risk subgroups in different young driver populations. Note that personality characteristics are relatively stable over time and cannot be manipulated by modest psychological means over a short period. However, understanding the characteristics and attitudes of young drivers at a higher risk of crashing will assist in tailoring road safety interventions to their needs and motivations and prevent these drivers from becoming older drivers at a higher risk of crashing. Interventions targeting specific high-risk subgroups of young drivers may be more effective than interventions or campaigns targeting all young drivers.

Since Crettenden and Drummond’s study (1994) a small number of studies have attempted to identify high-risk subgroups of young drivers based on personality characteristics and attitudes with some success (Beirness, 1993; Deery *et al.*, 1998; Ulleberg, 2001). To validate and understand the characteristics defining such a young

driver subgroup, it is essential that previous studies are replicated and extended. No such studies have examined subtypes of young South Australian drivers. Furthermore, to the best of my knowledge, no studies have examined subtypes based on personality factors and attitudes among a population of young drivers caught engaging in risky driving behaviour.

Research indicates that a driver who engages in risky driving behaviour is likely to engage in other risky behaviours (e.g., Jessor, 1987). Thus, any high-risk young driver subtypes identified on the basis of personality characteristics and attitudes might also engage in other risky behaviours such as alcohol consumption and antisocial behaviour. Therefore, high-risk subtypes should be validated against measures of other high-risk behaviours and any other attitudes and behaviours known to be associated with a higher risk of crashing.

1.6 Summary

Young drivers are over-represented in crashes, predominantly due to age or youth, and inexperience (the research presented in this thesis specifically investigates age-related factors). Nevertheless, not all young drivers are crash involved. There is increasing evidence within road safety literature suggesting the existence of a subgroup of problem young drivers, that is, young drivers with an elevated risk of crashing. Thus, the aim of this thesis was to address research deficits by examining characteristics that identify young drivers (aged 16 to 24 years) with an elevated risk of crash involvement and by validating high-risk driver subtypes among different young driver populations. Young driver interventions might be more effective if tailored to the needs and motivations of these specific subgroups of young drivers identified as being at a higher risk of crash involvement.

Drivers culpable for a crash may be a subset of high-risk drivers. These high-risk drivers might then be identified by their past driving behaviour, evident in driving

records. A review of the literature examining the ability of driver records to identify high-risk drivers, and, high-risk young drivers is presented in the next chapter.

CHAPTER 2 RELATIONSHIPS BETWEEN CRASH CULPABILITY, PRIOR DRIVING RECORD, AND FATAL CRASH INVOLVEMENT

2.1 Introduction

In Chapter 1, it was argued that a small specific subgroup of young drivers was responsible for the higher crash risk of young drivers. It was also suggested that past driving behaviour, reflected in driver records of crash involvement and traffic offences, might be useful in identifying these high-risk young drivers. Furthermore, driver records may be more useful in identifying high-risk drivers if high-risk drivers are defined as drivers deemed culpable for a crash, that is, drivers engaging in behaviour that caused the crash rather than drivers who may be involved in a crash due to driving exposure.

This chapter reviews the literature examining the ability of driver records to identify high-risk drivers, especially high-risk young drivers. The chapter begins with a general review of the literature examining the role of driver records in identifying crash involved drivers, and, specifically, drivers culpable for a crash. Other factors associated with crash culpability are also investigated such as age, sex and alcohol use prior to the crash. Following this, studies using driver records to specifically identify high-risk young drivers are reviewed. Finally, methodological limitations associated with these studies are discussed.

Of note, special emphasis has been placed on studies that used driver records to identify drivers culpable for a *fatal* crash because, generally, fatal crashes are investigated more thoroughly than less severe crashes.

2.2 Driver Records and Crash Involvement

The examination of past driving behaviour, evident in driver records of traffic offences and crash involvement, is important for identifying drivers with a higher risk of crash involvement. In fact, past driving behaviour has been used as the basis of

many driver related interventions and licensing control systems. The premise is simple: drivers who have a past record of traffic offences and crashes are more likely to repeat this behaviour.

A comprehensive review of studies using multivariate and multiple regression methods to identify variables correlated with increased crash risk concluded that driver records, particularly traffic offence records, were the most consistent and powerful predictor of subsequent crash involvement (Peck, 1993). Although traffic offences were the strongest predictor, it was acknowledged that no single variable or combination of variables contributed to a large percentage of the variation in crash risk. For example, in one of the reviewed studies (Burg, 1973), a higher multiple R was reported for a regression model (predicting crash frequency) that included driver records and biographical data (R= .23) than a model that excluded the driver record variables (R= .20). Traffic offence convictions in the previous three years were the strongest predictor.

Consistent with Peck's (1993) review, most other research examining driving records and crash involvement has found traffic offences to be a better predictor of crash involvement than crashes (Coppin & van Oldenbeek, 1966; Elliot *et al.*, 2001; Garretson & Peck, 1982; Harrington, 1972; Peck & Kuan, 1983; Peck *et al.*, 1971), but with some exceptions (see Flowers *et al.*, 1980; Hauer *et al.*, 1991). Peck et al. (1971) offered the explanation that traffic offences were a better predictor of crash involvement than crashes because of their greater frequency of occurrence and the inclusion of crash related behaviour in offence frequency; committing a traffic offence often leads to crash involvement and the detection and recording of the offence. Other research has suggested that traffic offences are more closely related to variations among individuals than are crashes because offences are more likely to involve intentional behaviours (Burg, 1970; Harrington, 1972). Drivers generally do not try to be involved in a crash. In contrast, behaviour leading to detection for a traffic offence

(e.g., speeding or drink driving) may be considered under greater volitional control and provide a measure of the drivers willingness to perform objectively risky driving actions (Catchpole, 2004). Reason, Manstead, Stradling, Baxter and Campbell (1990) found that traffic offences were connected to the motivations of the driver and were more intentional than driving errors, slips or lapses. According to Keskinen (1996), and Hatakka and colleagues' (2002) theoretical four-level hierarchical model of driving behaviour, a persistent traffic offender suggests problems located in the driver's highest hierarchical level of driving behaviour "goals for life and skills for living," or a driver's general motives and attitudes in life.

Contradicting these previous studies, of which all but one (Elliot et al., 2001) was conducted in California, a small number of studies have found prior crashes to be a better predictor of crash involvement than prior traffic offences. In one study, Poisson multiple regression analyses were used to identify crash risk factors among a large representative sample of licensed Texan drivers (Flowers et al., 1980). In another study, the driver records of Canadian drivers, known to be licensed both at the beginning and end of a four year period, were used to formulate a series of negative binomial regression models to predict the likelihood of future crash involvement (Hauer et al., 1991). It was suggested that the findings from these two studies differed to findings from the Californian studies due to differences in enforcement levels and the sensitivity of crash reporting policies in the different jurisdictions (Gebers & Peck, 2003; Peck, 1993). For example, traffic offences may be more actively policed in California than in Texas and Canada. Alternatively, Texan and Canadian authorities may require a lower monetary threshold for the reporting of crashes resulting in a greater number of reported crashes and greater predictive power.

Considering the specific *types* of crashes and traffic offences might assist in predicting subsequent crash involvement. Contrary to expectations, studies investigating this possibility found that specific crash types, including culpable

crashes, were not a better predictor of crash involvement than the total number of crashes (Hauer et al., 1991; Peck, 1993). For example, the study by Hauer and colleagues (1991) found that the performance of multivariate models was improved if crash records were included but culpability for the prior crash made little difference. An unpublished study by Peck and Gebers (as cited in Peck, 1993) examined the ability of a number of different types of crashes to predict crash involvement including: night-time, drink driving, single vehicle, police-reported, fatal and injury, and culpable crashes. None of these crash types predicted crash involvement as well as the total number of crashes. Peck (1993) offered the explanation that "confining the accident measure to some definable accident subset further skews an already highly skewed variable" (p. 156).

Findings from studies investigating the ability of specific traffic offence types to predict crash involvement have been mixed. An early study investigating the relationship between traffic offence frequency and crash rates in North Carolina reported that speeding offences were a good predictor of crash involvement (Campbell, 1958). Peck (1993) challenged these findings; he astutely noted that Campbell's results overstated the ability of driver records to identify future crash involvement because the analysis involved two independent and dependent variables measured concurrently. Hauer and colleagues (1991) reported that traffic offences were predictive of crashes but little was gained by distinguishing between offence types or the perceived seriousness of the offence. However, specifying the number of prior crashes and offences was important. Of note, drivers with a licence suspension during the four-year period were excluded from the study. As a result, many serious offenders were excluded from the analyses, so the level of association between driving records and crash involvement was most likely reduced. Similar to Hauer et al.,'s (1991) findings in Canada, several studies conducted in California demonstrated

that the total number of prior traffic offences was a better predictor of casualty crashes than individual specific offence types (Burg, 1974; Peck & Coppin, 1967).

Contrary to these studies, more recent research using multivariate statistical models (based on driver and licence variables, and crash and offence records in the preceding two years) reported that the two best models for predicting casualty crash involvement of Victorian drivers included the number of prior traffic offences by offence category (Diamantopoulou *et al.*, 1997). Both of these models were considered significantly superior to the "total offences" model.

The majority of reviewed studies used specific types of offences to predict casualty crash involvement. A Finnish study is one of the few published studies that attempted to use offence types to identify fatal crash involvement (Rajalin, 1994). The traffic offence records of drivers involved in a fatal crash were retrieved for the preceding three years and were compared to the offence records of a random sample of licensed drivers. Drivers involved in a fatal crash were more likely to be convicted of all types of prior driving offences: driving without a licence, driving behaviour offences, and drink driving.

Of interest, a study of Californian drivers involved in a fatal crash found that males were much more likely to record prior crashes, traffic offences and licence disqualifications than females (Garretson & Peck, 1982). However, no measure of annual mileage was included in the study and, therefore, sex differences might be attributed to male drivers spending more time on the road.

In summary, associations have been observed between driver records and crash involvement but these associations appear to be modest at best and subject to the effects of enforcement practices. Prior traffic offences appear to be a better predictor of crash involvement than prior crashes, at least for Californian drivers. There were inconsistent findings as to whether specific offence types were better predictors of crash involvement than the total number of traffic offences. Thus, driver

records may not accurately predict who will be involved in a crash but they may assist in identifying groups of drivers with an increased risk of crash involvement.

2.3 Driver Culpability

When examining crash involvement, some research has considered whether the driver was responsible or "culpable" for the crash. Driver culpability for a crash suggests that the behaviour of the driver contributed significantly to the crash. It is likely that a driver deemed culpable for a crash may be identified by previous risky driving behaviour, evident in driver records. Involvement in a crash where the driver is not responsible or non-culpable may be viewed as largely a function of driving exposure. Therefore, non-culpable crash involvement cannot be predicted by any variable because it is not the consequence of any specific behaviour (Elander et al., 1993).

Before reviewing studies that used driver records to identify culpable crash involvement, the following subsections discuss the assessment of driver culpability, age and sex differences in driver culpability and other crash characteristics associated with driver culpability.

2.3.1 Assessment of Driver Culpability

Driver culpability for a crash is generally assessed by one of two methods. The first method relies on information documented in police reports, Coroner's reports, statements from individuals involved in the crash, and statements from witnesses of the crash. Based on this information, drivers are judged to be either culpable or non-culpable for the crash. Many studies have adopted this methodology, most likely because this information is readily available. However, it has been argued that this method of determining culpability lacks objectivity; it is vulnerable to biases held by

investigating police officers, and does not follow a consistent scoring protocol (Janke, 1991).

The second method of establishing driver culpability for a crash attempts to provide a more objective assessment by using police evaluations but also considering contributory factors such as the road, vehicle and weather conditions. A number of studies have used scales or scoring protocols to assess the degree of driver culpability for the crash (Drummer, 1994; Soderstrom *et al.*, 1990; Soderstrom *et al.*, 1993; Terhune *et al.*, 1992). Typically, these studies were investigating the contribution of alcohol and other drugs to crash causation. To avoid influencing their judgement, investigators without knowledge of alcohol and drug test results performed the culpability analysis.

One such study assessed the culpability of drivers involved in non-fatal crashes in South Australia (Hunter *et al.*, 1998) using a method of culpability analysis developed by Robertson and Drummer (1994). Each crash was examined to identify whether any of the eight specified mitigating factors reduced the driver's responsibility for the crash. A driver was judged "culpable" if there were no mitigating factors and "partly culpable" if sufficient mitigating factors were identified. Information concerning the mitigating factors was taken from police reports of the crash. Despite following a scoring protocol and considering contributing factors, the results using this method of culpability analysis varied very little to that of the police evaluation of culpability; there was agreement in 97 per cent of crashes.

Note that both methods of assessing driver culpability are dependent on the thoroughness of crash investigation. However, this should not undermine driver culpability as a useful research concept.

2.3.2 *Age, Sex, and Driver Culpability*

There is considerable agreement among researchers that not only are younger drivers over-represented in crashes, but also they are more likely to be culpable for the

crash than middle-aged drivers. Young drivers have been estimated to be culpable for 48 per cent (Carsten *et al.*, 1989) to 70 per cent (Praxenthaler, 1995) of crashes while for middle aged drivers, culpability estimates range from 37 per cent to 45 per cent. However, research has also indicated that the oldest drivers are just as likely as the youngest drivers to be culpable for a crash. Matthews and Jones (1988) reported a U-shaped curve between age and driver culpability such that New Zealand drivers aged less than 19 years and over 60 years were more likely to be culpable than non-culpable for a two-vehicle injury crash. Several studies of drivers involved in a fatal or injury crash in the United States have reported a similar U-shaped curve for driver culpability across age groups (Chandraratna *et al.*, 2006; Perneger & Smith, 1991; Williams & Shabanova, 2003). Likewise, a study of fatally injured Australian drivers found that drivers aged less than 25 years and over 60 years had significantly higher culpability rates than drivers aged from 36 to 59 years (Drummer, 1994). Corresponding findings were evident for non-fatally injured South Australian drivers (Longo, 2001).

In contrast to age, evidence of an association between sex and driver culpability for a fatal crash is somewhat mixed. Most studies have reported no sex differences by driver culpability status (Drummer, 1994; Garretson & Peck, 1982; Perneger & Smith, 1991; Terhune et al., 1992) but see Chandraratna et al. (2006). However, sex differences by culpability status have been noted in studies comparing the culpability rates of males and females within certain age groups. For example, Williams and Shabanova (2003) found that young males were more likely than young females to be culpable for a fatal crash but females aged 55 years and over were more likely than males of the same age to be culpable. Longo (2001) reported that males aged less than 26 years were more likely to be culpable for a non-fatal crash than females aged less than 26 years. Culpability rates between males and females did not differ significantly in other age groups.

2.3.3 Other Driver Characteristics Associated with Driver Culpability

Certain factors related to the occurrence of a crash have been associated with the "culpable" status of the driver. In addition to driver records, some of these factors might also be useful in identifying high-risk drivers. Several studies have shown that culpable drivers were much more likely than non-culpable drivers, or licensed drivers from the general driving population, to have been drinking immediately before the crash and to be fatally injured as a result of the crash (Banks *et al.*, 1977; Garretson & Peck, 1982; Rajalin, 1994).

An association between drinking prior to the crash and culpability has been reported for both fatal (Drummer, 1994; Terhune et al., 1992) and non-fatal crashes (Longo, 2001; Soderstrom et al., 1990), and for different road users such as motorcyclists (Soderstrom et al., 1993). In these studies, the percentage of drivers testing positive for alcohol and deemed culpable for the crash ranged from approximately 83 to 94 per cent in comparison to 46 to 71 per cent for alcohol-free drivers. The percentage of drivers deemed culpable was slightly lower when examining multiple vehicle crashes only (69-79% culpable with a positive BAC, 28-45% culpable were alcohol free) (Longo, 2001; Soderstrom et al., 1993).

Perneger and Smith (1991) examined crash characteristics associated with fatal crash culpability. Odds ratios indicated that the strongest driver-related predictors of fatal crash culpability were alcohol use, driving without a licence and not wearing a seatbelt. Sex of the driver and driving without passengers had no influence on crash culpability status. When examining a subset of sober drivers involved in a fatal crash, Garretson and Peck (1982) found that driving unlicensed and without a seat belt at the time of the crash were the only significant predictors of fatal crash culpability.

2.4 Driver Records and Culpable Crash Involvement

It has been argued that driver records might be more useful in identifying drivers culpable for a crash than drivers simply involved in a crash because the culpable drivers' behaviour is considered to be more attributable to crash involvement. The non-culpable drivers' crash involvement could be considered a result of driving exposure. As discussed in section 2.3.1, the assignment of driver culpability relies heavily on the quality of crash investigation. Fatal crashes are generally investigated to a greater extent than other less severe crashes. Therefore, it would be expected that the assignment of driver culpability would be more reliable in a fatal crash. Consequently, driver records might more accurately identify drivers culpable for a fatal crash. In the following sections, studies examining the ability of driver records to identify drivers culpable for a fatal crash are reviewed followed by studies investigating drivers culpable for crashes of any severity other than fatal.

2.4.1 Fatal Crash Culpability

There are a limited number of studies that have investigated the ability of driver records to identify drivers culpable for a fatal crash, that is, high-risk drivers. However, these studies have shown that drivers found to be legally culpable for a fatal crash reported significantly more prior traffic offences than non-culpable drivers, or drivers from the general driving population (Bailey, 1992; Banks et al., 1977; Garretson & Peck, 1982; Rajalin, 1994). Only two of these studies also examined crash involvement records, and the findings were inconsistent.

Banks and colleagues (1977) conducted one of the first studies investigating driver records and driver culpability. They examined 41 fatal multiple vehicle crashes that involved at least two male drivers. Driver culpability was assigned by the criterion set by Maryland Traffic Law. Based on a matched-pair design, male drivers legally culpable for a fatal multiple vehicle crash were shown to have approximately three times the number of previous traffic offences than non-culpable male drivers. In

addition, the number of previous offences was positively associated with a positive alcohol reading at the time of the fatal crash among culpable drivers only.

Garretson and Peck (1982) conducted further research examining the driver characteristics and driver records of a larger sample of Californian drivers, both male and female, involved in a fatal crash. The driver records of crash involved drivers and randomly selected licensed drivers were compared. Drivers involved in a fatal crash recorded twice as many traffic offences in the previous three years than drivers in the general driving population.

Of greater interest, discriminant analyses were also performed to isolate the variables that best differentiated between culpable and non-culpable drivers. Driver culpability was based on the assessment made by the investigating officer. Similar to Banks et al's (1977) findings, culpable drivers reported more prior traffic offences than non-culpable drivers. Of all the driver record variables, the total number of prior traffic offences was the most significant discriminator. A strong relationship was also found between driver culpability and the number of crash involved vehicles, and drinking prior to the fatal crash. However, the authors were suspicious that knowledge of driver alcohol impairment may have influenced investigators judgement of driver culpability. To avoid potential confounding effects, drivers reported to be drinking prior to the crash were excluded from a second discriminant analysis. The second analysis showed that, in addition to the number of crash involved vehicles and prior total traffic offences, the main factors discriminating between culpable and non-culpable drivers were number of prior single vehicle crashes, prior major traffic offences, licence class and marital status. However, the removal of drivers drinking prior to the crash reduced the amount of variance accounted for by the analysis (from 19% to 10%).

Unlike the study by Banks et al. (1977), the Garretson and Peck (1982) study also examined crash records in relation to driver culpability. Although drivers

involved in a fatal crash had more prior crashes than drivers in the general driving population, crash history did not discriminate between culpable and non-culpable fatal crash involvement.

Bailey (1992) investigated the traffic and criminal convictions of all drivers involved in a fatal crash in New Zealand during 1986 by driver culpability status. Culpable drivers were defined as drivers with one or more driver cause codes assigned by the investigating traffic engineer. Overall, 41 per cent of drivers culpable for a fatal crash had at least one prior traffic offence compared to 33 per cent of non-culpable drivers; culpable drivers had an average of 3.5 traffic offences per driver compared to 2.4 for non-culpable drivers. However, when drivers drinking at the time of the crash were excluded from the culpable driver group, sober culpable drivers had a similar proportion (32%) of prior traffic offences as non-culpable drivers.

Bailey (1992) also compared the traffic conviction history of a random sample of licensed drivers to that of the three groups of drivers involved in the fatal crash; drink drivers at the time of the crash, sober culpable drivers and non-culpable drivers. The types of traffic offences examined were drink driving, dangerous driving, careless driving and speeding in urban and rural areas. Drinking drivers in the fatal crash were found to have a greater proportion of previous drink driving, dangerous driving and careless driving convictions than any of the other groups; they were five times as likely to have a prior drink driving conviction than the control group (26% vs. 5%). Little difference was found between sober culpable and non-culpable drivers for all types of traffic offences. Nevertheless, compared to the controls, a greater percentage of sober culpable drivers had prior careless driving (9% vs. 6%) and dangerous driving offences (5% vs. 2%). Overall, these results suggest that the traffic offence records of drivers in fatal crashes, regardless of driver culpability, differ from the records of drivers in the general driving population. However, no statistical analyses were conducted to determine whether any of these differences were meaningful.

Moreover, the entire traffic offence history of each driver was traced but no attempt was made to provide a measure of driving exposure or driving experience to accommodate for individual differences among drivers.

To digress slightly, a number of studies have found that drink driving is not only associated with crash culpability but also a general propensity to commit traffic offences. For example, South Australian drivers with one or more prior drink driving convictions were found to be more likely to be culpable for an injury crash than drivers with no prior drink driving convictions, and more likely to test positive for alcohol at the time of the crash (Longo, 2001). Several studies have also shown that drivers drinking prior to a crash, and drivers with previous drink driving convictions, are more likely to have prior traffic offences than non-drinking drivers and drivers without prior drink driving convictions (Bailey, 1995; Longo, 2001; Soderstrom et al., 1990).

Rajalin (1994) compared the traffic offence records (previous three years) of culpable and non-culpable Finnish drivers involved in a fatal crash with licensed drivers randomly selected from driver records. Crash investigation teams assessed driver culpability. According to likelihood analysis, drivers culpable for a fatal crash had 2.2 times as many traffic offences, on average, as non-culpable drivers and the non-culpable drivers had 1.5 times as many traffic offences as control drivers. The crash history of each driver was not examined.

Using a paired case-control methodology, Perneger and Smith (1991) examined whether certain driver characteristics and types of prior crashes or traffic offences could identify drivers deemed culpable for a two vehicle fatal crash. For each fatal crash, one driver was identified as the culpable driver based on assigned driving errors while the other driver was designated the control. If both drivers were assigned an error or the presence of adverse environmental effects was noted, the crash was excluded. The results indicated that a previous conviction for driving while

intoxicated (Odds Ratio = 2.69), previous licence suspension (OR = 2.18), and previous crash within the last year (OR = 1.41) (but not last 2 or 3 years) were the strongest driver record factors associated with driver culpability for a fatal crash. Prior speeding offences had no influence on crash culpability status. Responsibility for the previous crash was not considered and the time period in which offences or suspensions occurred prior to the fatal crash was not specified. Although specific offence types were examined, the total number of traffic offences was not considered as a separate risk factor.

Of all the risk factors examined in the Perneger and Smith (1991) study, drinking alcohol prior to the crash was the strongest predictor of fatal crash culpability. Drinking drivers were 11 times more likely than a sober driver to be culpable for the fatal crash. Thus, similar to Garretson and Peck's (1982) research, the data were re-analysed excluding drivers with a positive BAC reading at the time of the crash. Driver records were less relevant to driver culpability for the subset of sober culpable drivers; the relative risk of fatal crash culpability decreased substantially.

2.4.2 Crash Culpability

The following studies did not make a distinction on levels of severity (i.e., fatal, serious or minor injury) of the crash in which the driver was deemed culpable. Chen, Cooper and Pinili (1995) examined almost two million Canadian driver records to identify drivers most likely to have one or more culpable crashes during a two year period. Driver records were based on the number of culpable crashes and traffic offences in the previous three years. Crash culpability was defined as involvement in a crash for which the percentage of culpability assigned by insurance adjusters was equal or greater than 50 per cent.

The percentage and rate of culpable crashes was found to increase with both the number of prior traffic offences and number of prior culpable crashes. Overall, logistic regression showed that a model using prior culpable crash involvement could

identify up to 23 per cent more drivers culpable for a crash in the following two years than a model using only prior traffic offences. The predictiveness of the number of prior crashes was not examined. Following prior crash culpability, of the 15 traffic offence types analysed, “right-of-way” traffic convictions (i.e., failure to yield and disobeying traffic signals) and criminal code convictions (i.e., mostly impaired driving) were the next best predictors of culpable crash involvement. The authors suggested that “driving while impaired” traffic offences were not as important as right-of-way traffic offences because drivers who were suspended for less than nine months were included in the analyses. The suspended drivers, of whom many were drink drivers, may have had less driving exposure and, consequently, a reduced likelihood of crash involvement. The authors also pointed out that driving while impaired offences received the greatest penalty of all offences. The penalty point system was designed to reduce future crash involvement and so the data reflected the penalty point system in place.

Chandraratna and colleagues (2006) used a similar methodology to Chen et al. (1995) but their study focussed on factors determining culpability for a crash that had already occurred, rather than determining the likelihood of being involved in a crash. The records of drivers involved in at least two crashes and deemed culpable for a crash occurring in the year 2002 were selected for analysis. Consistent with Chen et al’s (1995) findings, multiple logistic regression analyses demonstrated that the number of previous culpable crashes was associated with culpable crash involvement. In addition, prior speeding offences, traffic offences other than speeding, and licence suspensions were also related to crash culpability.

Some sex and age differences have been found in the traffic offence history of culpable drivers. For example, Laapotti and Keskinen (2004) demonstrated through logistic regression analyses that male drivers culpable for a fatal crash were 3.6 times more likely than female drivers culpable for a fatal crash to have committed a traffic

offence in the five years preceding the fatal crash. Furthermore, an interaction between sex and age showed that culpable young male drivers (18-25 years) were 1.5 times more likely than culpable middle-aged male drivers (35-55 years) to have had at least one previous traffic offence. However, this study did not take into consideration individual variations in driving experience.

2.4.3 Summary

Generally, traffic offences appeared to be useful in identifying drivers culpable for a fatal crash, that is, high-risk drivers. There are mixed findings regarding crash history, but some evidence that culpable crashes are a better predictor of future fatal or injury crash culpability than traffic offences. With regard to the ability of specific types of prior traffic offences to identify culpable drivers, research findings have been inconsistent. Results have varied from studies finding no relationship between traffic offence types and crash involvement, to findings of an association between driver crash culpability and prior drink driving offences, speeding offences, right-of-way offences, and licence disqualifications. Further research is needed to clarify the ability of specific types of traffic offences to identify high-risk drivers.

There is clearly a relationship between alcohol and driver culpability for a crash; drivers testing positive for alcohol at the time of the crash were more likely to be culpable for the crash. Furthermore, drivers consuming alcohol prior to the crash were more likely to have a prior traffic offence, particularly a drink driving offence, than non-drinking drivers. Consequently, it is not surprising that studies excluding drinking drivers from analyses found little difference between the driver records of non-drinking culpable and non-culpable drivers. The exclusion of drinking drivers meant omitting some of the most high-risk drivers from analyses, reducing much of the variance.

It must be emphasized that it is very difficult to compare findings from different studies. Different predictor variables were used in each study and often the

definition of specific traffic offence types varied by jurisdiction and country. The severity of the crash outcome also varied from fatal to all crashes reported to police. Moreover, details as to how culpability was assessed were often vague and the methods of culpability analysis adopted were diverse.

The next section reviews the literature examining the ability of driver records to identify high-risk young drivers.

2.5 Young Drivers

Young drivers, particularly young male drivers, are more likely to be culpable for a crash than other (i.e., middle-aged) drivers (see section 2.3), but can driving records identify these high-risk young drivers? The following sections review evidence from studies examining the ability of driver records to identify young drivers at a higher risk of crash involvement (section 2.5.1), specifically young drivers at a higher risk of culpable crash involvement (section 2.5.2).

2.5.1 *Driver Records and Young Driver Crash Involvement*

Several studies have examined the role of crash and traffic offence records as predictors of crashes among younger drivers. In one of the first studies, Harrington (1972) attempted to identify driver record and school performance variables associated with an increase in crash risk among 16-17 year old Californian drivers. Driver records were followed for four years after licensing. Of the driver record variables, multiple regression equations showed that the number of traffic offences during the four-year period was the most important predictor of total crashes during the same period. Adding the type of traffic offence to the analysis increased the multiple correlation coefficient only slightly.

The best predictor of crashes and traffic offences in the third and fourth year of driving was the number of traffic offences incurred during the first two years of driving, although the multiple correlations were low. Analyses incorporating the number of specific types of traffic offences in the first two years explained more variance than the total number of offences. The author suggested a weighted point system based on traffic offence type would be better than the number of prior traffic offences for predicting crashes.

On a smaller scale than Harrington (1972), Sobel & Underhill (1976) examined the relationship between crash involvement and a number of psycho-social variables, including traffic offences, among young drivers aged 16 to 19 years. During the two-year study period, traffic offences and mileage were found to be associated with crash involvement for males, although traffic offences alone explained only five per cent of the variation in crashes. Mileage was the only variable that predicted crash involvement for females.

A second study by Rajalin (1994) compared the traffic offence records of drivers involved in a fatal crash to the traffic offence records of randomly selected licensed drivers, by age group. The driver records of drivers who were stopped by police for committing a traffic offence, termed “risky drivers”, were also examined and compared to the records of drivers randomly stopped at the same location, or “controls”. Offence rates, calculated per million kilometers by age group, indicated that the fatal crash involved drivers and the risky drivers had greater rates of prior traffic offences than the respective control groups within each age group.

With respect to the drivers involved in a fatal crash, the highest traffic offence rate and the highest speeding offence rate, per distance driven, was recorded by the youngest drivers (less than 25 years of age). Traffic offence and speeding offence rates decreased substantially for drivers aged 35 years and over. Thus, fatal crash involvement appeared to be preceded by numerous traffic offences, particularly

speeding offences, among the youngest drivers only. In contrast, risky drivers had similar high traffic offence and speeding offence rates across all age groups. The authors argued that these results supported the theory that traffic offences, rather than involvement in a fatal crash, were a reflection of intentional behaviour. However, no distinction was made between drivers culpable and not culpable for the fatal crash. Consequently, the driver records of culpable drivers, drivers whose driving behaviour may have been more intentional and resulted in crash causation, could not be compared to the driver records of the risky drivers.

Within Australia, a study examining the driver records of young Western Australian novice drivers found that both traffic infringements and traffic convictions were associated with an increased risk of a subsequent crash in the first year of driving, 1.90 times and 3.10 times, respectively (Palamara et al., 2002). The majority of traffic infringements were for speeding whilst traffic convictions, although rare, were mainly for alcohol related offences. With regard to first year drivers' involvement in serious injury crashes, traffic infringements alone were predictive; serious injury crash risk increased by 89 per cent. Although the effects of driving experience were controlled, the actual amount of time spent driving was not measured due to the unavailability of recent driving exposure data.

Elliot and colleagues (2000) noted that the predictive power of driver records, particularly culpable crashes, appeared to increase with increasing driving experience or years of driving. Previous culpable crashes significantly predicted subsequent crashes for more experienced young drivers but previous crash history was less predictive for the inexperienced young drivers. In fact, previous year crashes were not found to be a predictor of subsequent year crashes until the third year of driving experience. The authors concluded that early driving incidents were, at least partly, attributable to inexperience that declined with continued driving exposure. Later driving incidents were attributable to other factors associated with individual

differences. McCartt, Shabanova, and Leaf (2003) suggested that traffic offences may only have a limited value in identifying high-risk drivers in the first year of driving because most crashes occur among young drivers with no previous offences.

Another Australian study showed that young Queensland drivers involved in more severe crashes reported a greater prevalence of specific types of prior traffic offences than drivers involved in minor crashes or no crashes (Siskind & Sheehan, 2002). Male drivers involved in a serious crash, relative to a minor crash, recorded more drink driving offences and “other” offences. Compared to male drivers who had no crashes, male drivers involved in a serious crash reported a greater prevalence of drink driving, speeding and “other” offences on average. Male drivers involved in a minor crash had, on average, more speeding and “other” offences than male drivers not involved in a crash. Females involved in a serious crash, compared to a minor crash, had a greater prevalence of speeding and drink driving offences. Interestingly, the relative risk of a serious crash for both offence types was larger among females than among males. However, this result should be interpreted with caution, because the number of specific offences incurred by females was small, leading to large confidence intervals.

Although traffic offences, particularly drink driving offences, predicted subsequent serious crashes, relative to both minor and no reported crashes, the authors acknowledged that the elevations in risk are modest and suggested that other methods be employed to detect young drivers at a high risk of crash involvement.

2.5.2 *Driver Records and Young Driver Culpable Crash Involvement*

Research discussed in the previous section suggests that driver records, particularly traffic offences, can be used to identify young drivers, particularly young male drivers, at a higher risk of crash involvement. However, this relationship is modest at best. In addition, although there is evidence that a traffic offence in the first year of driving increases subsequent crash risk, other research suggests traffic

offences should only be examined after several years of driving experience. It is possible that using driving records to identify crash involvement specifically resulting from young driver behaviour (i.e., culpable crashes), rather than merely reflecting driving exposure, might be more useful in identifying high-risk young drivers. Thus, in the following section, studies that employed driver records as a means of identifying young driver culpable crash involvement are reviewed.

One of the first studies that attempted to use driver records to identify young drivers at a higher risk of crashing also conducted multiple regression analyses to predict partial culpable crash involvement, that is, crashes in which the violation of a traffic law contributed to a crash resulting in an injury or fatality (Harrington, 1972). For males, traffic offences and property damage crashes in the first two years of driving were the best predictors of culpable crash involvement in the third and fourth year of driving. For females, crash costs was the best predictor. However, the multiple correlations were too low to provide accurate individual prediction. Analyses examining the type of traffic offence were not performed.

A more recent study investigating the ability of driver records to predict young driver crash involvement also examined the ability of driver records to predict culpable crashes; driving incidents thought to be indicative of more deliberate risk taking behaviour (Elliot et al., 2001). Culpable crashes were defined as crashes in which the driver also committed a traffic offence. This comprehensive study followed the official driver records of a large cohort of young Michigan drivers for up to nine years after licensing. Previous year traffic offences were found to be better predictors of subsequent year crashes (and traffic offences) than either previous year crashes or culpable crashes. For example, one previous year offence was associated with an increase in the odds of one or more subsequent crashes by 40 per cent but a previous year crash was associated with an increase of only 21 per cent and a previous culpable crash by 19 per cent. Of greatest interest, previous year traffic offences were best at

predicting culpable crash involvement; one previous offence was associated with an increase in the odds of a culpable crash by 51 per cent. A greater number of offences in the preceding year had the best predictive power for culpable crash involvement (70% increase in odds), particularly serious offences (90% increase). These findings are consistent with the assumption that traffic offences are under greater volitional control and may be more characteristic of individual behaviour than crashes and, therefore, be better at predicting more intentional driver behaviour.

Horwood and Fergusson (2000) specifically examined the association between drink driving behaviour and culpable crash involvement among a cohort of young New Zealand drivers. Self-reported drink driving behaviour was associated with increases in both culpable and non-culpable crashes. However, when adjusting for distance travelled and driving experience, drink driving was associated with increases in the rate of culpable crashes only. These findings suggest that the association between drink driving and non-culpable crash involvement reflected the driving experience and driving exposure variables. Young drivers who self-reported engaging in frequent drink driving behaviour had a culpable crash rate that was 2.5 times higher than the crash rate of young drivers who did not report drinking and driving. Even when controlling for confounding factors, (i.e., unsafe driver behaviour, driver attitudes, gender and driving experience), the relationship between drink driving and culpable crash involvement persisted, although it was substantially reduced. Drink drivers reported culpable crash rates 1.5 times higher than non-drink drivers. However, one of the main limitations associated with this study, was that drink driving behaviour was based on self-report, not official driver records. As is the case for all self-reported data, it is unknown whether self-reported drink driving behaviour reflected actual drink driving behaviour.

2.5.3 Summary

A limited number of studies have used driver records to identify young drivers culpable for a crash. From this research, it appears that a history of detections for traffic offences is associated with young driver culpability for a crash. With respect to young novice drivers, there is some evidence that a traffic offence in the first year of driving may increase the risk of a subsequent crash (Palamara et al., 2002). However, other studies (Elliot et al., 2000; McCartt et al., 2003) suggest that the driving records of young drivers need to be examined for longer than one year following licensure as many young drivers are not detected for traffic offences until their second or third year of driving. It is also important to note that these studies did not account for driving exposure. Younger and older novice drivers could have been subjected to different levels of driving exposure, different travel patterns, and variations in the amount of time spent on different road types and at different times of the day.

The literature indicates that self-reported drink driving behaviour appears to predict young driver culpable crash involvement. However, this relationship needs to be explored further by examining actual drink driving behaviour, recorded in official drink driving offence records. There is also little research exploring whether specific offence types are associated with young driver crash culpability. To address research deficits, further research should examine whether specific types of traffic offences, including drink driving offences, can identify young drivers culpable for a crash.

2.6 Limitations

In general, when using crash and traffic offence records to identify drivers at a higher risk of crash involvement, it is worth noting some limitations that may contribute to discrepancies in the predictiveness of driver records between studies and the failure to find any relationship. The sensitivity of crash reporting policies, different enforcement levels, insufficient time periods of driver record analysis, and

under-reporting of crashes and offences in official records may all influence the predictive value of driver records.

Zylman (1972) argued that research based solely on official driver records may yield spurious results and, in many cases, non-significant results because the likelihood of having a crash or traffic offence recorded may be more dependent on local policies and practices than the driver's proficiency or driving behaviour. Moreover, different countries, and different states or jurisdictions within each country, tend to have different reporting criteria for crashes that may depend on crash injury severity and/or level of monetary cost associated with vehicle and property damage (Peck, 1993). For example, if the reporting criteria are stricter, only the more serious crashes are reported rather than every incident, resulting in fewer reported crashes and less predictive power. Thus, differences in the sensitivity of crash reporting policies may have contributed, at least partially, to discrepancies in the predictiveness of driver records between studies.

Some studies have not examined crash involvement records over a sufficient time period. Because crashes are infrequent events, it is essential that studies incorporating driver records follow crash involvement over a substantial time period so that there are enough crash events for meaningful statistical analyses. As a result, studies not using an adequate follow-up period may have less predictive power and fail to find any significant relationships. This point is particularly relevant for young drivers.

With regard to traffic offences, it is important to remember that few relevant traffic offences are recorded in official driver records because they contain only the number of times a driver was *caught* offending. Therefore, official offence records under-report the actual amount of offending behaviour performed. Clearly, levels of active traffic offence enforcement will vary from region to region. In addition, not all

offences are enforced equally (Smiley *et al.*, 1991) and this may bias the data such that some groups of drivers are over-represented.

2.7 Summary

From the literature reviewed in this chapter, it is evident that driver records can be of some value in identifying high-risk drivers, particularly drivers culpable for the most severe crashes, fatal crashes. However, it is important to remember that these associations are modest at best. In these studies, driver culpability was assessed by either information contained in police reports, or with the addition of scales to score the level of culpability based on factors relating to the crash. It was argued that the latter method provided greater objectivity when determining driver culpability, although similar results were produced by both methods. Note that variables other than driver records have also been associated with driver culpability status: younger and older drivers, males, drinking prior to the crash and being killed in the crash.

The total number of traffic offences appeared to be the best driver record variable for identifying culpable or high-risk drivers. It is likely that traffic offences are a better predictor of crash involvement than crashes because offences reflect intentional driving behaviour and offences occur more frequently than crashes, resulting in greater predictive power. While some studies found that specifying the type of traffic offence did not improve the predictive ability of driver records, other studies reported that a variety of offence types (i.e., drink driving, right-of-way) were associated with driver culpability. There was also evidence that culpable crashes were useful in identifying high-risk drivers. Further research is needed to clarify whether specific types of crashes and traffic offences can identify high-risk drivers.

Similar to the finding for drivers of all ages, traffic offences appeared to be the best driver record variable for identifying young driver culpability. However, this finding is based on a very limited number of studies and warrants further research. There were contradictory findings with regard to the predictiveness of driver records

for novice drivers; crashes within the first year are most likely due to inexperience, and these crashes often occur before any traffic offences are incurred. As the predictive power of driver records appeared to increase with years of driving experience, allowing a longer period for crash and traffic offence accumulation would provide a better indication of the robustness of any association between prior driver records and young driver crash involvement. In addition, research is needed to further investigate the role of driver records in identifying high-risk young drivers with several years of driving experience.

Differences in the quality and thoroughness of enforcement, or the crash reporting policies in different regions, may influence the predictiveness of prior traffic offences and crashes between states and countries. For these reasons, it is important to investigate, in a South Australian context, the role of traffic offences and crash involvement in the prediction of culpable fatal crash involvement. Thus, the next chapter presents a study that examines whether prior driving behaviour, reflected in driver records, could identify high-risk drivers; that is, drivers culpable for a multiple vehicle fatal crash in South Australia, from 1999 to 2002.

CHAPTER 3 IDENTIFYING HIGH-RISK DRIVERS USING PRIOR DRIVER RECORDS[1]

3.1 Introduction

The study presented in this chapter was based on the premise that drivers culpable for a crash, particularly a fatal crash, may be a subset of high-risk drivers. These high-risk drivers might be identifiable by their past driving behaviour, evident in driver records. Although the statistical nature of crash frequencies makes it hard to predict who will be crash involved, previous international research, described in Chapter 2, found some associations between driver records and crash involvement. In particular, traffic offences were found to be a better predictor of culpable crash involvement than were crashes (e.g., Garretson & Peck, 1982). From the limited number of studies specifically examining younger drivers, traffic offences were also found to be the driver record variable most commonly associated with crash culpability (e.g., Elliot *et al.*, 2001). Examination of the ability of specific traffic offence types to identify high-risk drivers revealed mixed results. Research findings varied from no relationship, to findings of associations between driver crash culpability and drink driving offences, speeding offences, right-of-way offences, and licence disqualifications (Chandraratna *et al.*, 2006; Chen *et al.*, 1995; Perneger & Smith, 1991). Nevertheless, even though driver records, particularly traffic offences, appear useful for identifying high-risk drivers, associations between driver records and driver culpability were modest at best.

The finding that previous traffic offences are more closely associated with driver crash culpability than previous crashes may arise because traffic offences are

[1] This chapter contains material that was presented in a somewhat different form in: "Wundersitz, L.N., & Burns, N.R. (2004. Relationships between prior driving record, driver culpability and fatal crash involvement. In Proceedings of the 2004 Road safety research, policing and education conference, 14-16 November 2004, Perth, Western Australia. Conference proceedings Volume 1: Peer reviewed papers. Perth: Office of Road Safety."

more intentional and therefore connected to the motivations of the driver. As opposed to crashes, traffic offences reflect a willingness to undertake objectively risky driving (Catchpole, 2004). In addition, this finding is, at least partially, attributable to the greater frequency of traffic offences in comparison to crash involvement.

Some difficulties arise when comparing findings from various studies examining driver records. Each study used different predictor variables and often the definition of specific offence types varied by region. The severity of the crash outcome reported to police also varied from fatal crashes only to all crashes. Differences in the quality and thoroughness of enforcement, and the crash reporting policies in different regions, may also have influenced the predictive power of traffic offences and crashes across states and countries.

Furthermore, driver records need to be examined over a substantial period of time to improve their predictive power, particularly because crashes occur infrequently. A prolonged period of analysis is particularly important when studying younger drivers because crashes occurring in the first year of driving are often not preceded by traffic offences and are likely to be due to inexperience rather than risk taking tendencies.

Using South Australian data, the present study aimed to determine relationships between driver records and driver culpability for a fatal crash. To assess such relationships, databases were matched to allow examination of official driver records, both crashes and traffic offences, for drivers and riders involved in a fatal crash in South Australia between 1999 and 2002. Drivers involved in a fatal crash were selected for the analysis because fatal crashes are investigated much more thoroughly by police than other crashes. The identification of drivers culpable for a fatal crash from driver records, that is, high-risk drivers, might assist in identifying and developing new licensing approaches or countermeasures for such drivers before a crash occurs.

This chapter begins by comparing the driver and crash characteristics of culpable and non-culpable drivers involved in a fatal multiple vehicle crash to determine whether any of these factors were associated with the assignment of driver culpability. To explore a possible link between high-risk drivers and driver history, the driver records of culpable and non-culpable drivers involved in a multiple vehicle fatal crash were then compared. Years of driving experience were also taken into consideration. Using the same methodology, the ability of driver records to identify high-risk young drivers (i.e., young drivers deemed culpable for a multiple vehicle fatal crash) was also investigated. Finally, the implications of the findings for the identification of drivers at a higher risk of crashing were discussed.

3.2 Method

3.2.1 Data Set

Licensed drivers involved in a multiple vehicle fatal crash within South Australia from 1999 to 2002 were identified and extracted from the Traffic Accident Reporting System database (TARS) maintained by the Traffic Information Management Section of the Department of Transport, Energy and Infrastructure (DTEI). The TARS database records all road crashes within South Australia reported to police.

The original study sample consisted of 764 drivers and riders involved in a fatal motor vehicle crash within this period. A fatal crash is defined as a crash resulting in injuries causing the death of at least one person (driver, passenger, cyclist, motorcycle rider or pedestrian) within 30 days of the crash. Drivers and motorcycle riders will subsequently be referred to collectively as “drivers”.

A total of 71 drivers were excluded from the sample because their driving records could not be obtained (see Table 3.1). These excluded drivers had either never held a driver’s licence (aged less than 16 years), their licence number was unknown

(aged 16 years and over), or they held an interstate or overseas driver's licence. Note that more culpable drivers were excluded than non-culpable drivers, and more culpable drivers had never held a licence. Consequently, the sample was reduced to 693 drivers who held a South Australian driver's licence and were involved in a fatal crash in South Australia, from 1999 to 2002.

Table 3.1
Reasons for exclusion of drivers/riders in this study by driver culpability in a fatal crash

Reason for Exclusion	Culpable[a]	Non-culpable[b]
Interstate licence	26	23
Overseas licence	7	1
Never held a licence	6	1
Unknown licence number	4	3
Total (N)	43	28

[a] Drivers deemed culpable for the fatal crash by police.
[b] Drivers deemed non-culpable for the fatal crash by police.

This study was restricted to multiple vehicle fatal crashes only, defined as fatal crashes involving two or more motorised vehicles. Drivers of all motorised vehicle types were included to keep the sample of fatal crash involved drivers as representative of fatal crashes as possible. Drivers involved in a multiple vehicle fatal crash (*N*=388) were selected for analysis so that each crash involved one culpable or "case" driver (*n*=182) and at least one non-culpable or "control" driver (*n*=206). Driver culpability was determined using "apparent error "codes listed in the TARS database; the driver error codes were based on police assessment of legal responsibility for the crash. Even if more than two vehicles were involved in a single crash, only one driver was deemed culpable. Note that because some crashes involved more than one non-culpable driver, the total numbers of culpable and non-culpable drivers were not equal. This research design controlled potentially confounding

situational variables such as weather conditions or the time and location of the crash because they were matched for each set of drivers involved in a given crash.

The mean age of all drivers involved in a multiple vehicle fatal crash was 41.7 years (*SD*=18.7). There were 299 male drivers and 89 female drivers. A total of 36 motorcycle riders were included in the final sample of "drivers". As mentioned above, riders were included in the analysis to keep the sample of fatal crash involved individuals as representative of fatal crashes as possible. Furthermore, studies have shown that the percentage of riders deemed culpable for an injury producing crash was relatively similar to that of drivers deemed culpable for an injury producing crash (Soderstrom *et al.*, 1990; Soderstrom *et al.*, 1993). In addition, from the data in this study, analysis of drivers and riders separately (see Appendix A) showed that they were no more likely than drivers to be culpable for a fatal crash ($\chi^2(1)=0.10$, $p=.756$). Moreover, preliminary analyses examining whether driver records could identify drivers culpable for a fatal crash, the exclusion of riders from the analyses did not alter the direction of the results.

3.2.2 Crash and Traffic Offence Databases

The crash and traffic offence history of each driver involved in a fatal crash was tracked for five years prior to the fatal crash. The crash record of each driver was traced by linking their driver licence number with crash records on the TARS database. At this time, all crashes in which anyone was injured, or there were property damages exceeding $1000, were required to be reported to the police and recorded on the TARS database. Before January 1, 1998, crashes in which property damage exceeded $600 in non-injury crashes were required to be reported. Traffic offence records were tracked by linking driver licence numbers with DRIVERS, the licence and traffic offence database maintained by the Registration and Licensing section of DTEI.

Tracking crashes and traffic offences for longer periods increases the likelihood that driver records may be useful in predicting a driver's subsequent crash involvement. Within this study, a sufficient time frame of five-years was selected for tracking driver records. The five-year time frame is greater than that used in most studies examining driver records (typically a three year period). This time frame was also selected to avoid problems identified with crash data recorded in 1993; for unknown reasons, some property damage only crashes were not recorded.

There are several features of the data that warrant further discussion. The available crash and traffic offence data did not include crashes and traffic offences detected on roads outside of South Australia, nor did they include parking offences. Speeding offences detected by speed cameras were recorded in a different database but they were not included because the resulting infringement notices were posted to the vehicle owner who may not have been the driver at the time of the offence. Consequently, the number of speeding offences was not able to be examined in this report.

Traffic offences resulting from the target fatal crash and any crashes or offences incurred after the fatal crash were removed from the data set. However, in some cases, more than one traffic offence may have been detected and recorded from a single apprehension event (e.g., exceeding speed limit and not wearing a seat belt). These additional offences were retained for analysis because, in most cases, they represented two distinct risky behaviours. Traffic offences detected on the same date as a crash were also retained because it was difficult to match traffic offences and crashes due to delays in offence processing and the fact that only the date of the traffic offence is recorded. Consequently, the number of traffic offences committed cannot be used as an index of the number of separate events (nor as a proxy for driving exposure), as it is for crashes.

For drivers holding a learner's permit or provisional licence, contravening any of their licence conditions incurred a separate traffic offence on their record, additional to the offence that breached licence conditions. These secondary traffic offences were excluded from analyses because they primarily served an administrative purpose.

Some drivers (n=47) incurred licence disqualifications or suspensions during the five-year study period and, therefore, may not have been driving for the entire period under study. However, research suggests between 23 and 44 per cent of disqualified drivers admit continuing to drive while disqualified (Corbett & Simon, 1992; Kinchin, 1990; Mirrlees-Black, 1993; Watson, 2002). It is unknown whether, or to what extent, the disqualified drivers in this study continued to drive. Moreover, excluding drivers with disqualifications would bias the data by excluding many drivers with a substantial traffic offence history. Licence disqualifications and suspensions are usually incurred as the result of committing traffic offences; in this study the correlation between traffic offences and disqualifications was $r = .63$, $p<.01$. For these reasons, drivers with licence suspensions or disqualifications during the five years prior to fatal crash involvement were not excluded from the analyses. However, the resulting number of prior driving incidents was probably a conservative estimate of what it would have been had the driver not been disqualified for part of the time.

Crash and traffic offence records of culpable and non-culpable drivers were compared to identify any differences related to crash culpability status. It is acknowledged that changes in enforcement strategies or enforcement regulations over the five-year period may have influenced the number of traffic offences recorded. However, any such fluctuations should affect data for both culpable and non-culpable drivers to a similar extent.

In addition to driver records, driver characteristics (sex, age) and fatal crash characteristics (blood alcohol concentration (BAC) level, drivers fatally injured, crash type, apparent error) were also analysed by culpability status.

3.2.3 Driving Exposure and Driving Experience Data

The accumulation of crashes or traffic offences requires time spent on the road driving. However, driver records do not indicate how frequently a driver is actually driving or in what environments or road types the driver is driving. To account for driving exposure, an induced-exposure method was utilised such that non-culpable drivers were considered “controls” or an approximate exposure sample. Although driving exposure would not be expected to be identical for each set of culpable and non-culpable drivers involved in a given crash, it is likely that driving exposure would be comparable for the entire sample of crashes.

Some drivers, particularly very young drivers, did not have a driver’s licence during the entire five years before fatal crash involvement. Consequently, these drivers have less driving exposure and the relationship between driver history and fatal crash involvement may be underestimated. To account for potentially reduced driving exposure and inexperience, and to gain a better understanding of the relationship between driving history and culpable fatal crash involvement, a proxy measure of driving experience was included: the length of time (i.e., number of years) since each driver first acquired a South Australian learner’s permit. The date each driver was first issued a learner’s permit was acquired from the DRIVERS database. It is acknowledged that “years of driving” is a crude estimate of driving experience in the absence of information on the actual distance driven. Certainly, variations between individuals in the distance driven would be expected, even for those of the same age and years of driving. However, in this study, no other measure of driving exposure was available.

The date of first licensure was not recorded for 30 drivers. Consequently, driving experience was estimated for these drivers by examining their alphanumeric South Australian driver licence number. Licence numbers are distributed in alphanumeric order when a driver first receives a valid learner's permit. Cross tabulation of known dates of first licence, obtained from the DRIVERS database, and alpha numeric licence numbers enabled the compilation of an approximate timeline to estimate the month when a driver first received a South Australian learner's permit. The majority of drivers with no record of the date of first licence could then be estimated within a range of two months. The first day of the first month within the estimated range was selected to provide a conservative estimate of driving experience (i.e. allow the longest potential period of driving experience for each driver).

Some drivers may have held a valid interstate driver's licence prior to their South Australian licence. The DRIVERS database identified one driver who held an interstate licence for some time during the five years prior to fatal crash involvement. This individual was included in the primary analysis but was excluded from analyses incorporating driving experience. Other drivers may have spent time driving when interstate or overseas during the five years prior to the fatal crash but this could not be determined within the scope of this study. It might be expected that overall, the time spent out of South Australia would not unduly impact on the results of analyses.

3.2.4 Data Analyses

To determine whether prior driving behaviour could identify high-risk drivers, that is, drivers culpable for a multiple vehicle fatal crash, a variety of statistical tests were performed using the SPSS computer package. Independent samples *t*-tests and chi-square analyses were performed to examine any differences in driver characteristics, fatal crash factors and driver records by driver culpability status in the fatal crash.

With respect to driver records, for each individual type of driving incident, drivers with one or more prior driving incidents (versus drivers with no prior incidents), were cross tabulated with fatal crash driver culpability status and analysed using the chi-square test of association with no correction for continuity. Starmer, Grizzle and Sen (1974) have shown that the uncorrected chi-square test is possibly the best available test not requiring randomisation when all cell frequencies are large. Following the recommendation of Upton (1978), Fisher's exact test was adopted when the expected cell frequency was less than five so that the chi-square distribution did not approximate the test statistic distribution under these conditions. Fisher's test is usually more conservative than the chi-square test. For all chi-square analyses, a measure of the strength of association between two categorical variables (Phi ϕ) was reported.

Odds ratio estimates for fatal crash culpability, with 95 per cent confidence intervals, were reported for all prior driving incidents. An odds ratio is a measure of association which estimates how much more likely (or unlikely) it is for the outcome (i.e. driver culpability) to be present among a particular group, relative to a reference group. An odds ratio greater than one indicated a positive relationship of the independent variable with the likelihood of crash culpability.

To compare the difference between the mean number of prior driving incidents for culpable and non-culpable drivers, independent samples *t*-tests were conducted. All *t*-tests were performed using Welch's procedure because it did not assume equal population variances, making the *t*-test more robust. The data included counts of relatively rare events, thus, the assumption of normally distributed data might have been violated. The degrees of freedom for *t*-tests using Welch's procedure were rounded down.

Cohen's *d* (Cohen, 1988), a standardised measure of the effect size or strength of the difference between means, was reported for all t-tests. Cohen's *d* is defined as

the difference between two means divided by the pooled standard deviation. According to Cohen's (1988) guidelines, an effect size of $d = 0.2$ represents a small effect, $d = 0.5$ a medium effect, and $d = 0.8$ a large effect.

In all analyses, $p < .05$ was the level of statistical significance adopted but exact probabilities or *p*-values were specified. Since some driving incidents had a low frequency of occurrence, attention was also paid to differences that approached the specified significance level. If sample sizes were increased and the differences were maintained, some of these differences would have been statistically significant.

Multivariate statistical analyses were then performed on any driver record variables that were shown in previous univariate tests to differ statistically significantly by driver culpability status. Binary logistic regression (Hosmer & Lemeshow, 1989) was used to model the likelihood of culpable fatal crash involvement, versus non-culpable fatal crash involvement, as a function of the number of prior driving incidents. Logistic regression quantifies the effect of any predictor or independent variables on the likelihood of the dependent variable (i.e., driver culpability) while adjusting for the effects of other predictor variables included in the analysis. It does not make any assumptions about the statistical distribution of an individual drivers' crash frequency. To account for any effects of driving experience (i.e. number of years holding a drivers licence during the previous five years), logistic regression analyses were repeated with driving experience entered into the model. Estimates of odds ratios and 95 per cent confidence intervals were obtained for the final model of each logistic regression.

To identify high-risk young drivers, these statistical analyses were repeated for a subgroup of younger drivers, aged less than 25 years, involved in a multiple vehicle fatal crash.

3.3 Results

3.3.1 Driver and Fatal Crash Characteristics

To determine if driver or crash related factors were associated with the culpable status of the driver, the following sections explored differences in driver sex and age characteristics (section 3.3.1), and factors associated with the fatal crash such as alcohol involvement and whether the driver was fatally injured (section 3.3.2). Crash type and driver error were also analysed, with all culpable and non-culpable drivers combined.

3.3.1.1 Driver age and sex

Analysis of driver age indicated that there was little difference between the mean age of culpable drivers (M=42.3 years (SD=20.6) and non-culpable drivers (M=41.2 years, SD=17.0, t (351) = 0.58, p=.564, d=0.06).

To show the relationship between age and driver culpability in detail, the age distribution of culpable and non-culpable drivers involved in a multiple vehicle fatal crash, across five-year age groups, is presented in Figure 3.1. The age distribution of culpable drivers was bimodal indicating that drivers in the young (less than 25 years) and very old (75 years and over) age groups were more likely to be culpable than non-culpable for crashes. The distribution for non-culpable drivers was unimodal and centred around drivers aged 25 to 34 years. This distribution was similar to the age distribution of all licensed drivers.

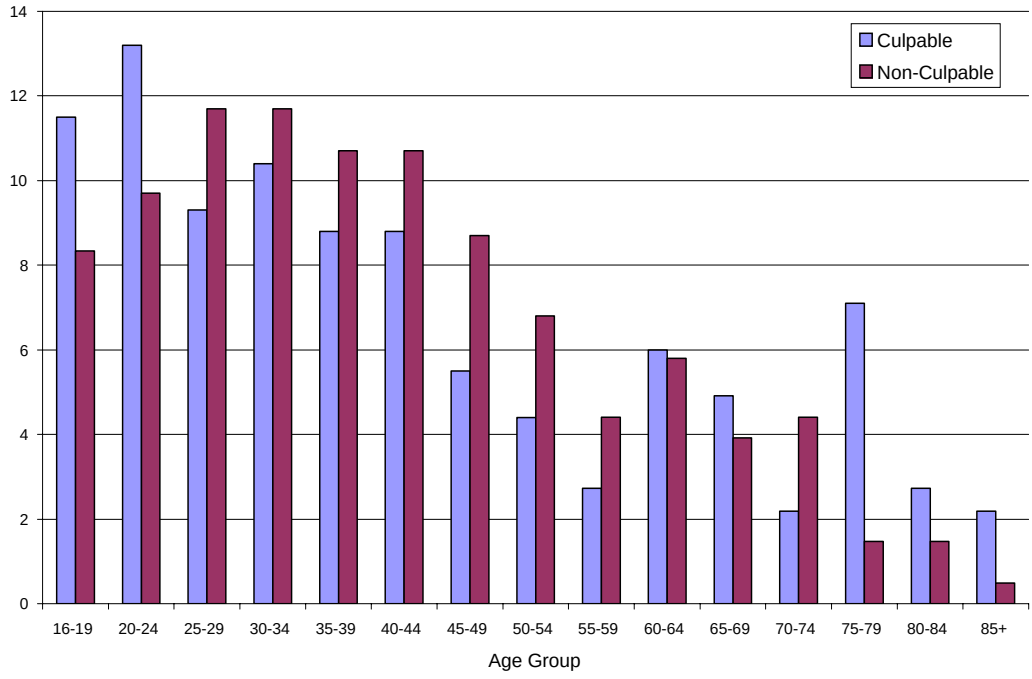

Figure 3.1. Age distribution of drivers involved in a multiple vehicle fatal crash by driver culpability

To determine whether these observed age differences by driver culpability status were statistically significant, drivers were classified into three age groups for chi-square analysis as seen in Table 3.2. Culpable drivers were more likely than non-culpable drivers to be aged less than 25 years and 60 years and over ($\chi^2(2)=8.4$, $p=.015$, $\phi=0.15$). The relationship between age and driver culpability is investigated further in section 3.3.3.

Table 3.2 also shows that males were over-represented in both groups of drivers; there were approximately three times as many males as females in each group. However, there was no sex difference by driver culpability status ($\chi^2(1)=0.1$, $p=.762$, $\phi=0.02$).

Table 3.2
Driver age group and sex by driver culpability

Driver characteristics	Culpable (*N*=182)		Non-culpable (*N*=206)	
	N	%	N	%
Age group				
<25 years	45	24.7	37	18.0
25-59 years	91	50.0	133	64.6
60+ years	46	25.3	36	17.5
Sex				
Male	139	76.4	160	77.7
Female	43	23.6	46	22.3

Figure 3.2 shows the percentage of drivers culpable for a fatal crash by age and sex. Despite some difference in percentages between males and females aged less than 25 years (13% vs. 6%) and over 75 years (5% vs. 9%), these differences were not statistically significant.

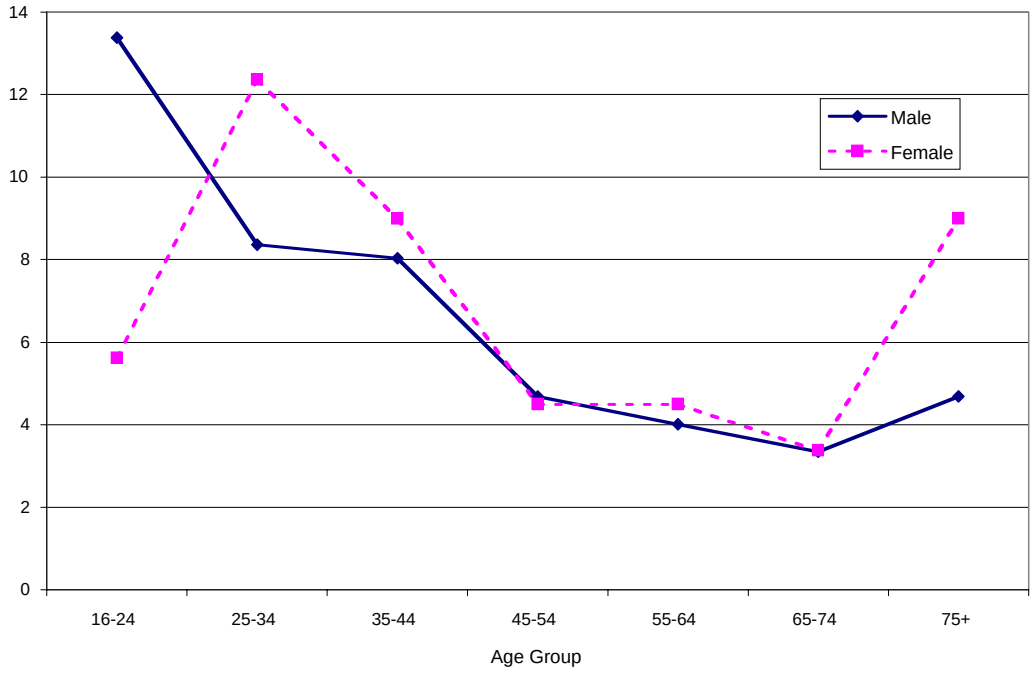

Figure 3.2. Distribution of drivers culpable for a fatal crash by age and sex

3.3.1.2 Driver fatally injured and alcohol involvement

The number of drivers fatally injured and blood alcohol concentration (BAC) levels at the time of the multiple vehicle fatal crash are shown in Table 3.3 by driver culpability status. In total, 41 per cent of drivers were fatally injured in the fatal crash. Culpable drivers (56%) were more likely to have been fatally injured in the multiple vehicle fatal crash than were non-culpable drivers (27%, $\chi^2(1)=32.2$, $p<.001$, $\phi=0.29$).

There were 133 drivers with unknown BAC levels (130 not tested, 3 blood denatured). Of the drivers with a known BAC reading (n=225), culpable drivers (21%) were about seven times more likely than non-culpable drivers (3%) to have a BAC at or above 0.05mg/L ($\chi^2(2)=18.5$, $p<.001$, $\phi=0.27$). Of the drivers with a positive BAC level (n=48), culpable drivers had a significantly higher mean BAC level (M=0.127mg/L, SD=0.09) compared to non-culpable drivers (M=0.054mg/L, SD=0.09, t (15)=2.36, p=.032, d=0.84). Furthermore, of all the alcohol positive drivers, 77 per cent were deemed to be culpable for the crash compared to 50 per cent

of alcohol-free drivers. These findings are consistent with BAC levels at the time of the fatal crash having influenced the assessment of driver culpability.

Table 3.3
Driver fatally injured and alcohol involvement in multiple vehicle fatal crash by driver culpability

	Culpable (*N*=182)		Non-culpable (*N*=206)	
Crash characteristics	N	%	N	%
Fatally injured?				
Yes	101	55.5	56	27.2
No	81	44.5	150	72.8
	Culpable (*N*=141)		Non-culpable (*N*=114)	
	N	%	N	%
BAC level				
Zero	104	73.7	103	90.4
0.001 - 0.049 mg/L	8	5.7	8	7.0
0.050 mg/L or greater	29	20.6	3	2.6

Note: 133 unknown BAC readings

Further analysis of drivers fatally injured in the fatal crash by BAC level is given in Table 3.4. Drivers with a known positive BAC were significantly more likely to be fatally injured as a result of the fatal crash than drivers recording a zero BAC level (83% vs. 55%, $\chi^2(1)=13.0$, $p<.001$, $\phi=0.27$).

It is probable that this finding is partially a reflection of the method of BAC data acquisition in South Australia. BAC data for deceased drivers is routinely acquired from autopsy toxicology reports. Less comprehensive BAC data is available for drivers who were not fatally injured. All injured drivers (14 years and over) involved in a motor vehicle crash in South Australia attending hospital are required to submit to a blood alcohol test but BAC testing of non-injured drivers is based on police discretion. As a result, many BAC readings for drivers were listed as unknown in the database. In this study, 56 per cent (129/231) of drivers not fatally injured in the fatal crash had an unknown BAC compared to 1 per cent (2/157) of drivers who were

fatally injured. Furthermore, of the drivers with an unknown BAC, a greater percentage of these drivers were deemed non-culpable (69%) than culpable (31%) for the fatal crash.

Table 3.4
Known alcohol involvement in multiple vehicle fatal crash by driver fatally injured in fatal crash

	BAC level			
	Zero BAC		Positive BAC	
Driver fatally injured?	N	%	N	%
Yes	114	55.1	40	83.3
No	93	44.9	8	16.7
Total	207	100.0	48	100.0

Note: 133 unknown BAC readings

3.3.1.3 Type of fatal crash

The types of multiple vehicle fatal crashes are listed in Table 3.5. This table has not been examined by driver culpability status because each crash, by definition, involved one culpable and at least one non-culpable driver. It was not surprising that “head on” (37%) and “right angle” (36%) crashes were most common in this sample of fatal crashes because these types of crashes involve more than one driver. One “hit parked vehicle” crash was included as a multiple vehicle crash because three vehicles were involved in the crash.

Table 3.5
Type of multiple vehicle fatal crash

Type of fatal crash (*N*=388)	%
Head on	36.9
Right angle	35.8
Right turn	9.8
Side swipe	6.4
Rear end	6.2
Roll over	2.3
Hit fixed object	1.8
Hit parked vehicle	0.8
Total	100.0

3.3.1.4 Apparent driver error

An “apparent driver error” (including “No error”) was assigned by police to each fatal crash involved driver and recorded in the TARS database. Only one apparent error was listed for each driver. It must be acknowledged that some driver errors are underestimated such as “excessive speed”. Drivers will rarely admit to police that they were travelling at an excessive speed at the time of the crash and it is difficult to reconstruct crash events to obtain a legally sustainable estimate of travelling speed before the crash. Police usually investigate fatal crashes to a greater extent than casualty crashes. Nevertheless, these limitations should be considered when viewing the apparent driver errors listed for culpable drivers in Table 3.6.

The most commonly assigned apparent driver errors for culpable drivers were failing to keep left (21%), disobeying traffic signs or signals (19%), driving under the influence of alcohol (15%) and failing to give way (13%).

Table 3.6
Apparent driver error for culpable drivers in multiple vehicle fatal crash

Apparent driver error	N	%
Fail to keep left	39	21.4
Disobey - sign or signals	34	18.7
Driving under the influence of alcohol (D.U.I.)	28	15.4
Fail to give way	24	13.2
Fail to stand	16	8.8
Excessive speed	13	7.1
Overtake without due care	11	6.0
Inattention	8	4.4
Follow too closely	6	3.3
Died/asleep/sick at wheel	2	1.1
Change lanes to endanger	2	1.1
Total	182	100.0

3.3.2 Identifying High-Risk Drivers

To investigate whether driver records can identify high-risk drivers, that is, drivers culpable for the fatal crash, this section examined the official records of drivers involved in a multiple vehicle fatal crash, five years prior to the crash. Involvement in a prior crash, involvement in a culpable crash, and total traffic offences were investigated separately. Four specific categories of traffic offences were also considered individually as seen in Table 3.7. Other categories of traffic offences were not explored separately because there were not enough offences recorded for meaningful analyses. Prior licence disqualifications were also examined. However, some drivers who incurred a licence disqualification may have subsequently appealed successfully against the disqualification. It is unknown what proportion of drivers successfully appealed.

Table 3.7
Description of specific traffic offence types

Traffic offence	Incorporated offences
Drink driving offence	Driving under the influence of alcohol, exceeding the prescribed legal blood alcohol concentration limit.
Speeding offences	Exceeding the speed limit (all categories).
Careless driving offences	Reckless or dangerous driving, driving without due care, overtaking without due care, failing to keep left of barrier lines, disobeying traffic signals or give way/stop signs, following too closely.
Seat belt/helmet offences	Failing to wear a seat belt or motorcycle helmet, failing to ensure child restrained or wearing seat belt.

3.3.2.1 Prior crashes and traffic offences

A summary of the percentage of drivers incurring at least one crash, traffic offence or licence disqualification (dichotomous variables) prior to the fatal crash, is provided in Table 3.8, by driver culpability status in the fatal crash. The estimated odds of being culpable in the fatal crash for each driver record variable are reported along with 95 per cent confidence intervals.

Table 3.8
Percentage of drivers detected for at least one of the listed incidents during the five years prior to multiple vehicle fatal crash involvement by driver culpability in the fatal crash

Type of prior incident	All (N=388)	Culpable (*n*=182)	Non-culpable (*n*=206)	χ^2	*p*-value	Odds ratio	95% Confidence interval
Crashes	28.9	30.2	27.7	0.31	0.580	1.13	(0.73-1.76)
Culpable crashes	18.6	20.9	16.5	1.22	0.269	1.34	(0.80-2.23)
Traffic offences	41.8	41.2	42.2	0.04	0.838	0.96	(0.64-1.44)
Drink driving offences	3.6	5.5	1.9	3.51	0.061	2.94	(0.91-9.53)
Speeding offences	33.2	32.4	34.0	0.11	0.744	0.93	(0.61-1.42)
Careless driving offences	5.9	6.0	5.8	0.01	0.927	1.04	(0.45-2.42)
Seat belt/helmet offences	7.5	8.8	6.3	0.86	0.354	1.43	(0.67-3.06)
Licence disqualifications	12.1	13.7	10.7	0.85	0.357	1.33	(0.72-2.45)

Drivers involved in a multiple vehicle fatal crash were more likely to have had at least one traffic offence (42%) in the previous five years, than at least one previous crash (29%) or a previous crash for which they were deemed culpable (19%). Speeding offences (33%) were the most common type of traffic offence recorded by drivers. Just over 12 per cent of drivers had a licence disqualification within the five years before the fatal crash.

Drivers culpable for the fatal crash were slightly more likely than non-culpable drivers to have recorded at least one previous crash (30% v 28%) or previous culpable crash (21% v 17%), although these differences were not statistically significant.

There were very small differences between culpable and non-culpable drivers for all traffic offences, and for speeding and careless driving offences considered separately. Culpable drivers were more likely than non-culpable drivers to have had a prior drink driving offence; this difference approached statistical significance (ϕ=0.10). The odds ratio suggested that incurring a prior drink driving offence, relative to no offences, increased the odds of being culpable for a subsequent fatal

crash by 194 per cent. However, this difference was not statistically significant. Similarly, drivers detected for a prior seat belt/helmet offence or licence disqualification had a higher odds ratio of subsequent culpable fatal crash involvement (by 1.43 and 1.33 respectively) but, again, these differences were not statistically significant. Relatively wide confidence intervals can be attributed, partly, to the small number of drivers with prior driving incidents.

3.3.2.2 Number of prior crashes and traffic offences

Differences in driver records by driver culpability status might be missed when examining “indicative” or dichotomous (i.e., prior incident/no prior) data only. Therefore, the actual numbers of crashes and traffic offences were explored in greater detail in the following section. To illustrate differences in driver records by driver culpability status in the fatal crash, Figures 3.3 to 3.10 show the number of crashes, culpable crashes, traffic offences and the four specific types of traffic offences incurred by drivers during the five years prior to fatal crash involvement. Complete tables showing the number of prior driving incidents by driver culpability status for each individual variable are presented in Appendix B.

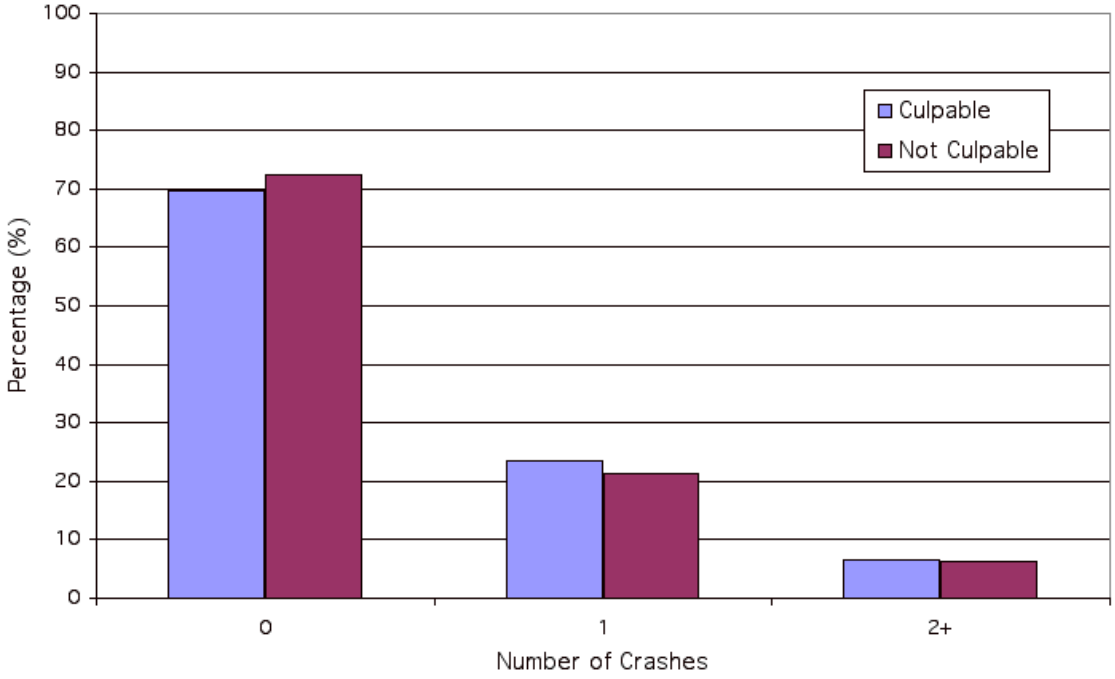

Figure 3.3. Number of crashes by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

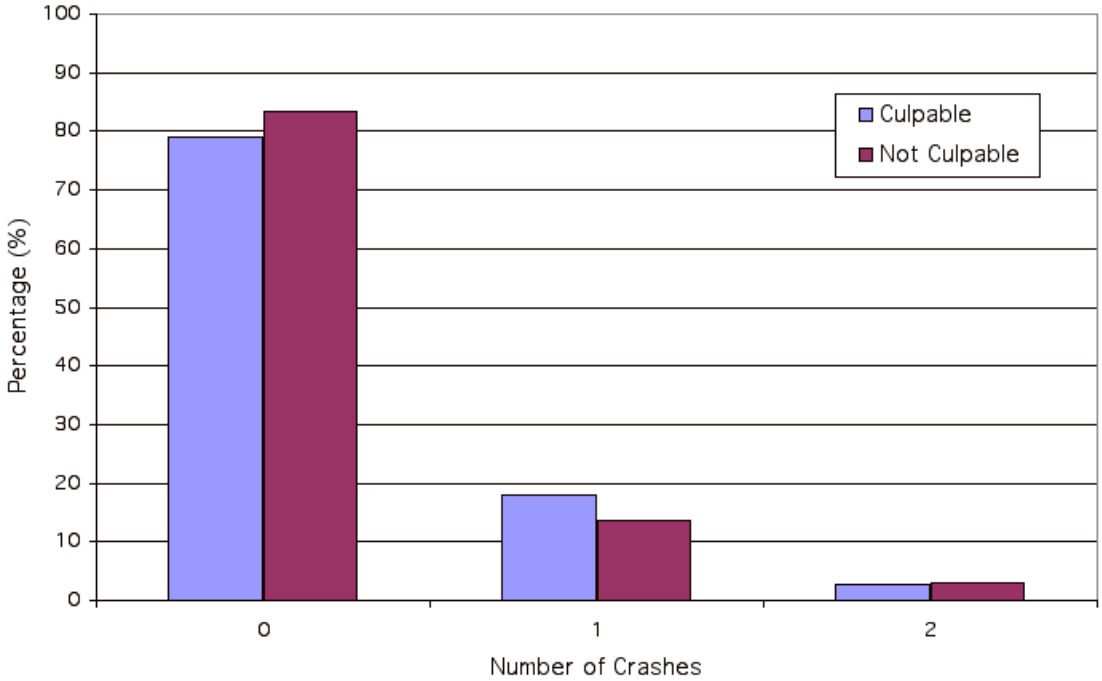

Figure 3.4. Number of culpable crashes by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

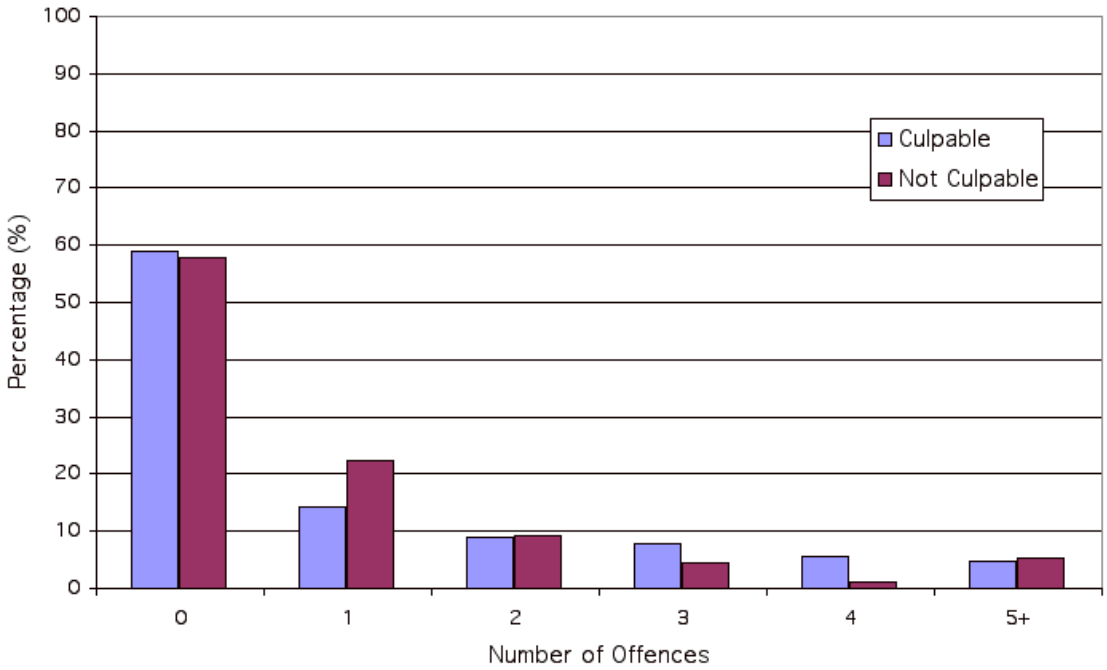

Figure 3.5. Number of traffic offences by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

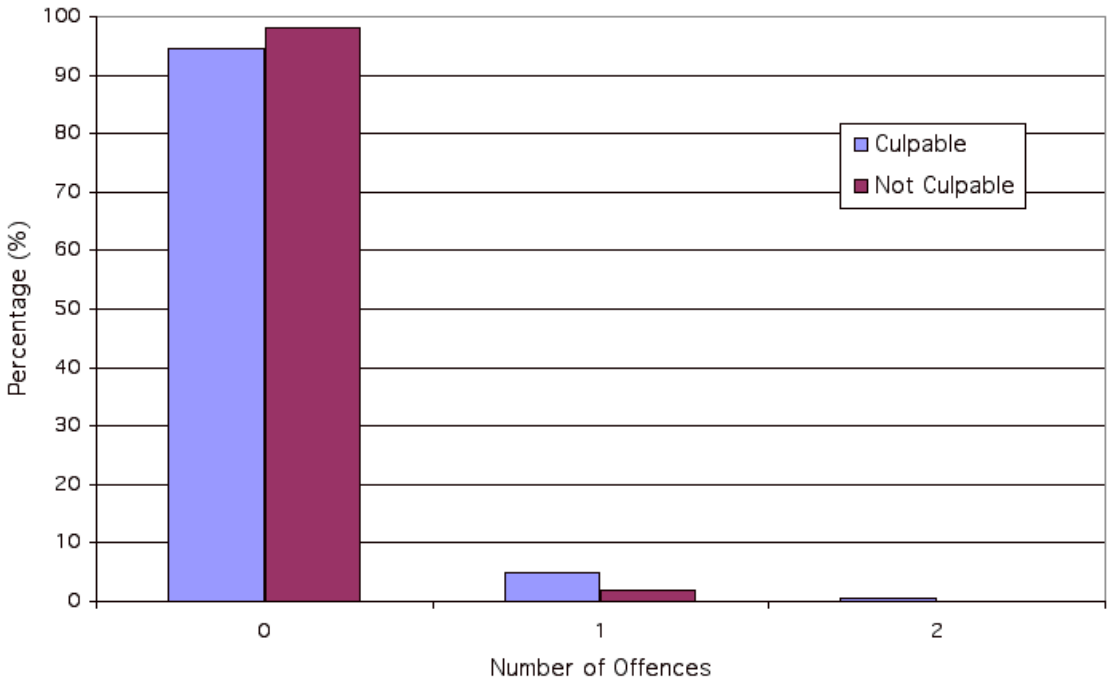

Figure 3.6. Number of drink driving offences by percentage of drivers during the five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

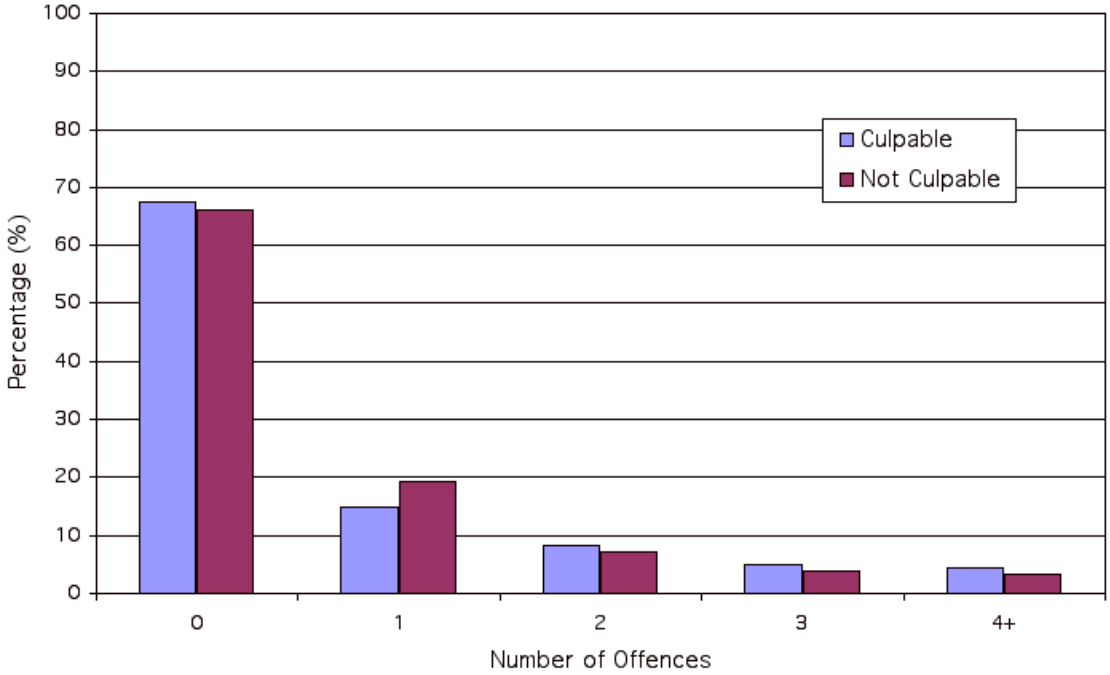

Figure 3.7. Number of speeding offences by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

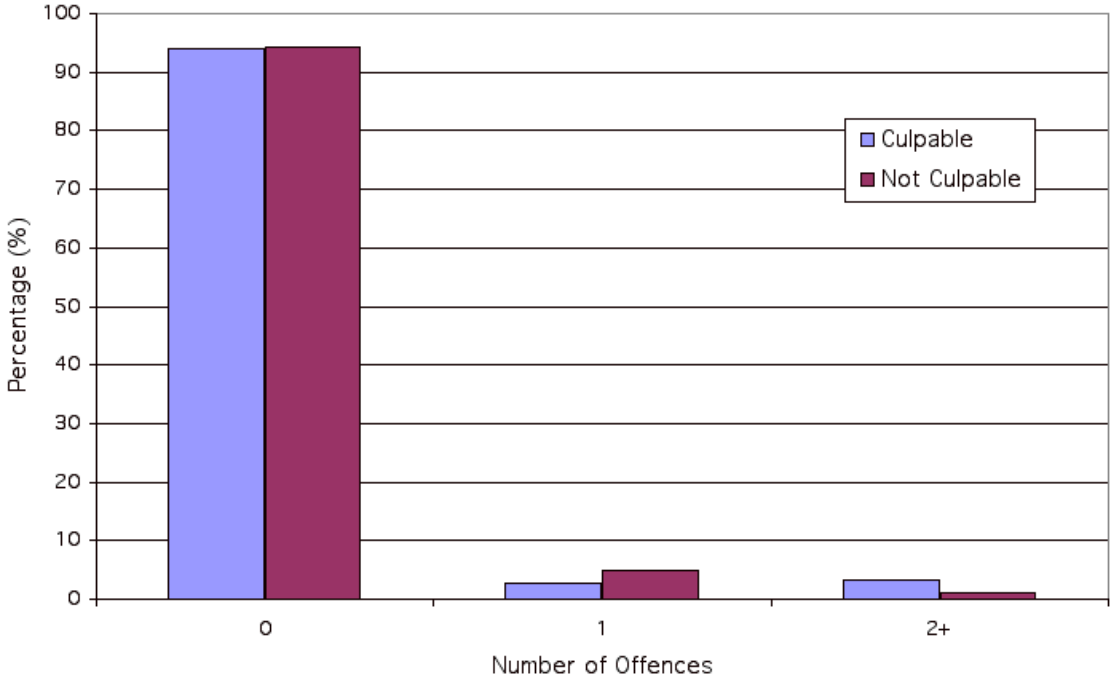

Figure 3.8. Number of careless driving offences by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

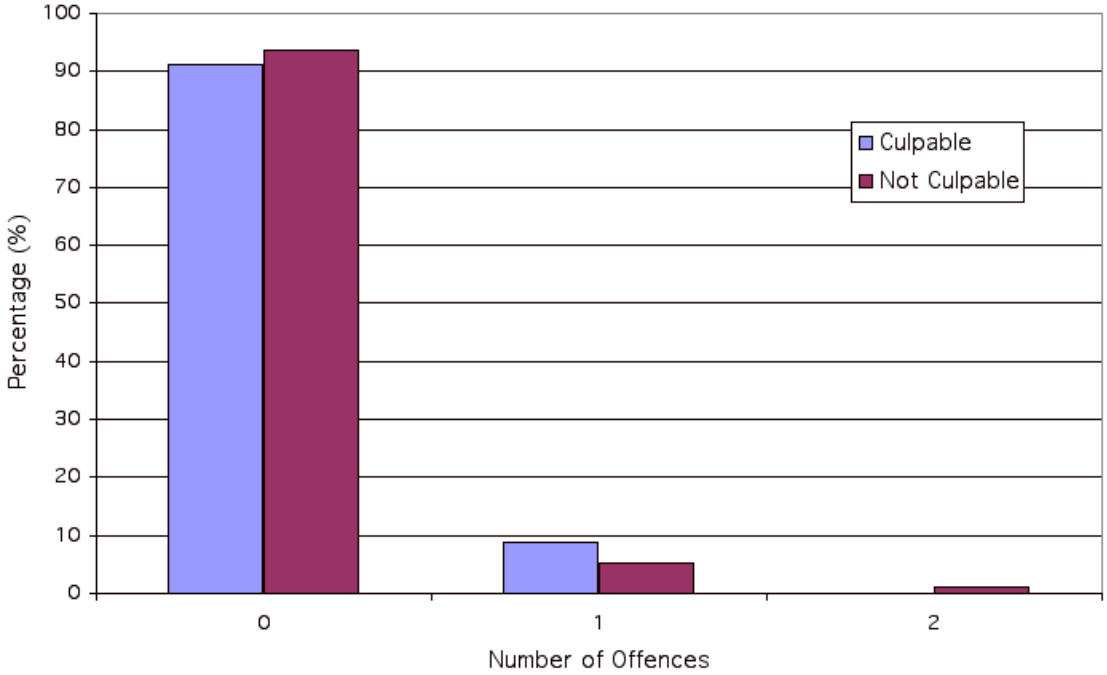

Figure 3.9. Number of seat belt/helmet offences by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

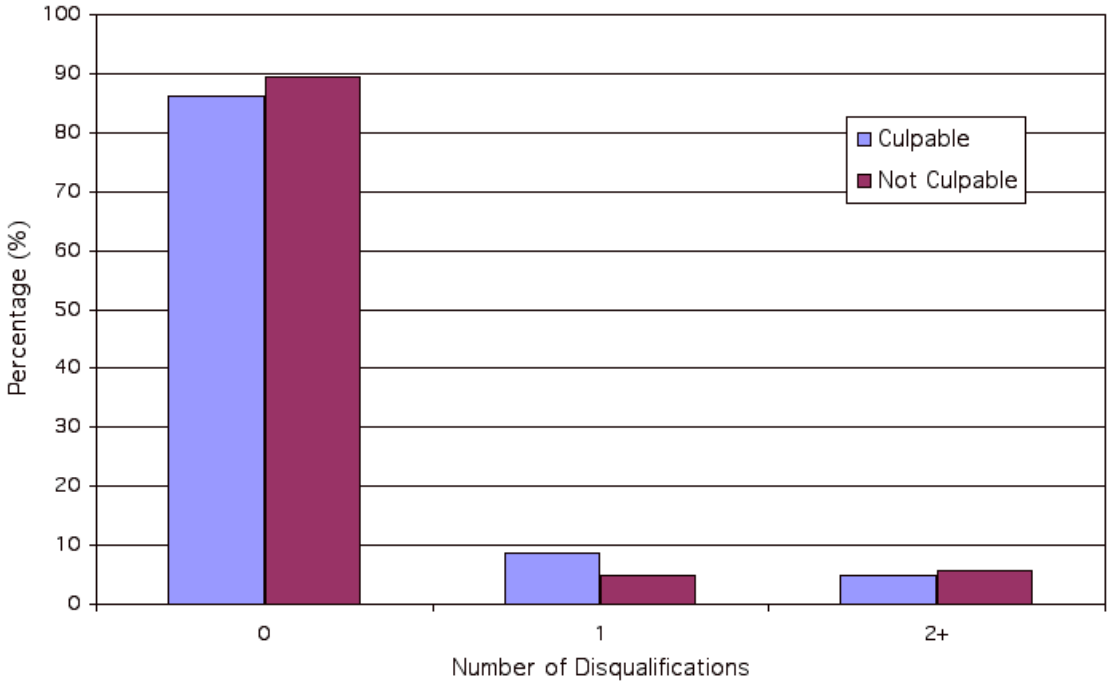

Figure 3.10. Number of licence disqualifications by percentage of drivers during five years prior to the multiple vehicle fatal crash, by driver culpability in the fatal crash

Statistical analyses were performed to determine if drivers culpable for a fatal crash, or high-risk drivers, were associated with a greater number of prior crashes

and/or traffic offences than non-culpable drivers. Independent samples *t*-tests were conducted for continuous variables in univariate analyses, and binary logistic regression was conducted for the multivariate analysis. A summary of the mean number of each prior driving incident is presented in Table 3.9 by driver culpability for the fatal crash.

There were no statistically meaningful differences in the means of prior driving incidents for culpable and non-culpable drivers. Of note, drivers culpable for a fatal crash had a higher mean number of drink driving offences in the previous five years than non-culpable drivers (t (267) = 1.90, p=.059), although this difference only approached statistical significance and the corresponding effect size was small (d = 0.19). The small effect size is likely to be at least partly attributable to the small number of drivers with prior drink driving offences. Only 10 culpable drivers had a prior drink driving offence; of these, one had two prior offences. Four non-culpable drivers had prior drink driving offences.

Table 3.9
Mean number of selected driving incidents during the five years prior to multiple vehicle fatal crash involvement by driver culpability in the fatal crash

	Culpable (N=182)		Non-culpable (N=206)				
Type of prior incident	Mean	SD	Mean	SD	*t*-value	*df*	*p*-value
Crashes	0.38	0.67	0.36	0.68	0.37	386	0.711
Culpable crashes	0.24	0.49	0.19	0.47	0.87	386	0.384
Traffic offences	1.10	1.82	0.87	1.43	1.34	386	0.180
Drink driving offences	0.06	0.26	0.02	0.14	1.90	267	0.059
Speeding offences	0.70	1.37	0.61	1.10	0.68	386	0.494
Careless driving offences	0.12	0.52	0.07	0.33	0.98	298	0.329
Seat belt/helmet offences	0.09	0.28	0.07	0.30	0.51	386	0.609
Licence disqualifications	0.23	0.72	0.23	0.84	0.03	386	0.978

A number of drivers (n=71), particularly younger drivers, had not actually been driving for the entire five year reporting period. Drivers licensed for less than the

full period are likely to have less driving exposure, and consequently less opportunity to be involved in a crash or commit a traffic offence in comparison to drivers licensed for the full period.

Analysis of the mean number of years of driving experience indicated that the driving experience of culpable drivers (M=4.49, SD=1.19) did not actually differ from that of non-culpable drivers (M=4.61, SD=1.04, t (360) = 1.02, p=.310, d = 0.11). Nevertheless, drivers with less than one year of driving experience were omitted from the analysis, to determine if reduced driving experience influenced the results. The direction of the results did not change; the number of drink driving offences continued to border on statistical significance (t (250) = 1.93, p=.054, d = 0.19). The analysis was repeated omitting all drivers with less than five years of driving experience. Again, the substantive interpretation did not change.

To determine whether prior driving incidents *predicted* driver culpability (dependent variable) in a multiple vehicle fatal crash, a logistic regression was performed. Prior drink driving offences was the only driving incident that differed by driver culpability status in the univariate analyses, so it was entered into the logistic regression. Driver age was also included as an independent variable in the model because it was found to differ by driver culpability status (see section 3.3.1.1). To differentiate the effects of driving experience from the effects of driver records and age, the logistic regression was performed twice; the first did not take account of driving experience (see Table 3.10), the second took account of driving experience (see Table 3.11).

The positive regression coefficient indicated that the probability of being culpable for a fatal crash increased with the number of prior drink driving offences. The odds ratio indicated that drivers with a prior drink driving offence were over three times more likely to be culpable for a fatal crash. Young drivers aged less than 25 years and older drivers aged 60 years and over also had a greater probability of being

culpable for a fatal crash. Although the model was statistically significant ($\chi^2(3)=13.6$, $p=.003$), only 59 per cent of cases were correctly classified suggesting the model is not that accurate in predicting fatal crash culpability (i.e., the driver culpability status of 41% of drivers would be misclassified or incorrectly predicted).

Table 3.10
Results of logistic regression analysis for driver culpability in a multiple vehicle fatal crash (N=388)

Variable	*B*	SE	Wald	*p*-value	Odds ratio	95% CI
Prior drink driving offences	1.22	0.58	4.36	0.037	3.37	(1.08-10.54)
Age (25-59 years) [a]			9.51	0.009	1.00	
Age (16-24 years)	0.60	0.26	5.25	0.022	1.82	(1.09-3.05)
Age (60 years and over)	0.69	0.26	6.86	0.009	1.99	(1.19-3.33)

[a] Odds ratios and coefficient estimates are relative to the reference age group of drivers aged 25-59 years.

The results of the logistic regression accounting for driving experience (i.e., number of years holding a driver's licence in previous five years) are presented in Table 3.11. After allowing for driving experience, the number of drink driving offences in the previous five years predicted culpability in a multiple vehicle fatal crash.

Being less than 25 years of age no longer contributed significantly to the prediction of fatal crash culpability when driving experience was added to the logistic regression. This finding can be attributed, at least partially, to the positive correlation between age and driving experience, $r = 0.47$ ($p<.01$). Although it was not a significant result, the negative sign of the beta coefficient indicates that less driving experience was associated with driver culpability.

This model incorporating driving experience was statistically significant ($\chi^2(4)=13.5$, $p=.009$) but, as for the previous model, only 58 per cent of cases were

correctly classified indicating the model is not that accurate in predicting fatal crash culpability.

Table 3.11
Results of logistic regression analysis for driver culpability in a multiple vehicle fatal crash, accounting for driving experience (N=387)

Variable	*B*	SE	Wald	*p*-value	Odds ratio	95% CI
Prior drink driving offences	1.23	0.58	4.47	0.035	3.43	(1.09-10.75)
Age (25-59 years) [a]			8.12	0.017	1.00	
Age (16-24 years)	0.50	0.32	2.38	0.123	1.65	(0.87-3.11)
Age (60 years and over)	0.70	0.26	6.97	0.008	2.01	(1.20-3.36)
Driving experience	-0.05	0.12	0.17	0.683	0.683	(0.76-1.20)

Note: One driver missing because driving experience was unknown.
[a] Odds ratios and coefficient estimates for age group are relative to the reference age group of drivers aged 25-59 years.

3.3.3 Identifying Young High-Risk Drivers

3.3.3.1 Prior crashes and traffic offences

To determine if prior driving incidents can identify young high-risk drivers, the driver records of young drivers involved in a multiple vehicle fatal crash were examined by driver culpability status. A summary of the percentage of young drivers aged 16 to 24 years incurring at least one driving incident in the five years prior to the fatal crash is shown in

Table 3.12.

There were no statistically significant differences between culpable and non-culpable young drivers for any of the prior driving incidents listed. However, the odds ratio indicated that young driver involvement in at least one crash almost doubled the odds of being culpable in a subsequent fatal crash. Large percentage differences were observed by young driver culpability status for prior drink driving offences (7% vs. 0%) and failure to wear a seatbelt/helmet offences (18% vs. 5%). However, these

differences were not statistically significant because of the small number of cases in each analysis. The relatively wide confidence interval for seat belt offences can also be attributed to the small number of non-culpable drivers with prior traffic offences.

Table 3.12
Percentage of young drivers detected for at least one of the listed incidents during the five years prior to multiple vehicle fatal crash involvement by driver culpability in the fatal crash (n=82)

Type of prior incident	Culpable (%) (*n*=45)	Non-culpable (%) (*n*=37)	χ^2	*p*-value	Odds ratio	95% Confidence interval
Crashes	48.9	32.4	2.27	0.132	1.99	(0.81-4.92)
Culpable crashes	31.1	27.0	0.16	0.686	1.22	(0.47-3.19)
Traffic offences	53.3	40.5	1.33	0.248	1.68	(0.70-4.04)
Drink driving offences	6.7	0.0	2.56	0.248[a]	-	-
Speeding offences	42.2	35.1	0.43	0.513	1.35	(0.55-3.31)
Careless driving offences	11.1	10.8	0.01	1.000[a]	1.03	(0.26-4.15)
Seat belt/helmet offences	17.8	5.4	2.90	0.105[a]	3.78	(0.75-19.06)
Licence disqualifications	26.7	29.7	0.09	0.759	0.86	(0.33-2.26)

Note. An odds ratio could not be calculated for drink driving offences because non-culpable drivers did not have any prior drink driving offences.
[a] *p*-values were calculated using Fisher exact tests (2-tailed).

To examine young drivers prior driver records in detail, the *numbers* of prior driving incidents were examined by driver culpability status (see Table 3.13). No statistically significant differences were found between culpable and non-culpable young drivers by prior driving incidents, although there was a trend for young culpable drivers to record more drink driving offences than non-culpable drivers. Consequently, driver records do not appear to be useful for predicting young driver culpability in a multiple vehicle fatal crash.

Table 3.13
Mean number of listed incidents for younger drivers during the five years prior to multiple vehicle fatal crash involvement by driver culpability in the fatal crash

Type of prior incident	Culpable (*n*=45) Mean	*SD*	Non-culpable (*n*=37) Mean	*SD*	*t*-value	*df*	*p*-value
Crashes	0.58	0.69	0.57	1.04	0.05	80	0.958
Culpable crashes	0.31	0.47	0.32	0.58	0.11	80	0.909
Traffic offences	1.58	2.11	1.35	2.12	0.48	80	0.631
Drink driving offences	0.07	0.25	-	-	1.77	44	0.083
Speeding offences	0.82	1.32	0.76	1.19	0.23	80	0.816
Careless driving offences	0.20	0.63	0.14	0.42	0.54	80	0.591
Seat belt/helmet offences	0.18	0.39	0.08	0.36	1.17	78	0.248
Licence disqualifications	0.38	0.86	0.73	1.54	1.24	53	0.220

It could be argued that since some young drivers may have little driving experience, they have reduced opportunity to be involved in a crash or be detected committing a traffic offence compared to more experienced drivers. Moreover, some studies (Elliot *et al.*, 2000; McCartt *et al.*, 2003) suggest that driver records have limited value in identifying high-risk young drivers in the first year of driving because most crashes at this time are due to inexperience and few are preceded by traffic offences.

To address these concerns, young drivers with less than one year of driving experience (*n*=70) were omitted from the data. Analyses following the omission of these drivers confirmed that no prior driving incident variables differed statistically significantly by culpability status. The same analyses were repeated omitting drivers with less than two years of driving experience (*n*=61) and drivers with less than three years of experience (*n*=47). No differences were found, indicating that the limited driving experience of some young drivers had no effect on the likelihood that driver records may be useful in identifying high-risk young drivers.

Further analysis confirmed that there was no difference in driving experience by young driver culpability status for the fatal crash; culpable drivers had held a driver's licence (first received Learners Permit) prior to fatal crash involvement for an average of 3.3 years (*SD*=1.63) in comparison to an average of 3.2 years (*SD*=1.57) for non-culpable drivers (t (79) = 0.57, p=.569, d = 0.06).

3.3.3.2 Driver and crash characteristics

Driver records may not be useful for identifying young drivers culpable for a fatal crash but other driver and crash related factors may be predictive of young driver culpability. Results from section 3.3.1.1 showed that, in general, males were no more likely to be culpable for the multiple vehicle fatal crash than females. However, sex differences by driver culpability status may be specific to young drivers. Fatal crash culpability may also be more closely associated with the youngest young drivers (drivers aged 16-17 years) rather than "older" young drivers (drivers aged 22-24 years). Furthermore, studies have consistently found that alcohol consumption prior to a crash is associated with driver culpability (e.g., Rajalin, 1994). Therefore, it is likely that alcohol use before the crash is associated with young driver culpability in a fatal crash.

Demographic characteristics and crash related factors associated with young drivers (aged 16-24 years) were examined individually using chi-square analysis and t-tests. There was no difference in the age of drivers by driver culpability status. Culpable drivers had a mean age of 19.8 years (*SD*=2.42) and non-culpable drivers had a mean age of 19.7 years (*SD*=2.05, t (80) = 0.19, p=.854) d = 0.04). With regard to the sex of the driver involved in the fatal crash, almost 59 per cent of male drivers (n=40) were culpable in comparison to 36 per cent of female drivers (n=5). Although the effect size was large, this difference was not statistically significant ($\chi^2(1)$=2.50, p=.114, ϕ=0.18).

Concerning fatal crash characteristics among young drivers, no non-culpable drivers had a positive BAC at the time of fatal crash compared to 25 per cent (n=8) of young culpable drivers ($\chi^2(1)=6.73$, p=.015 Fisher's Exact Test, $\phi=0.35$).

In summary, a positive BAC level recorded at the time of the fatal crash was the only driver or crash related factor statistically significantly associated with young driver culpability. However, alcohol consumption could not be included as an independent variable (predictor) in a logistic regression because all young drivers with a positive BAC were deemed culpable. Thus, driver records, demographics and factors associated with the fatal crash were not useful in identifying high-risk young drivers; that is, young drivers culpable for a multiple vehicle fatal crash.

3.4 Discussion

Driver records will not accurately predict who will be involved in a fatal crash. However, they may assist in identifying groups of drivers with an increased risk of fatal crash involvement. This study examined relationships between driver records and multiple vehicle fatal crash culpability. To conduct this study, routinely collected data from two separate databases were merged. The method of induced driving exposure attempted to ensure that driving exposure and environmental factors of culpable and non-culpable drivers were similar. In fact, the induced exposure method reflected the methodology typically used in traditional fatal crash case-control studies whereby controls are selected from the same location, at the same time of day, and at the same time of week as when the crash occurred. Thus, any differences between culpable and non-culpable drivers cannot be explained by these factors.

Given that a fatal crash occurred, the first part of this study aimed to determine what driver-related factors were associated with the "culpable" status of the driver.

3.4.1 Driver and Fatal Crash Characteristics

Analysis of driver characteristics demonstrated that culpable drivers were more likely to be young drivers aged less than 25 years or older drivers aged over 60 years. This finding was consistent with previous research (Carsten et al., 1989; Perneger & Smith, 1991; Praxenthaler, 1995; Williams & Shabanova, 2003). Note that being a young driver no longer contributed to fatal crash culpability when driving experience was considered. This finding was, at least partly, attributable to the high correlation between driver age and driving experience. Most South Australian drivers first acquire their driver's licence at the age of 16 or 17 years. Therefore, age and experience are inextricably confounded and the strong association between them makes it difficult to separate the relative effects of each variable.

Although males made up the majority of drivers involved in fatal crashes, they were no more likely than females to be culpable for the crash. There have been mixed findings for sex and driver culpability. This finding is consistent with a previous study investigating driver culpability and gender (Perneger & Smith, 1991) but contradicts other studies that found young males were more likely to be culpable (Longo, 2001; Williams & Shabanova, 2003).

Certain driver-related factors at the crash scene were examined to determine whether they contributed to the assignment of driver culpability. Consistent with previous research (Banks *et al.*, 1977; Garretson & Peck, 1982; Perneger & Smith, 1991; Soderstrom et al., 1990), culpable drivers were almost three times more likely than non-culpable drivers to be have been drinking alcohol prior to the crash and almost twice as likely to be fatally injured in the crash. Given the well known strong association between high BAC levels and increased crash risk (e.g., Borkenstein *et al.*, 1964; McLean & Holubowycz, 1981), it was not surprising that culpable drivers were more likely to be drinking prior to the fatal crash. It is also conceivable that the

known strong relationship between a positive BAC and crash involvement influenced police assessment of driver culpability.

The relationship between culpability and being fatally injured in a crash is not so clear and previous research has offered little clarification. However, further analysis of alcohol consumption revealed an interaction with driver fatality status. Culpable drivers with a BAC over the South Australian legal limit (0.05 mg/L) were more likely to be fatally injured than culpable drivers with a BAC below the legal limit. Consistent with previous research, these findings suggest that alcohol consumption over the legal level not only impaired performance to cause the crash, but was also associated with a greater likelihood of being the fatally injured driver (Waller *et al.*, 1986; Warren *et al.*, 1981). To some extent, this finding can be attributed to the nature of BAC recording procedures, whereby the BAC levels for drivers who were fatally injured were recorded more comprehensively than they were for drivers who were not fatally injured.

Some might argue that those fatally injured in the crash did not get an opportunity to tell their version as to what happened in the crash and this might influence police determination of driver culpability for the crash. However, fatal crashes involving multiple vehicles are investigated more thoroughly than other crashes, often for legal reasons, so this limitation is not of serious concern.

The driving errors identified at the time of the fatal crash were found to be typical of certain high-risk groups previously recognised in studies of fatal crash involvement (Williams & Carsten, 1989; Zador *et al.*, 2000).

3.4.2 Identifying High-Risk Drivers from Driver Records

Drivers culpable for a fatal crash may be a subset of high-risk drivers and these drivers may be identifiable by their past driving behaviour. However, investigation of fatal crash involved drivers indicated that prior crash involvement

was not associated with fatal crash culpability. Of the past studies investigating driving records and fatal crash culpability, these findings were consistent with Garretson and Peck (1982) but not with Perneger and Smith (1991). Similar to all crashes, prior culpable crash involvement was not associated with fatal crash culpability. Note that the only studies that found a relationship between prior culpable crash involvement and subsequent crash culpability did not examine fatal crashes (Chandraratna et al., 2006; Chen *et al.*, 2000).

Previous research has suggested that the total number of prior traffic offences committed by drivers provided the best means to differentiate between culpable and non-culpable crash involved drivers (Bailey, 1992; Banks et al., 1977; Garretson & Peck, 1982; Rajalin, 1994). Contrary to previous findings, prior drink driving offences was the only type of traffic offence associated with culpability for a fatal crash. Most noteworthy, drivers with a prior drink driving offence were over three times more likely to be culpable for the fatal crash although few drivers actually had prior drink driving offences. This relationship persisted even when accounting for years of driving experience. Some research has reported an association between drink driving offences and culpability in a subsequent crash (Chen et al., 1995; Longo, 2001; Perneger & Smith, 1991) but also see (Bailey, 1992). For example, Perneger and Smith (1991) reported a very similar association between prior "driving while intoxicated" offences and an increased risk of fatal crash culpability (odds ratio = 2.69). Similar to the present study, Perneger and Smith (1991) used an induced driving exposure measure but they did not appear to account for the limited driving experience of younger drivers.

Most, but not all, drink driving offences in South Australia incur a licence disqualification. Indeed, a strong correlation between drink driving offences and licence disqualifications was found in the data. It is likely that some of the drivers detected for drink driving offences were not driving for some time during the five-

year period of analysis because their licence was disqualified. Therefore, the association between prior drink driving offences (and other traffic offences and crash involvement) and driver culpability may be underestimated.

Of interest, Perneger and Smith (1991), among others (Garretson & Peck, 1982), reported that the risk estimates for driver records almost halved when examining fatal crashes without alcohol involvement. However, by omitting alcohol positive drivers from the analysis, some of the riskiest drivers were removed, and, consequently, much of the variance was reduced (see Garretson & Peck, 1982).

With regard to the specific types of traffic offences, it is clear that many of the differences by driver culpability status were not significant due to the low number of prior offences, apart from speeding offences. These drivers may have committed a greater number of traffic offences but it is only the offences for which they were detected that were recorded.

It is possible that drivers involved in a fatal crash may not have differed by culpability status, apart from age and prior drink driving offences, because even non-culpable drivers may have been partly responsible for the crash, rather than reflecting driving exposure. Thus, *all* drivers involved in a fatal crash might be considered high-risk and differ from the general driving population in terms of driver records, as suggested by Rajalin (1994). Interestingly, of those drivers involved in a fatal crash, a high proportion had recorded at least one traffic offence (42%) or crash (29%) in the previous five years. Moreover, even though *speed camera* offences were not included in this study, one third of drivers had recorded at least one previous speeding offence. Thus, the proportion of fatal crash involved drivers with previous driving incidents appears to be high, suggesting that fatal crash involved drivers may indeed be a high-risk group. To investigate this, further research should consider comparing the driver records of those involved in a fatal crash with the general driving population in South Australia.

3.4.3 Identifying High-Risk Young Drivers from Driver Records

Of all the demographic factors, fatal crash characteristics, and driver record variables examined, only a positive alcohol level recorded at the time of the crash was associated with younger driver fatal crash culpability. However, there was a trend for young culpable drivers to record more drink driving offences but few drink driving offences were recorded. Alcohol consumption prior to a crash has consistently been associated with driver culpability in the literature (Longo, 2001; Perneger & Smith, 1991; Rajalin, 1994), although few studies have specifically examined young drivers. Clearly, alcohol consumption has a strong association with crash culpability, regardless of age.

The fact that none of the driver record variables were related to young driver culpability is inconsistent with previous findings that have reported various relationships (Elliot et al., 2001; Harrington, 1972). There are several possible reasons for the non-significant results. Firstly, although both culpable and non-culpable younger drivers generally reported a greater proportion of drivers with prior crashes and traffic offences than drivers of all ages, the younger driver group was a small subset of the data set. Thus, the smaller sample size reduced statistical power. Considering the trend for young culpable drivers to record more drink driving offences, further research examining the driver records of a greater number of younger drivers involved in a fatal crash would assist in validating these findings.

Secondly, the non-culpable younger drivers involved in a fatal crash may not simply reflect driving exposure, but may be involved in a fatal crash because they are less proficient at avoiding a crash; most likely attributable to inexperience and lack of defensive driving skills. Several studies have proposed that non-culpable crash involvement is not accidental (Catchpole et al., 1994a; Peck, 1993). For example, a study based on casualty crashes found that the over-representation of young drivers in situations involving a failure to cope with conflicts created by the unexpected actions

of other road users, was greater than their over-representation in crashes generally (Catchpole et al., 1994a). It was deduced that “not-at-fault” casualty crash involvement was not random but was a result of young drivers’ driving behaviour contributing to their over involvement in these crashes. In the present study, even when the most inexperienced drivers were removed from the analysis (i.e., drivers holding a driver’s licence for less than one, two and three years), the non-significant relationship between driver records and driver crash culpability persisted. However, removing these drivers from subsequent analyses further reduced the sample size and, consequently, statistical power.

If young driver fatal crash culpability status is not a useful tool for determining any relationship between driver records and young drivers at a higher risk of crashing, then what are the alternatives? Young drivers with a number of traffic offences might be considered high-risk drivers. Rajalin (1994) suggested that traffic offences, rather than fatal crashes, were a better approximation of intentional behaviour. Elliot (2001) showed that traffic offences were more easily predicted from driver records than crashes among a large cohort of young drivers. Two separate studies also found that multiple regression equations created to predict subsequent traffic offences could predict subsequent crashes as well as, or better than, a crash prediction equation, among drivers already found to be negligent (Harano *et al.*, 1975; Marsh & Hubert, 1974). In contrast, a recent study of drivers from the general driving population found that a canonical function generated to predict subsequent traffic offences could not quite predict subsequent crashes as well as a function designed solely to predict crashes (Gebers & Peck, 2003). Interestingly, none of the previous studies were conducted specifically among younger drivers. Nevertheless, these studies suggest that younger traffic offenders might be a better “high-risk young driver” group for future studies investigating the ability of driver records to identify high-risk drivers. Alternatively, variables other than driver records, such as

personality factors and attitudes, may be more useful in identifying younger drivers at a higher risk of crashing. This possibility is investigated in the chapters to follow.

In summary, none of the driver record variables examined in this study was useful in identifying high-risk *young* drivers in South Australia.

3.4.4 Limitations

Several potential methodological issues and limitations associated with driver culpability and driver records were identified: the assessment of driver culpability, the absence of a driving exposure measure, and factors contributing to incomplete prior driving records. The assessment of driver culpability relied on police judgement of legal responsibility. Thus, the determination of driver culpability relied heavily on the quality of crash investigation and this may vary from jurisdiction to jurisdiction. However, fatal crashes are investigated more thoroughly and consistently than other casualty crashes so this should not have presented a major problem in this study. In support of this claim, a study that compared the results of a culpability analysis (using scoring protocol and considering contributing factors) with police evaluations of responsibility for non-fatal crashes occurring in South Australia found that there was agreement in 97 per cent of cases (Hunter *et al.*, 1998).

The accumulation of crashes or traffic offences requires time spent on the road driving, that is, driving exposure. Driver records do not indicate how frequently a driver is actually driving or in what environments or road types the driver was driving. As a result, an induced-exposure method was utilised such that non-culpable drivers were considered to be “controls”, or an approximate exposure sample. Although driving exposure would not be expected to be similar for each set of drivers involved in a given crash (i.e., culpable and non-culpable driver), it is likely that driving exposure was comparable for the entire sample of drivers involved in a multiple vehicle crash.

Time spent interstate or overseas and licence disqualifications may contribute to reduced driving exposure and a conservative estimate of driver records had the driver not been disqualified or absent for part of the time. However, such conservative estimates of driving records would be expected to affect both culpable and non-culpable drivers equally.

In conclusion, based on driver records, prior drink driving offences appeared to be the only variable that could identify high-risk drivers, that is, drivers culpable for a multiple vehicle fatal crash in South Australia. Driver records were not useful for identifying young high-risk drivers. Consequently, the next chapter reviews the literature examining other means of identifying young drivers, specifically, individual characteristics such as personality factors and attitudes.

CHAPTER 4 IDENTIFYING HIGH-RISK YOUNG DRIVERS USING PERSONALITY CHARACTERISTICS AND ATTITUDES: A LITERATURE REVIEW

4.1 Introduction

Although young drivers have an elevated crash risk, such a broad generalisation masks substantial heterogeneity among young drivers. Not all young drivers are crash involved and not all young drivers display high risk taking tendencies (Williamson, 2003). There is some evidence within road safety literature confirming the presence of subgroups of young drivers with an elevated crash risk (e.g., Crettenden & Drummond, 1994; Sobel & Underhill, 1976).

Past attempts to identify high-risk drivers have relied heavily on previous driving behaviour, evident in crash and traffic offence records (see Chapter 2). While there has been some success in identifying high-risk drivers from driver records, findings from Chapter 3 indicate that driver records are not useful for identifying *young* high-risk drivers. It is likely that a variety of individual characteristics such as personality factors, motivations, and driving related attitudes are related to drivers with an elevated crash risk.

Some research has attempted to identify high-risk drivers by identifying specific subtypes of drivers based on combinations of these characteristics. This research was based on the assumptions that the relevant driver population is heterogeneous and that individual variability allows classification into subtypes. These studies use a multivariate statistical technique, cluster analysis, to identify young driver subtypes based on personality characteristics and attitudes (Beirness, 1995; Deery et al., 1998; Ulleberg, 2001). The identification and validation of young driver subtypes may assist in tailoring interventions and road safety campaigns to the needs of specific subtypes of young drivers who are at a higher risk of crash involvement.

This thesis aimed to ascertain which personality and attitudinal characteristics define high-risk young drivers and to identify subtypes among young drivers. Thus, to validate and understand the personality and attitudinal characteristics defining young drivers, it is important to replicate a study that identified young driver subtypes and to extend the generalisability of these findings. Consequently, a decision was made to replicate an Australian study by Deery, Kowaldo, Westphal-Wedding, and Fildes (1998), using similar personality and attitude variables.

The first part of this chapter (section 4.2) summarises research examining each of the personality and attitudinal factors used in Deery et al's (1998) study in relation to risky driving and crash involvement. Findings from this literature review will provide useful background information about characteristics that might identify young drivers at a higher risk of crashing. The second part of this chapter (section 4.3) reviews studies using cluster analytical techniques based on combinations of personality characteristics and attitudes, to identify subtypes of high-risk drivers.

4.2 Relationships between Personality Characteristics and Attitudes, and Risky Driving and Crash Involvement

Personality refers to the unique personal qualities or traits that characterise an individual and distinguishes them from others (Nunnally, 1978). In other words, personality is a collection of emotion, thought, and behaviour patterns unique to a person that interact to determine how individuals perceive events, how they respond to them, and the intensity of their response (Kassin, 2003). Personality traits are thought to be relatively stable and endure over long periods.

In the driving context, personality characteristics may influence how individuals approach and respond to certain driving situations. Moreover, personality not only predisposes individuals to behave in a certain way but may also moderate the effects of measures designed to restrain these behaviours. Therefore, the goal of road safety researchers is not to influence personality as such but to identify personality

characteristics of drivers at a higher risk of crashing and find measures that influence these high-risk groups more efficiently.

A number of personality traits have been associated with crash involvement and risky driving behaviour. Risky driving refers to driving behaviours such as drink driving, speeding, following too closely, and reckless or aggressive driving. Such risky behaviours are likely to precede detection for a traffic offence or a crash. Beirness (1993) identified six broad dimensions of personality that appeared to be strongly and consistently associated with risky driving behaviour and crash involvement in the literature: thrill seeking, impulsiveness, hostility/aggression, emotional instability, depression, and locus of control (i.e., internal vs. external). However, this earlier personality research conducted from the 1950s to 1980s was criticised because studies: had not been validated in different populations, suffered from methodological problems such as inadequate control for variation in exposure, used inadequately standardised tests, and used small sample sizes (Grey *et al.*, 1989). A more recent review of the young driver literature dedicated a small section to personality research (Williamson, 1999). Williamson (1999) noted that the personality attributes of sensation seeking, aggressiveness, and egocentrism were linked to higher crash risk in younger drivers but also commented "the research on the relationship between personality and injury risk has been very patchy and unsystematic" (p. 14).

In light of findings from these reviews and in order to replicate Deery et al's (1998) study of young driver subtypes (see Chaper 5), the following personality characteristics and attitudes were selected for detailed examination in the following section: sensation seeking, driver aggression and hostility, emotional adjustment, tension reduction, depression, and locus of control. This review scrutinises the nature of the relationship between each personality characteristic and risky driving behaviour and crash involvement, examines the mechanisms behind this relationship, and investigates any interactions between these factors.

Note, however, that not all studies relate exclusively to young drivers. Personality factors are relatively stable over time and, therefore, such factors might also underlie older driver crash involvement. Consequently, studies of drivers of all ages are included to provide information pertaining to the usefulness of personality characteristics and attitudes for identifying high-risk drivers. Due to the large amount of research examining the sensation seeking and driver aggression/hostility, these topics are divided into subsections.

4.2.1 Sensation Seeking

It is likely that risk taking while driving may result in crashes. Consequently, drivers involved in crashes might be expected to exhibit more risk-taking characteristics than other drivers. Sensation seeking is a personality construct commonly used as a measure of risk taking. According to Zuckerman (1994), sensation seeking "is a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (p. 27). Thus, in the driving context, drivers with high levels of sensation seeking are motivated to engage in risky driving behaviour to satisfy a need for sensation or thrill seeking.

There are several theories regarding the specific psychological mechanisms through which sensation seeking influences driving. Sensation seekers may perceive less risk in driving situations than low sensation seekers; that is, risk perception may mediate the relationship between sensation seeking and risky driving (Arnett, 1990; Burns & Wilde, 1995; Furnham & Saipe, 1993; Wilson & Jonah, 1988). Sensation seekers may perceive certain driving situations as less risky because they perceive their driving skills to be advanced (Jonah, 1997). Alternatively, sensation seekers may perceive behaviour as risky but are willing to accept the risk in order to experience thrills associated with the behaviour. For example, Rimmo and Aberg (1999) found sensation seeking was related to intentional risky behaviour (i.e., deliberate speeding,

driving recklessly and ignoring basic social codes) rather than unintentional driver errors among young Swedish drivers. Once drivers have engaged in a risky behaviour and have not received any negative consequences, their perceived level of risk may lower and they may engage in the behaviour again in the future (Jonah, 1997).

Note that sensation seeking differs to impulsiveness, the tendency to act spontaneously without considering the consequences. Sensation seeking and impulsiveness are reported to co-occur in some individuals. For example, Dahlen et al. (2005) reported a correlation of $r = 0.25$ between sensation seeking and impulsiveness. However, they are not completely overlapping constructs. While sensation seekers may *prefer* to take risks, impulsiveness may lead to risk taking because the individual lacks self-control (Barratt, 1994). For example, Jonah and Wilson (1986) found that drink drivers did not differ in their level of sensation seeking in comparison to non-drink driving bar patrons but they had higher levels of impulse expression.

Studies have consistently shown an association between sensation seeking and age, with the highest levels found in the 16 to 19 year old age group (Arnett, 1994; Arnett *et al.*, 1997; Jonah, 1997). Thus, sensation seeking may provide at least a partial explanation for the higher risk taking and crash rates among young drivers. Gender differences have also been noted with males recording higher scores than females (Arnett et al., 1997; Hartman & Rawson, 1992; Zuckerman, 1984), consistent with other research that has found males seek risky activities more than females (Watanabe, 1998; Zuckerman *et al.*, 1978).

The various forms of Zuckerman's (1979) Sensation Seeking Scale (SSS) are the most popular operationalizations of the sensation seeking construct. The internal reliability of the total sensation seeking score from Form V, the most popular version, has been shown to be around .76 (Deditius-Island & Caruso, 2002). The SSS consists of four different dimensions or subscales that can be used separately or combined as a

total score: Thrill and Adventure Seeking (TAS), a preference for adventurous or risky activities; Experience Seeking (ES), a desire to adopt a non-conforming lifestyle; Boredom Susceptibility (BS), an aversion for repetitive or monotonous situations; and Disinhibition (Dis), the need to seek social stimulation. Whilst these dimensions are modestly correlated, they appear to relate differently to risky behaviours (Zuckerman, 1994).

Arnett (1994) has criticised the SSS for its use of a forced choice item format, outdated and awkward language, the inclusion of some activities that are age related, and confounding between the items used in the scale and the behaviour measured. In response to these potential deficiencies, Arnett developed another measure of sensation seeking, the Arnett Inventory of Sensation Seeking (AISS) (Arnett, 1994). The AISS has reported slightly lower internal consistency (α =0.70) than the SSS (Arnett, 1994; Arnett et al., 1997).

4.2.1.1 Sensation seeking, risky driving, and crash involvement

A large body of literature has attempted to relate sensation seeking to risky driving and crash involvement. Jonah (1997) examined 40 studies from a number of countries to assess this relationship. These studies predominantly used the SSS or AISS. Jonah (1997) reported that only four studies failed to demonstrate a statistically significant positive relationship. Correlations between sensation seeking and risky driving behaviour and sensation seeking and crash involvement ranged from about 0.30 to 0.40, accounting for between 10 and 15 per cent of the variance. It is interesting that the relationship between sensation seeking and risky driving and crash involvement is consistently much stronger than for other personality characteristics.

Clearly, from the 1970s to the present day, a wide range of risky driving behaviours have consistently been associated with high levels of sensation seeking including: drink driving, speeding, following too closely, and reckless/aggressive driving among both adolescent and adult drivers (Arnett, 1990; Arnett et al., 1997;

Desrichard & Denarie, 2005; Heino *et al.*, 1996; Rosenbloom, 2003; Zuckerman & Neeb, 1980). However, Jonah (1997) noted that the association between sensation seeking and crash involvement appeared to be weaker than that with risky driving. Indeed, a number of studies of young and adult drivers from different countries have reported a limited association or no relationship at all between sensation seeking and crash involvement. For example, Clement and Jonah (1984) found that the self-reported usual highway driving speed of young Canadian drivers increased as a function of sensation seeking scores, even after controlling for age, driving experience and distance travelled. However, self reported traffic convictions and crashes in the last three years were not related to sensation seeking. A study of college students in the United States showed that high sensation seekers were more likely to report a number of risky driving behaviours (i.e., speeding, not wearing seat belts, driving after drinking, aggressive driving) but not crashes or traffic violations in the last two years (Jonah *et al.*, 2001). Sumer (2003) found sensation seeking was associated with higher preferred speed and dysfunctional drinking but did not predict crashes among professional and general Turkish drivers. A study of young male Canadian drivers reported that sensation seeking correlated significantly with moving traffic violations (r = 0.25), but only weakly with crashes (r = 0.15) (Trimpop & Kirkcaldy, 1997).

A number of studies failed to find a significant relationship between sensation seeking and crash involvement due to small sample sizes. Crashes do not occur frequently, therefore, small sample sizes further reduce the number of crashes and decrease the power of statistical analyses. For example, Furnham and Saipe (1993) found that the SSS subscales of TAS and BS correlated significantly with self-reported traffic offences (r = 0.19, r = 0.31, respectively) but not crashes among a small sample of British drivers (N=73). However, only 20 drivers reported a traffic offence and it is likely that there were even fewer crashes. Another study using a small sample size (N=51) correlated male taxi driver's sensation seeking scores to

their official driver records (Burns & Wilde, 1995). Total sensation seeking scores correlated significantly with speeding offences (r = 0.42) and traffic offences, (r = 0.35) but not crashes. A correlational study of US college students aged 18 to 21 years found that sensation seeking was not associated with self reported crashes or traffic citations (Smith & Heckert, 1998). Again, a small sample size (N=75) and subsequent low number of crashes probably contributed to the lack of association.

Dahlen and colleagues (2005) controlled for a number of factors (i.e., age, gender and trait driving anger) and found that sensation seeking predicted self reported lapses in concentration, minor loss of vehicular control, aggressive driving, risky driving, and anger expression via aggressive driving among young college students. Sensation seeking did not predict traffic offences or crash involvement. However, the lack of association might be attributable to the fact that 70 per cent of the sample was female. Females tend to record fewer crashes and traffic offences than males. Consequently, fewer incidents were reported resulting in reduced statistical power.

Nevertheless, a number of studies have found relationships between sensation seeking and crash involvement. One of the earliest studies to investigate sensation seeking categorised respondents (users of LSD in psychotherapy or experiments) according to their driving record in the last three years (Jamison & McGlothlin, 1973). Higher levels of sensation seeking were found among those who had more traffic offences and crashes. Among a less extreme sample of male Dutch drivers, Heino et al. (1992) reported a positive relationship between sensation seeking and self-reported crashes. Twice as many high sensation seeking drivers reported one or more crashes when compared to low sensation seeking drivers.

An association between sensation seeking and crash involvement is even more evident among young drivers. Hartman and Rawson (1992) investigated sensation seeking in college athletes and non-athletes but also enquired about crash

involvement. Students with high scores on the SSS reported more crashes than students with low scores (r = 0.34). A study of young Australian drivers in their first year of driving found that drivers who scored high on an impulsivity and sensation seeking scale had a higher incidence of crashing (Stevenson *et al.*, 2001). Beirness (1995, 1988) conducted a large multi-year cohort study of Canadian high school students to examine the influence of personality and lifestyle factors on their crash involvement. The study began when students were in Grade 9, 10 or 11 and followed them over the two subsequent years. Students were divided into two groups based on driver records: those who reported crash involvement in their third year of the study and those who reported no crashes for the entire three years. The crash group reported higher levels of sensation seeking. Note that most students did not hold a driver's licence at the commencement of the study but by the third year, 90 per cent had obtained one. Thus, the differences in sensation seeking before licensing suggest sensation seeking has some predictive value.

Other studies reporting a relationship between sensation seeking and crash involvement have broadened the scope beyond crashes to incorporate other driver behaviour such as licence suspensions, traffic offences and near-miss crashes. Wilson and Jonah (1988) applied problem behaviour theory to a sample of drivers to predict scores on a risky driving index. The index consisted of crashes for which the driver was deemed culpable, traffic offences, and licence suspensions during the previous three years. A composite "thrill seeking" measure correlated with the risk index (r = 0.32) and was a principal contributor to the personality system of their model. Iversen and Rundmo (2002) examined relationships between sensation seeking, locus of control and normlessness (not respecting presumed norms or social rules) on risky driving and crash involvement among Norwegian drivers. Sensation seeking was the strongest predictor of risky driving and had a direct association with crash

involvement. The measure of crash involvement incorporated crashes and near-miss crashes as a driver or passenger.

Several studies have examined sensation seeking scores among different types of high-risk drivers in comparison to controls. Donovan (1985) compared three groups of male US drivers on a variety of personality, attitudinal, and drinking measures: drivers arrested for drink driving, drivers with multiple non-alcohol related traffic offences and/or crashes (high-risk drivers), and a representative sample of the general driving population. Drink driving offenders and high-risk drivers had similar high sensation seeking scores that were greater than scores for general drivers. Wilson (1992) attempted to replicate and extend the generalisability of Donovan's (1985) findings by controlling for age and education, including both sexes in proportion to their frequency in the drink driver and high-risk driver populations, and recruiting drivers from randomly generated computer files rather than remedial classes. Similar to Donovan's results, the drink driving offenders and high-risk drivers reported higher sensation seeking levels than the control group but drink drivers had higher levels than the high-risk drivers. A discriminant function analysis indicated that sensation seeking contributed significantly to the function discriminating between groups. However, overall the discriminant function had a low rate of correct classification rendering the interpretation doubtful.

An Austrian study examined venturesomeness, a measure similar to sensation seeking, among a population of young drivers known to be high-risk in comparison to controls (Renner & Anderle, 2000). Venturesomeness is a dimension of the Eysenck-personality scale for adults designed to measure adventure or thrill seeking (Eysenck & Eysenck, 1978). The young drivers were young traffic offenders assigned to a psychological training course after committing certain traffic offences within the first two years of driving. This is one of the few studies to specifically investigate young traffic offenders. In comparison to controls, young traffic offenders scored higher on

extraversion and venturesomeness, but not for impulsiveness. Overall, the authors concluded that the young offender's personality functioning was normal rather than seriously deviant. Crash involvement was not examined.

It has been suggested that one of the reasons for the mixed findings for sensation seeking and crash involvement is that the total aggregate scores on sensation seeking may mask associations that are otherwise revealed when only subscales are used (Loo, 1979). Jonah's (1997) review of the sensation seeking literature concluded that the TAS subscale was the most strongly associated with risky driving followed by Dis, ES and BS subscales. After reviewing a variety of empirical studies, Deditius-Island (2002) argued that the BS subscale had unsatisfactory reliability. Of interest, more recent studies found the Disinhibition subscale to be more closely related to risky driving than other subscales (Greene *et al.*, 2000; Rimmö & Aberg, 1999; Trimpop & Kirkcaldy, 1997). Greene et al. (2000) noted that the observed different relations between the four subscales and risky driving suggest the practice of using a "total" sensation seeking score is somewhat questionable.

In summary, there appears to be an association between sensation seeking and traffic offences, and other measures of risky driving behaviour across a number of different countries for young and adult drivers. The relationship between sensation seeking and crashes is not as strong. However, some of the studies that failed to find a significant relationship between sensation seeking and crash involvement had small sample sizes. It appears that when the scope of crashes is expanded to include involvement in a crash as a passenger and near misses, a significant association with sensation seeking is more likely. The broader definition most likely increases the number of reported crash events and allows analyses that are more powerful. This is particularly relevant for studies examining young drivers who may have little driving experience or exposure. Nevertheless, the association between sensation seeking and crash involvement appeared to be substantial among young drivers.

Finally, there is some evidence that drivers already defined as high-risk (i.e., drink drivers, multiple crash involved drivers) tend to record higher sensation seeking scores than other drivers. Thus, sensation seeking appears to be a useful construct for identifying young drivers at a higher risk of crashing.

4.2.2 Driving Aggression and Hostility

4.2.2.1 Driving aggression (incorporating competitive speed)

Aggressive driving behaviour is a complex phenomenon resulting from interaction with the environment, and psychological factors such as hostility and anger. Some researchers propose that any definition of aggressive driving should include intention to cause physical or psychological harm to others (Dula & Geller, 2003; Ellison *et al.*, 2001). However, others argue that it is difficult to objectively ascertain intent to harm others via driving aggression (Buss, 1961). Furthermore, intentional behaviours aiming to hurt others on the road are extreme and might be more appropriately treated as criminal acts (Tasca, 2000). Several researchers have concluded that the most useful definition of driving aggression is: a deliberate driving behaviour that may not intend to harm or frighten others but which shows disregard for their safety and rights (Tasca, 2000; Ulleberg, 2004). This definition of driving aggression is adopted in the present study. Using this definition, aggressive driving behaviours include behaviours considered “reckless” or “risky”, such as tailgating, speeding, dangerous overtaking, and failure to give way or stop for other drivers. Other explicit aggressive behaviours that do not intend to harm others but may irritate, anger, or annoy include flashing headlights, horn honking, and swearing or gesturing at other drivers.

Since the 1950s, a number of studies have investigated the relationship between the different aspects of aggressive driving behaviour and crash involvement. Beirness (1993) noted that in a number of the earlier studies that driving aggression

was not measured directly but inferred from other aspects of behaviour, or implicated as a means of explaining crash involvement. For example, a study by Pelz and Schuman (1968) found that young drivers with several crashes and traffic offences reported more physical aggression (e.g., involvement in fist fights) than young drivers with no crashes or traffic offences. It was suggested that such aggressive tendencies might also be evident in the driving context.

In one of the more thorough early studies, Goldstein and Mosel (1958) administered a questionnaire to examine 14 aspects of driver's attitudes that might be associated with crash involvement. They reported that an attitude of competitiveness or aggression, which they called competitive speed, was related to traffic offences and crashes for which the driver was culpable. This relationship was observed only among males although the small number of cases may explain the non-significant result for females. Although more of a descriptive study, Parry (1968) found a higher prevalence of crashes in drivers who reported driving aggressively. The measure of "spontaneous" driver aggression used by Parry was comprehensive in that the items measuring aggressive behaviour ranged on a continuum from "swearing under one's breath at other drivers" to "giving chase to an annoying driver".

MacMillan's (1975) research was one of the first well-controlled studies to show that driving in an aggressive and competitive way increased the risk of crashing. More recently, a number of studies have demonstrated that self-reported aggressive driving is significantly correlated with crashes and traffic offences. Chliaoutakis and colleagues (2002) found "irritability while driving", (i.e., driving when angry or stressed, indecent gestures, swearing at other drivers, etc.) was associated with self-reported crashes among young Greek drivers. However, the items measuring irritability did not distinguish between a state of irritability and the corresponding stable personality construct. Interestingly, "driving violations", behaviours such as

dangerous overtaking, tailgating, and right of way violations, were not associated with crash involvement.

Wells Parker et al. (2002) also reported a significant relationship between aggressive driving and crash involvement in a representative sample of US drivers. However, in contrast to Chliaoutakis et al. (2002), milder forms of driving aggression, such as verbal expressions of frustrations or annoyance, were not related to crash involvement. More extreme forms of aggressive driving involving provocation and threatening driving were related to crash involvement and this association was present when controlling for age, sex, driving frequency, annual miles driven, and verbal/frustration expression. Nevertheless, the relationship between aggressive driving and crashes was only significant for involvement in serious crashes, not for all crashes. Moreover, respondents did not specify whether they were a driver or passenger in the crash.

Dula and Ballard (2003) created the Dula Dangerous Driving Index (DDDI) that included the subscales of aggressive driving, negative emotional driving, and risky driving. Among college students, high scores on the DDDI were positively correlated to traffic offences (r = 0.33) and culpable crash involvement (r = 0.24). Some sex differences were found; males reported more aggressive and risky driving than females.

Miles and Johnson (2003) reported an association between high-risk young drivers and higher levels of aggressive driving. Multiple traffic offenders (excluding alcohol related offences) reported more careless aggressive driving behaviours and aggressive attitudes towards driving than did university students. Offenders also reported higher levels of the Type-A behaviour pattern; that is, a sense of competitiveness, impatience, and underlying hostility. However, considerable demographic differences (i.e., sex and age) between the groups were not taken into account in the analyses and there was no measure of driving exposure.

In summary, there appears to be reasonable evidence suggesting a relationship between aggressive driving and driving in a competitive way and crash risk for drivers of all ages and young drivers. The reliability of the association between aggressive driving and crash risk is supported by the fact that these studies employed different measures of aggressive driving.

4.2.2.2 Factors associated with driving aggression

Research has identified a number of factors associated with increased aggressive driving behaviour including demographic characteristics, situational conditions and personality factors or motivations. These factors may contribute directly to driving aggression, or lead to feelings of frustration, anger or hostile appraisals of other drivers. Such factors are discussed briefly, acknowledging the complex nature of interactions between factors.

Age and gender have consistently predicted differences in the prevalence of aggressive driving behaviour. A number of studies maintain that age is negatively related to driver aggression, that is, younger drivers are more aggressive drivers (Krahe & Fenske, 2002; Lajunen & Parker, 2001; Parry, 1968; Wilson, 1992). A plausible explanation is that young drivers may make a greater effort to protect their personal space, and their vehicle may be their most valuable possession, or personal space (Hauber, 1980). Thus, they feel the need to be defensively aggressive and punish perceived violators. Alternatively, as drivers gain experience, they are more frequently exposed to conflicts and frustrations that might heighten their threshold of anger or frustration and teach them how to cope with such emotions (Geen, 1990; Lajunen & Parker, 2001). Interestingly, Lajunen and Parker (2001) found annual mileage was negatively related to aggression for females, but not males. Conversely, Catchpole (2005) noted that young drivers aged 17 to 21 years were more likely to report aggressive driving with increased total hours of driving experience.

Many studies show males report more overt physical aggression (Baron & Richardson, 1994; Berkowitz, 1993), competitiveness (Goldstein & Mosel, 1958; MacMillan, 1975), and aggressive driving (Catchpole & Styles, 2005; Lawton *et al.*, 1997a; Parry, 1968) than females despite no gender difference in reported irritation or anger experienced when driving (Buss & Perry, 1992; Dula & Ballard, 2003). Taken together, these findings suggest that frustrations experienced in the driving context are more likely to result in aggressive driving among males. In support of this position, Shinar (1999) demonstrated that younger drivers and males responded most aggressively to traffic related frustrations.

Studies suggest that the propensity to engage in aggressive driving is likely to increase in certain driving situations. There is some evidence that frustration caused by delays and traffic congestion promotes aggressive driving related behaviour (Hennessy & Wiesenthal, 1999; Shinar, 1998), particularly when it is unexpected (Lajunen *et al.*, 1998). This view reflects the frustration-aggression hypothesis, first proposed by Dollard and colleagues (1939). Frustration, the interference with goal directed behaviour, provides a motivation to harm another person or object perceived to be the primary cause of the frustration. Other research suggests that situations providing driver anonymity facilitate overt aggressive driving behaviour (Lowenstein, 1997); this has been demonstrated by both field and driver simulator studies (Ellison et al., 2001; Ellison *et al.*, 1995).

Characterisation of driving aggression as caused purely by frustration ignores the possibility that it may function as an outlet for thrill or sensation seeking. There is some evidence that drivers with high levels of aggression also have high levels of sensation seeking (Arnett et al., 1997; Jonah et al., 2001). For example, Arnett et al. (1997) found that the traits of aggressiveness and sensation seeking both predicted reckless driving behaviour and were significantly correlated with each other. Jonah et al. (2001) reported that US college students with high sensation seeking levels

reported higher levels of aggressive driving behaviour while driving than did low sensation seekers. Within the psychiatric literature, several studies have suggested a link between impulse control disorders and aggressive driving behaviour (Jerome, 2004; Malta *et al.*, 2005; Richards *et al.*, 2002). For example, individuals with Attention-Deficit/Hyperactivity Disorder reported frequent frustration, impulsive and aggressive behaviour when driving (Jerome, 2004).

There is some evidence that an angry mood promotes aggressive driving. For example, Arnett (1997) found that young drivers reported that they drove faster when in an angry mood. However, frustration and anger do not always lead to aggression and aggression does not always stem from frustration and anger. Providing an example of the former, Lajunen and Parker (2001) investigated the relationship between driving anger and two overt forms of driving aggression (i.e., verbal and physical aggression). Verbal aggression influenced driving aggression via driving anger. Physical aggression also increased the likelihood of aggressive driving behaviour but the lack of association between physical aggression and driver anger was interpreted as suggesting that anger does not always precede aggressive driving behaviour.

4.2.2.3 Hostility

Within the driving environment, aggression may arise as a consequence of hostility, that is, the tendency to give a negative appraisal of other individuals who are perceived to be potentially harmful, threatening, or oppositional (Gulian *et al.*, 1989; Hennessy & Wiesenthal, 2004; Malta, 2004; Matthews *et al.*, 1991). For example, Donovan, Marlatt and Salzberg (1983) reported that driving related aggression and competitive speeding increased as a function of increased levels of general hostility.

It is possible that the individual isolation of drivers precludes personal explanations for negative driving behaviours (Ohbuchi & Kambara, 1985). A driver who does not see an environmental explanation for such actions may interpret them as

intentional, personally directed aggression. Matthews and Norris (2002) examined this phenomenon, known as “hostile attribution bias”. They found that drivers with high trait aggression were more likely to perceive the actions of other drivers as hostile when the intent of other drivers was unclear. Yagil (2001) found that hostile attributions by males were directed more toward male than female drivers and were related to a negative image of other drivers. It was also noted that highly irritable and competitive drivers were more likely to react aggressively to driving related frustrations than other drivers. Path analysis showed that irritability and competitiveness mediated the relationship between hostility, anxiety and driver’s image, and aggressive reactions.

Matthews, Emo and Funke (2005) built on previous research and argued, “risky behaviours related to aggression may result from a confrontive coping strategy adopted in response to the perceptions of other traffic as threatening or frustrating” (p. 279). In support of Matthews et al’s (2005) hypothesis, a study examining the overtaking behaviour of drivers showed that confrontive coping was positively correlated with two behavioural indices of risk-taking: frequency of overtaking and shorter following distances (Emo *et al.*, 2004). Furthermore, findings from the study showed that anger was unrelated to the indices of risk suggesting that drivers do not need to be in an angry mood to adopt confrontive coping.

4.2.2.4 Hostility, risky driving, and crash involvement

Hostility might be expressed overtly or covertly through a variety of cognitive, verbal, and behavioural means (Bendig, 1962; Buss & Durkee, 1957; Buss & Perry, 1992). Thus, a measure of global hostility does not address the various forms and intensities in which hostility is expressed. Buss and Durkee (1957) recognised the need for identification of the more specific ways in which individuals expressed hostility. In response, they developed the Buss-Durkee Hostility Scale (1957), a

standardised psychometric instrument with seven subscales, to assess the various forms of hostility.

Several studies using the Buss-Durkee Hostility Scale have shown that different high-risk drivers have a predisposition for overt or physical hostility (i.e., assaultiveness, verbal hostility). For example, Donovan et al. (1985) used five subscales of the Buss-Durkee Hostility Scale and found that groups of drink drivers and multiple offenders reported higher levels of assaultiveness, verbal hostility and resentment than did drivers from the general population. The drink drivers and multiple offenders did not differ on any of the hostility measures. The multiple offenders reported higher levels of driving-related aggression and competitive speed than the drink drivers and controls. However, the age distribution of the three groups differed substantially, and it is probable that the younger age of the multiple offenders contributed to group differences.

Wilson (1992) attempted to replicate and extend Donovan's study by including females and controlling for age. In contrast to Donovan's findings, drink driving offenders differed from controls for assaultiveness but not for verbal hostility, driving-related aggression or competitive speed. In addition, younger drivers scored highest on all of the measures. These findings suggest that the high levels of hostility of high-risk drivers (i.e., drink drivers and multiple offenders) found in Donovan et al's (1985) study may have been partially attributable to age.

Wilson and Jonah (1988) combined the two Buss-Durkee subscales measuring overt expression of hostility to form a composite "aggression" score. Measures of driving-related aggression and competitive speed were also included. All three measures were modestly correlated with a risk index incorporating culpable crashes, traffic offences and licence suspensions within the previous three years (r = .17, r = .18, r = .23, respectively).

In summary, there is a wide variety of driving behaviours considered aggressive and these behaviours vary in severity. Nevertheless, there is substantial evidence that aggressive driving behaviour or driving in a competitive way is related to crash involvement for drivers of all ages. Moreover, the differential influence of situational factors (i.e., unexpected traffic congestion), states (i.e., an angry mood), and trait motivations (i.e., hostility, sensation seeking) on driving aggression was evident in the literature. With respect to hostility, a number of studies indicated that the overt expression of hostility was related to risky driving and elevated crash risk. More specifically, overt expression of hostility characterised groups of drivers at a higher risk of crashing such as drink drivers and multiple offenders.

Of greatest interest, young drivers were found to be associated with higher levels of hostility and driving aggression than other drivers. Furthermore, evidence of a relationship between these constructs and young driver crash risk suggests that aggression and hostility would be useful in identifying high-risk young drivers.

4.2.3 Emotional Adjustment

According to Personal Maladjustment Theory, as advocated by Selzer (1968), crash involved drivers are likely to be under personal stress and experiencing difficult life events. Emotions, often associated with personal problems, are thought to have a negative effect on a driver's attention level and to distract them from the driving task (Beirness *et al.*, 1992). Indeed, Beirness (1993) described emotionally unstable drivers as "social deviants who are emotionally labile, irritable, oversensitive to criticism, and may also be experiencing personal problems" (p. 134).

Early studies suggested drivers at a higher risk of crashing were emotionally unstable or maladjusted (e.g., Mayer & Treat, 1977; Tillman & Hobbs, 1949). Mayer and Treat (1977) conducted two pilot studies investigating social and psychological predictors of high-risk drivers. The first study reported that young drivers aged 18 or 19 years and identified as high-risk (i.e., involved in three or more crashes in three

years) had higher scores on personal maladjustment or stress (i.e., stressful life changes, general psychopathology, anxiety) and on social maladjustment than did young drivers not involved in a crash but matched for sex, age and driving exposure. The second study examined crash involved drivers of all ages and found that drivers deemed culpable for a crash had significantly higher levels of personal and social maladjustment than did non-culpable drivers. The authors suggested that high levels of personal maladjustment were associated with a higher risk of crash involvement because drivers were more likely to miss or misinterpret relevant information, due to an overloading of their information processing system with irrelevant information. They also suggested that these drivers may be depressed and less likely to protect themselves from danger. However, it must be acknowledged that these studies were based on small extreme samples, and, as a result the generality of these results is somewhat limited.

More recently, Smart and colleagues (2005) conducted a large longitudinal study of young Australian drivers to determine the correlates of risky driving, speeding offences and crash involvement. For early adulthood (19-20 years), they found that low and high risky driving groups had higher levels of anxiety than the intermediate group. Another interesting finding was that drivers with multiple speeding offences were more emotionally well adjusted (i.e., low anxiety and depression) than were those without speeding offences. Crash involvement was not predicted by anxiety or depression. These findings are difficult to interpret but they appear to suggest that these measures of emotional adjustment differentially predict different driving behaviours.

By contrast, in another longitudinal study of a birth cohort, Begg and Langley (2004) investigated the relationship between personality factors assessed at age 18 years and persistent risky driving behaviours among young adults at age 26 years.

Negative emotionality, a measure resembling emotional adjustment, did not predict persistent risky driving.

Neuroticism is a personality construct that, in a broad sense, reflects emotional instability and the expression of negative emotions. Individuals scoring high on neuroticism are generally anxious, over emotional, and have maladaptive coping mechanisms (Beirness et al., 1992). Several studies have argued that neuroticism is related to high levels of negative affect such as depression and anxiety (Costa & McCrae, 1980; Meyer & Shack, 1989). Eysenck (1965) suggested that drivers scoring high on neuroticism would be more likely to be crash involved but few studies have found an association between neuroticism and crash involvement or risky driving. Shaw and Sichel (1971) found that bus drivers with bad safety records had higher neuroticism levels than drivers with fewer crashes. Matthews, Dorn and Glendon (1991) found drivers scoring high in neuroticism had high levels of general driver stress as measured by the Driving Behaviour Inventory (Gulian et al., 1989). However, they found no significant relationship between neuroticism and crash involvement or speeding offences. Other studies have also reported no difference in neuroticism levels of high-risk drivers with multiple traffic offences (Miles & Johnson, 2003) or crashes (Arthur & Graziano, 1996) when they are compared to groups with no prior records. Note that the issue of causality was not explored in these studies. While neurotic drivers might have greater crash involvement or more traffic offences, the greater crash involvement of these drivers may cause neuroticism.

In contrast to the findings mentioned above, Furnham and Saipe (1993) reported that drivers with previous traffic offences had lower neuroticism scores than drivers with no offences. In addition, Lajunen (2001) investigated the relations between EPQ personality factors and traffic fatality rates per 100,000 vehicles in 34 countries and reported that neuroticism was negatively correlated with fatality rates. Interestingly, countries with low and high average scores for neuroticism had higher

traffic fatality rates than those with medium scores. These results were interpreted to suggest that an intermediate level of sensitivity or concern for road safety was necessary. Lajunen (2001) offers an interesting and plausible explanation for these non-intuitive findings: higher levels of instability and anxiety may adversely effect driving while low levels of neuroticism, expressed as overconfidence or lack of concern may actually encourage risk taking. This notion deserves further investigation.

Mood states may interact with personality traits to adversely affect driving behaviour. An increasing number of studies are exploring these associations. For example, the findings from a study examining the tendency to react aggressively to the frustrating behaviour of another driver indicated that a *state* of anxiety increased irritability and, consequently, aggression (Yagil, 2001). Garrity and Demick (2001) found that the bipolar states of depression-dejection, anger-hostility, and tension-anxiety (considered as aspects of emotional instability) were negatively associated with cautiousness while driving. Of interest, the mood state of tension-reduction was strongly related to neuroticism but not to the other traits. The authors suggested that the relationship between neuroticism and negative driving behaviour identified by previous research might be attributed to the state of tension-anxiety. If this were correct, neurotic drivers engage in risky driving behaviour when in a state of anxiousness or when feeling tense.

In summary, there is contradictory evidence of an association between emotional adjustment and crash involvement or risky driving. These mixed results may be partly attributable to the different measures of the concept of emotional adjustment or stability. Few studies have examined emotional adjustment in relation to young drivers and crash involvement. Neuroticism, a measure of emotional adjustment that has been studied in some detail, appears to be associated with increased crash risk at both low and high levels but not at intermediate levels. There is

some evidence that poor emotional adjustment (e.g., anxiety, tension) may interact with mood states or frustrations arising from the driving situation. This concept is explored further in the next section.

4.2.4 Tension Reduction

Drivers with poor emotional adjustment, or with feelings of hostility or stress have been found to express their emotions or frustration by driving to "blow off steam" or to reduce tension (Beirness, 1993; Harano *et al.*, 1975; Mayer & Treat, 1977; Schuman *et al.*, 1967). For example, Schuman and colleagues (1967) reported that driving for emotional relief after experiencing personal problems was common among young males.

Social learning theory suggests that if an individual has not learnt sufficient means of coping with tension, driving may be used as a way of venting these feelings (Grey et al., 1989). Driving to reduce tension can be particularly problematic if the individual drives less cautiously when upset (i.e., low levels of driving inhibition). The use of driving to release tension has been associated with crash involvement. Mayer and Treat (1977) found high levels of an attitude towards using driving to reduce tension, or "blow off steam", among young crash involved drivers in comparison to young drivers with no crashes. However, this attitude was not as important in discriminating between the two groups as were other variables. Donovan et al. (1985) also reported higher levels of the same "tension reduction" attitude among male drink driving offenders and male high-risk drivers (i.e., multiple crashes or offences). Wilson (1992) used the same tension reduction measure as Donovan et al. (1985) among drivers of both genders. Interestingly, Wilson (1992) found no difference between drink driving offenders, high-risk drivers, and controls. This finding suggests that the use of driving for tension reduction is a characteristic specific to male drivers with an elevated risk of crashing.

In one of the most comprehensive studies to date, Harano et al (1975) used a personality assessment, among other tests, to examine differences between two extremes, multiple crash (i.e., three or more crashes) and non-crash involved drivers. “Emotional driving”, a personality measure referring to the use of a vehicle for emotional expression such as “blowing off steam”, was found to be important in predicting crash involvement. “Ascendency”, a second personality measure reflecting an assertive, independent personality type was indirectly related to crash involvement through correlations with other factors that were related to crash involvement.

Thus, there appears to be some evidence of a relationship between the use of driving to release tension and frustrations and crash involvement, specifically among males. This suggests that tension reduction might be useful for identifying young drivers at a higher risk of crashing. However, there are few recent studies on this relationship.

4.2.5 Depression

Depression is associated with emotional instability and has been identified as a characteristic of high-risk drivers, particularly drink drivers. For example, Selzer and colleagues (1967) conducted clinical interviews among alcoholic men and found that four indices of clinical depression were associated with crash involvement. McMillen (1992a) observed that drivers convicted of multiple drink driving offences had higher levels of depression and lower levels of emotional adjustment than first time offenders. High alcohol consumption may be a response to emotional problems and underlying depression but it is also known to increase the risk of crash involvement (Borkenstein *et al.*, 1964). Thus, the correlation between these factors makes it difficult to disentangle the separate effects of each on risky driving and crash involvement (Beirness et al., 1992).

Symptoms of depression have been reported among traffic offenders. Williams (1974) found that drivers convicted of serious traffic offences were more likely to

have minor psychiatric symptoms such as anxiety and depression than drivers matched on age, sex, suburb and type of driver's licence. Interestingly, a significant number of offenders reported a major emotional disturbance in their lives shortly before their detection for the traffic offence. However, offenders may have reported the event to explain their offending behaviour and no attempt was made to verify if the event actually occurred.

Sumer (2003) found "psychological symptoms", as indicated by the Brief Symptom Inventory (Derogotis, 1993) subscales depression, anxiety, hostility, and psychoticism, had a direct association with aberrant driving behaviour as measured by the Driver Behaviour Questionnaire. Other personality factors were also examined (i.e., sensation seeking, aggression) but it was only psychological symptoms that predicted the number of self-reported crashes. This relationship was indirect, mediated by aberrant driving behaviour.

Other studies of depression and risky driving have viewed depression as normative rather than pathological. Wilson and Jonah (1988) found only a weak relationship between depression, measured by a subscale of the Basic Personality Inventory, (Jackson, 1984) and risky driving (r = .10). A subsequent study found no difference in depression between high-risk groups, multiple crash/offenders and convicted drink drivers, and controls (Wilson, 1992).

Contrary to Wilson's findings, Donovan et al. (1985) found that two high-risk groups of male drivers (i.e., multiple crash/offenders and convicted drink drivers) reported higher levels of depression than drivers from the general driving population. Depression was measured using a scale developed by Costello and Comrey (1967) that represented more of a depressive mood than a clinical state. Another study by Donovan et al. (1986) found that a group of drivers characterised by depression reduced their level of risk with improvements in their affective state. Donovan et al. (1986) interpreted the findings from the two studies as suggesting that depression as a

transient state, rather than a stable trait, is related to risky driving and crash involvement. Furthermore, temporary states of depression may be a consequence of stressful life events, as suggested by Williams et al's (1974) study.

In summary, studies suggest a relationship between depression and risky driving behaviour; depression may be indirectly associated with crash involvement. When attempting to identify high-risk drivers, depression should be considered as more of a temporary state than as a trait, and it is likely to be related to stressful life events. Similar to emotional adjustment, few studies have examined the relationship between depression and young driver crash involvement.

4.2.6 Locus of Control

Locus of control or internality-externality refers to the extent to which individuals view events as attributable to their own behaviour (internal locus of control), or uncontrollable factors (external locus of control) (Rotter, 1966). An external locus of control is related to a lack of caution in avoiding unfavourable outcomes (Hoyt, 1973; Phares, 1976). In the driving context, it is plausible that one would assume that drivers at a higher risk of crashing would attribute the causes of crashes to external factors beyond their control. However, results from studies investigating the relationship between locus of control and crash involvement or risky driving behaviours have been mixed. Mayer and Treat (1977) reported that high-risk young drivers, that is, drivers involved in three or more crashes in three years, had significantly lower external locus of control scores than non-crash involved young drivers. Guastello and Guastello (1986) found no direct relationship between locus of control and crash involvement. A meta-analysis conducted by Arthur, Barrett and Alexander (1991) reported a mean overall correlation of $r = .20$ between locus of control and crash involvement. An external locus of control was associated with higher levels of crash involvement.

One of the so-called “big five” personality traits, conscientiousness, may be considered to be similar to internal locus of control. Arthur and Graziano (1996) found that less conscientious individuals were more likely to self-report crash involvement.

While limited associations were found between general locus of control measures and crash involvement, it was thought that a locus of control measure specifically tailored to the target behaviour, driving, would be more useful. An early study by Goldstein (1958) reported that drivers who attributed crashes to personal responsibility (internal) had significantly more crashes for which the driver was deemed responsible, than drivers who attributed crashes to chance factors (external). The authors suggested that formal recognition of responsibility for the crash might have promoted attitudes of personal responsibility.

Montag and Comrey (1987) developed two separate scales for measuring driving internality and driving externality. In contrast to Goldstein (1958), they found that driving internality was associated with cautious driving while driving externality was related to involvement in fatal crashes among male drivers. They also reported that a general measure of locus of control explained only 12 per cent of the variance in the number of crashes, compared to 38 per cent when using their driving-related locus of control measure. Arthur and Doverspike (1992) utilised the same scales among a university student population consisting of both genders. However, they found the opposite pattern of correlations; driving internality was associated with elevated not-at-fault crash rates. Lajunen and Summala (1995) also sampled a university student population but reported correlations between driving internality and alertness, and driving externality and self-reported aggressive driving behaviour. Iversen and Rundmo (2002) found that neither driving internality nor driving externality were associated with risky driving or crash involvement among Norwegian drivers.

Ozkan and Lajunen (2005) expanded on the one-dimensional internal-external scale by developing a multidimensional instrument to measure driving-related locus of control (T-LOC). Causes of crashes could be attributed to: self, other drivers, vehicle and environment, and to fate. Based on a university student sample, fate (i.e., external orientation) was not related to any of the dependent variables, but self (internal orientation) predicted every variable including self-reported number of crashes, active crashes, traffic offences, aggressive violations, ordinary violations, and driving errors. Several researchers have speculated that driving related internal locus of control may increase the risk of crashing because drivers are overconfident and overestimate their ability to control the situation (Beirness, 1993; Ozkan & Lajunen, 2005). This view is particularly relevant to young drivers who tend to overestimate their driving skills (see Section 1.3.2).

Some studies have examined the interaction between locus of control and other personality and situational characteristics in relation to driving behaviour. Gidron, Gal and Desevilya (2003) showed that internal locus of control moderated the negative effects of hostility on dangerous driving behaviour, suggesting that a feeling of responsibility overcame hostile attitudes and behaviours. However, this finding was observed largely among drivers with a low internal locus of control but not in drivers with a high internal locus of control. Driving internality by itself was not related to dangerous driving behaviour.

These equivocal research findings for locus of control orientation may be due to methodological causes. In many studies, self-reported crashes were recorded retrospectively. Thus, it was possible that involvement in a crash, particularly a serious or fatal crash, influenced drivers to attribute crashes to external causes. For example, half of Montag and Comrey's (1987) sample were known, from official records, to have been involved in a fatal crash. Kouabenan (2002) investigated this possibility by comparing drivers who had never been involved in a crash to those who

had. No relationship was found between the number of prior crashes and fatalistic beliefs (i.e., externally orientated). Of interest, drivers with little driving experience (0-2 years) and very experienced drivers (16-20 years) held the most fatalistic beliefs. It is likely that the fatalistic beliefs or lack of personal control felt by the less experienced drivers are related to their lack of crash avoidance knowledge and skills.

In summary, research on the relationship between locus of control and crash involvement or risky driving behaviours is not clear. Drivers with an external locus of control may be at a higher risk of crashing due to their lack of caution and lack of crash avoidance skills. Alternatively, drivers with an internal locus of control may be at a higher risk because they overestimate their own driving ability. Mixed findings were also evident for locus of control measures specific to the driving context.

4.2.7 Summary of Findings

The literature reviewed in this chapter indicates that certain personality factors and attitudes are found in drivers with an elevated risk of crashing: sensation seeking, driving aggression, hostility expressed overtly, a temporary state of depression, and the use of driving to release tension or frustration. However, findings were somewhat mixed for emotional adjustment and locus of control. Nevertheless, this review suggests that the majority of the characteristics examined would be valuable in identifying and developing a profile of young drivers at a higher risk of crashing. In fact, some of these characteristics were identified among groups of drivers known to be at a higher risk of crashing such as drink drivers and multiple traffic offenders. However, few studies attempted to identify these characteristics among groups of young drivers known to be at a higher risk of crashing.

Much of the evidence supporting associations of these characteristics with crash risk was based primarily on studies examining the separate and distinct contributions of each personality variable (e.g., Furnham & Saipe, 1993; Iversen & Rundmo, 2002; Smith & Heckert, 1998; Trimpop & Kirkcaldy, 1997). Clearly, many

of these characteristics co-occur in individuals and interact with each other. The identification of driver subtypes, based on *combinations* of personality characteristics and attitudes associated with increased crash risk, is discussed in the next section.

4.3 Driver Subtypes

To identify high-risk drivers, a simple profile can be established by selecting the common characteristics of drivers who engage in high-risk behaviours (i.e., young, single males). However, a single profile conceals the diversity of this population. For example, research has shown that a substantial proportion of drivers who engage in high-risk behaviour (drink driving, multiple crashes/offences) cannot be distinguished from the general driving population (Donovan & Marlatt, 1982; Donovan *et al.*, 1988). Furthermore, relationships between personality and attitudes and risky driving behaviour discussed in this chapter are derived primarily from univariate studies that examine each variable separately. However, many of these characteristics co-occur in individuals and interact with other traits.

More recently, multivariate techniques, such as cluster analysis, have provided a means of identifying subgroups of drivers based on common characteristics that put them at risk of crashing. The identification of subtypes of high-risk drivers acknowledges heterogeneity within the population and categorises drivers into more homogenous subgroups. It is useful to identify subtypes, particularly high-risk subtypes, for the development and specific targeting of countermeasures and interventions. Studies using personality characteristics and attitudes to identify subtypes of drivers, including subtypes of young drivers, with cluster analysis are summarised in Table 4.1 and discussed in the sections that follow.

4.3.1 Identifying High-Risk Driver Subtypes

Several studies have used cluster analysis to identify subgroups of drivers on the basis of a variety of personality and attitudinal measures associated with higher

crash risk. These studies were based on samples of mainly male adult drivers already considered to be at a higher risk of crashing, such as convicted drink driving offenders (Arstein-Kerslake & Peck, 1985; Donovan & Marlatt, 1982; Steer *et al.*, 1979; Wells Parker *et al.*, 1986) and drivers detected for multiple traffic offences or involved in multiple crashes (Donovan et al., 1988; Wilson, 1991). For example, Donovan and Marlatt (1982) were able empirically to derive clinically and theoretically meaningful subtypes among male convicted drink driving offenders. They identified five clusters or subtypes of which three were considered more deviant than the others. One subtype was characterised as risk enhancing with the highest levels of driving related aggression, competitive speed, sensation seeking, assaultiveness, and hostility. This subtype consisted of the youngest individuals who reported significantly more crashes per year than any other subtype. A second subtype had similar attributes to the previous subtype but to a lesser extent. Most notably, this subtype used driving to reduce tension and had an internal locus of control. The final subtype differed on an affective level; this subtype was the most emotionally unstable with the highest levels of resentment and depression. Of interest, two subtypes (representing 45% of the sample) were described as relatively well adjusted with few characteristics differentiating them from the average driver. This finding suggests that not all drink driving offenders possess deviant characteristics.

Table 4.1
Summary of studies identifying driver subtypes using cluster analysis based on personality variables

Study	Participants	Method to determine no. of clusters	No. of clusters	Brief description of clusters
Donovan & Marlatt (1982)	161 male DWIs (from alcohol program)	Clustan, fusion cofficients	5	Cluster 1 – Use driving for tension reduction Cluster 2 - Well-adjusted Cluster 3 – Low emotional adjustment Cluster 4 - Aggressive, hostile, sensation seeking Cluster 5 - Well-adjusted
Donovan, Umlauf & Salzburg (1988)	193 male HRDs (4 offences/ crashes in 1 year or 5 offences/crashes in 2 years)	Clustan, fusion coefficients	3	Cluster 1 - Well-adjusted Cluster 2 - Impulsive, over-acting Cluster 3 - Emotionally distressed, risk-enhancing driver attitudes
Wilson (1991)	238 convicted DWIs, 285 HRDs (accident 3+ and demerits 9+ combined)	SAS, CCC	4	Cluster 1 – Hostile/ responsible Cluster 2 - Deviant Cluster 3 - Well-adjusted Cluster 4 – Irresponsible
Beirness (1993), (1995)	2,400 high school students (3 year study, first year aged 13-16 years)	Unknown	3	Cluster 1 – Thrill seeking Cluster 2 – Conventional Cluster 3 – Inadequate
Deery, Kowaldo, Westphal-Wedding & Fildes (1998)	198 novice drivers (16-19 years)	SAS, CCC	5	Cluster 1 – High risk/ deviant Cluster 2 – Low emotional adjustment Cluster 3 - Moderate Cluster 4 - Least deviant, well-adjusted Cluster 5 - High-risk/ deviant
Ulleberg (2001)	2,524 high school students (18-23 years)	Clustan Graphics 5, fusion coefficients	6	Cluster 1 - Low risk Cluster 2 - High risk Cluster 3 - Low risk Cluster 4 - Medium risk Cluster 5 - High risk but less deliberate Cluster 6 - Low risk

Note: HRD = High Risk Driver (multiple traffic offences) DWI = Driving While Intoxicated offenders

Subtypes have also been identified from within multiple traffic offender and multiple crash involved populations (Donovan et al., 1988; Wilson, 1991). These subtypes had similar attributes to the drink driving offender subtypes. Donovan et al. (1988) found three subtypes in a population of male multiple traffic offenders. Two subtypes were considered to be at higher risk in traffic. The first of these subtypes, labelled a “thrill seeking” subtype, was characterised by high levels of impulsiveness, sensation seeking, assaultiveness and verbal hostility, and they used speed to drive competitively, or aggressively. This subtype was the least likely to drive cautiously when upset (low driving inhibition). The second subtype was considered as an emotional group with risk enhancing attitudes. Individuals in this subtype were characterised by the highest levels of driving aggression, hostility (assaultiveness, verbal and indirect hostility), depression, and low emotional adjustment. They had an external locus of control and were most likely to use driving to reduce tension. The final subtype was the largest group and was characterised as well adjusted with low levels of potentially risk-enhancing personality dimensions. When the subtypes were validated against external variables, the two high-risk groups reported greater alcohol consumption. While controlling for the number of years licensed, drivers in the emotional subtype were found to have significantly more traffic offences during the previous three years than the well-adjusted subtype. There were no significant differences between subtypes for crashes. Thus, driver record suggests that the emotional subtype was a higher risk group than the thrill seeking subtype.

Wilson (1991) found four subtypes within a combined convicted drink driver and multiple crash/offence driver sample. The largest subtype consisted of a well-adjusted group. Wilson (1991) considered the second subtype as hostile but responsible; these individuals reported elevated levels of hostility but low levels of thrill seeking and placed a high value on responsibility. This subtype also exhibited some degree of poor personal adjustment. The two remaining subtypes were

considered high-risk and were similar to the drink driving offender subtypes found by Donovan and Marlatt (1982) and the high-risk subtypes reported by Donovan (1988). One subtype was labelled “deviant” and resembled the previously described emotional subtype. Individuals in this subtype were characterised by the highest levels of sensation seeking, impulsiveness, hostility, driving aggression, irresponsibility, personal problems, and depression. The other subtype also demonstrated high levels of sensation seeking, hostility, irresponsibility and used speed to drive competitively but reported few personal problems. Similar to Donovan et al’s (1988) results, the two higher risk groups accumulated more recorded traffic offences over a five-year period than the other subtypes but, as described above, there was no difference for crashes.

Despite differences in the sample sizes and variables, the findings from these studies suggest similar, although not identical combinations of personality traits among high-risk drivers. High-risk driver subtypes were typically characterised by driving-related aggression, hostility, sensation seeking, and competitive speed. In addition to these attributes, high-risk subtypes also had high levels of emotional instability and depression, and used driving to reduce tension. However, most of these studies were based on samples of mainly adult male drivers who were already considered at a higher risk of crash involvement.

4.3.2 Identifying High-Risk Young Driver Subtypes

Driver subtypes have been identified and validated among drink drivers and drivers with multiple traffic offences/crashes. Moreover, high-risk subtypes were characterised by some similar attributes. Macdonald (1994) noted that the concept of subtypes of “young problem drivers” had been proposed but there was limited evidence supporting the existence of such groups. Several studies have since attempted to identify subtypes of young drivers based on personality characteristics and attitudes.

Beirness and Simpson (1993, 1995) conducted one of the first studies using cluster analysis to classify young drivers into subtypes based on personality and attitudinal measures. The cluster analysis used data from a large longitudinal cohort study of Canadian high school students, many of whom did not have a driver's licence in the first year of the study (Beirness & Simpson, 1988). Three subtypes were derived labelled "thrill seeking", "inadequate" and "conventional". The thrill seeking subtype was characterised by high sensation seeking, high tolerance of deviance, and was influenced by their peers. This subtype had the greatest proportion of males. Low confidence, low sensation seeking, an inability to deal with anger and frustration, non-traditional values, and poor academic performance defined the inadequate subtype. The conventional subtype was the most well adjusted subtype with high confidence levels, traditional values, good academic performance at school, and was not highly influenced by peers. Interestingly, analysis of driver records two years following licensure revealed that the thrill seeking subtype reported much greater crash involvement (27%) than the other subtypes (14% and 9%, respectively). The thrill seeking subtype also reported more risky driving behaviours such as not wearing seat belts, drink driving, and traffic offences. These findings show a clear link between young driver subtypes based on personality factors and crash involvement.

Two studies that are more recent have also classified young drivers into subtypes based on personality characteristics in Australia (Deery et al., 1998) and Norway (Ulleberg, 2001) using cluster analysis. Deery et al. (1998) identified five subtypes among Australian novice drivers, two of which were categorised as high-risk. The two high-risk subtypes were characterised by high levels of driving-related aggression, competitive speed, driving to reduce tension, sensation seeking, assaultiveness, and hostility. Approximately 80 per cent of each of the high-risk groups was male. Consistent with "emotional" subtypes identified among male drink driving offenders (Donovan & Marlatt, 1982) and multiple crash/traffic offenders

(Donovan et al., 1988; Wilson, 1991), one of these subtypes also reported a low level of emotional adjustment and assertiveness, and a high level of depression, resentfulness and irritability. This group had the riskiest driving style and the worst crash and traffic offence record. The other high-risk subtype resembled the thrill seeking, hostile subtype found in previous studies (Donovan & Marlatt, 1982; Donovan et al., 1988; Wilson, 1991). Similar to the other high-risk subtype, this subtype also reported a risky driving style but relatively few crashes.

Of the three remaining subtypes, one subtype was the most inhibited while driving, reported an external locus of control and high levels of depression, irritability, hostility, and resentfulness. Of interest, this subtype had the second highest number of crashes. Another subtype scored moderately on all dimensions. The final subtype, labelled the "least deviant", or at lowest risk, was characterised by the lowest levels of driving related aggression, competitive speed and driving to reduce tension.

Several limitations of Deery et al's (1998) study deserve some discussion. Firstly, the sample size was moderate (*N*=198). Thus, when the clusters were derived, several clusters were comprised of only approximately 20 novice drivers. Secondly, some drivers had very limited, if any, driving experience because they were recruited from licensing centres when obtaining a learner's permit or provisional driver's licence. Twenty per cent of drivers obtained a learner's permit on the day when recruited into the study and, therefore, had no driving experience. Deery et al. (1998) estimated that the remaining 80 per cent of drivers receiving a provisional driver's licence had approximately 30 to 50 hours of supervised driving experience, based on the average for Victorian learner drivers. Novice drivers have low crash and traffic offence rates during the learner stage when driving is supervised (e.g., Mayhew *et al.*, 2003). Consequently, due to the limited and mostly supervised driving experience, few drivers reported crashes (5.7%) or traffic offences (Mean = 0.22, *SD*= 0.39).

Retrospective logit analyses were conducted with age and licence type as covariates to statistically control for differences in driving exposure. However, the effects of exposure would be more accurately determined by collecting exposure data at the time of the initial questionnaire.

A large study (*N*=2524) of young Norwegian drivers found six driver subtypes (Ulleberg, 2001). Two of these subtypes were characterised as high-risk and shared some commonalities with the high-risk subtypes identified by Deery and his colleagues (1998). The first high-risk group consisted of mostly males (81%) and was characterised by low levels of anxiety and altruism, and high levels of sensation seeking, irresponsibility and driving anger. Despite a relatively high degree of crash involvement, individuals of this subtype had high confidence in their skill as driver. They also reported the most risky driving style and risk taking attitudes and they perceived the risk of receiving an injury in a crash as relatively low. This high-risk subtype is similar to the thrill seeking high-risk young driver subtype identified by Deery et al. (1998). The second high-risk group had a similar profile, exhibiting high levels of sensation seeking, driving related aggression, and driving anger. They reported a high degree of crash involvement, demonstrated risky driving behaviour, and had negative attitudes towards road safety. In contrast, the drivers in this subtype reported a high level of anxiety, had low confidence in their skill as a driver and their perceived risk of crash involvement was high. This subtype resembles the emotional young driver high-risk subtype found by Deery et al. (1998). However, unlike Deery's emotional subtype, there were more females (59%) than males in this subtype (41%). Ulleberg (2001) believed this result was probably because driving anger was the only traffic-related measure used when classifying drivers into clusters; generally research has found no gender differences for driving anger among younger drivers (e.g., Lajunen et al., 1998). In addition, females are typically more anxious, less confident

in their driving skills and report a higher perceived risk of crashing than males (e.g., DeJoy, 1992).

This study also examined how the different subtypes responded to a traffic safety campaign. The campaign aimed to enhance positive road safety attitudes, generate greater awareness of the risk of crashing, and to generally promote safe driving among young drivers. Interestingly, the two high-risk subtypes that were most in need of attitude change were least responsive to the campaign. These results serve to highlight the need for non-traditional approaches to young driver safety and the fact that young drivers should not be treated as a homogenous group.

Together, these studies suggest similar combinations of personality characteristics are related to young drivers at a higher risk of crashing. However, these studies differed on the number of high-risk groups derived from the analysis. Possible reasons for these differences include sampling from different driving populations, the use of different personality measures, and different methods for determining the number of clusters. Cluster analysis has been criticised for its sensitivity to the choice of variables and different clustering methods, and its subjectivity when determining the number of clusters (Everitt *et al.*, 2001; Ulleberg, 2001). For example, Aldenderfer (1984) noted that different clustering methods could generate different solutions from the same data set.

To validate and understand the characteristics defining young driver subtypes, it is important to replicate previous studies using the same personality variables and similar but appropriate clustering methods to extend the generalisability of findings.

4.4 Summary

To summarise, individual factors such as personality characteristics and attitudes have an important impact on driver behaviour and the likelihood of crash involvement. Thus, personality factors and attitudes can make a valuable contribution towards identifying young drivers at a higher risk of crashing.

Although few studies have attempted to identify subtypes of young drivers, findings suggest that similar combinations of personality characteristics are related to risky driving and crash involvement among young drivers. The high-risk young driver subtypes derived from cluster analyses in these studies were characterised by high levels of sensation seeking, driving-related aggression, a risky driving style, negative attitudes toward road safety, and poor driving records. In addition, some high-risk clusters reported emotional maladjustment and depression. However, the method for determining the number of clusters in these studies differed and each study used different personality variables. These methodological issues are important because cluster analysis has been criticised for its sensitivity to the choice of variables and different clustering methods. From this review, it is evident that research replicating previous cluster analytical methodologies is needed to confirm the validity of high-risk young driver subtypes.

Before attempting to identify subtypes of young drivers, the next chapter will determine whether the individual personality characteristics and attitudes discussed in this chapter can be identified among a group of young drivers thought to be at a higher risk of crashing, young traffic offenders.

CHAPTER 5 PERSONALITY CHARACTERISTICS, MOTIVATIONS AND ATTITUDES OF YOUNG TRAFFIC OFFENDERS[2]

5.1 Introduction

To tailor interventions and public education to the motivations and needs of young drivers at a higher risk of crashing, we need to gain a better understanding of the characteristics that define these young drivers. It is likely that a variety of characteristics such as personality factors, motivations, and driving-related attitudes are found in young drivers with an elevated crash risk and that many of these characteristics co-occur and interact with each other. Consequently, studies have attempted to identify young drivers at a higher risk of crashing by identifying specific subtypes of drivers based on combinations of these characteristics (Beirness, 1993; Deery et al. 1998; Ulleberg, 2001). To validate and further understand the personality and attitudinal characteristics defining young drivers, one of these studies, the Australian study by Deery and colleagues (1998) is replicated in Chapter 6.

A review of the literature examining each of the personality and attitudinal characteristics used in Deery et al's (1998) study in relation to risky driving and crash involvement was presented in Chapter 4. That review found that each of the selected personality characteristics and attitudes were related (to varying extents) to risky driving and increased levels of crash risk. Furthermore, some of these personality characteristics and attitudes were identified in groups of drivers known to be at a higher risk of crashing such as drink drivers and multiple offenders (e.g., Donovan et al., 1985; Wilson, 1992). However, few studies specifically attempted to identify

[2] This chapter contains material that was presented in a somewhat different form in: "Wundersitz, L.N., & Hutchinson, T.P. (2006). South Australia's Driver Intervention Program: Participant characteristics, best practice discussion and literature review. CASR Report Series CASR021. Adelaide: Centre for Automotive Safety Research." and "Wundersitz, L. N., & Burns, N. B. (in press). Personality characteristics and attitudes of young traffic offenders. In Proceedings of the Road Safety Research, Policing and Education Conference 2006, 25-27 October 2006, Gold Coast, Australia."

these characteristics among groups of young drivers known to be at a higher risk of crashing. Moreover, studies investigating the relationship between personality characteristics and the consequences of risky driving (i.e., crash involvement and traffic offences) have been criticised because they were not systematic (Williamson, 1999), were not validated in different populations, did not adequately control for variation in driving exposure, had small sample sizes, and used inadequately standardised tests (Grey *et al.*, 1989).

Therefore, before attempting to replicate Deery et al's (1998) study by identifying subtypes of young drivers, the present study aimed to determine whether certain personality characteristics and attitudes could be identified in a group of young South Australian drivers thought to be at a higher risk of crashing. Consequently, the characteristics of a sizeable sample of young drivers who had been detected by police for committing one or more traffic offences were examined. A group of young traffic offenders was selected because research suggests that traffic offences are more closely related to variations among individuals than are crashes (see Chapter 2). Driving behaviour leading to detection for a traffic offence (e.g., drink driving) is considered more intentional and connected to the motivations of the driver (Burg, 1970; Harrington, 1972). In contrast, drivers generally do not try to be involved in a crash. Moreover, most research examining driving records has found traffic offences to be a better predictor of crash involvement than crashes among young drivers (e.g., Elliot *et al.*, 2001; Harrington, 1972).

In the present study, the characteristics of young traffic offenders were examined in relation to a comparison group of young South Australian drivers, university students. To the best of my knowledge, this was the first study to examine the characteristics of young South Australian traffic offenders. Furthermore, this study was important because it investigated personality factors and attitudes in more depth than previous studies of young drivers at a higher risk of crashing.

The offenders and students were administered a questionnaire, originally developed by Donovan and Marlatt (1982) and adapted by Deery et al. (1998). Based on a wide variety of personality characteristics and driving-related attitudes, a profile of the offender group was developed relative to the students. Driving histories, both self-reported and official records, were also examined to confirm that the offender group was a higher risk group in traffic than the student group. To determine if offenders continued to be a higher risk group than students, official driver records were tracked for one year following administration of the questionnaire.

In light of previous findings on high-risk drivers, the young traffic offenders were expected to have high scores, relative to the students, on sensation seeking (e.g., Beirness & Simpson, 1988; Renner & Anderle, 2000), measures of aggression and hostility (particularly overt hostility; Lajunen & Parker, 2001), driving-related aggression (e.g., Begg & Langley, 2004), competitive speed or driving in a competitive way (e.g., Deery et al., 1998), and driving to reduce tension and frustration (e.g., Mayer & Treat, 1977). Offenders might also be expected to report a depressive state (Donovan et al., 1986) and have some degree of personal or emotional maladjustment, although previous findings have been inconsistent (e.g., Lajunen, 2001; Mayer & Treat, 1977). Offenders would be expected to be less likely to hold road-safety-oriented attitudes than the students, be more likely to perceive risky behaviour as acceptable, perceive less risk in driving situations, and be overconfident in their driving skills (e.g., DeJoy, 1992).

With regard to driving behaviour, offenders would be expected to exhibit a riskier driving style than the students (e.g., Baxter *et al.*, 1990). According to Problem Behaviour Theory (Jessor, 1987), the offenders would also be expected to report higher levels of mild social deviance, alcohol consumption, and risky behaviours other than risky driving (e.g., Beirness & Simpson, 1988; Wilson & Jonah, 1988).

Finally, offenders were expected to have more subsequent crashes and traffic offences than the students.

5.2 Methodology

5.2.1 Participants

Participants comprising the "offenders" group were recruited from among young drivers attending the Driver Intervention Program (DIP) run by the South Australian Department of Transport, Energy and Infrastructure. Any driver aged 25 years and under who has violated the conditions of their learner's permit or provisional driver's licence[3], resulting in licence disqualification[4], is required to attend the program[5].

Young drivers attending DIP were approached to participate in the study at DIP sessions held during a three-month period from 27 October 2003 to 28 January 2004. DIP participants were approached at all four venues operating in metropolitan Adelaide during this period: Hampstead, Noarlunga, Oaklands Park, and Salisbury. Thus, the sample is representative of all DIP participants in the metropolitan area who agreed to participate in the study.

The original sample consisted of 358 drivers who had been detected committing offences resulting in licence disqualification. To ensure all participants had some unsupervised driving experience, only data from participants who had held a current South Australian provisional driver's licence were retained for analysis. Thus, data for 15 drivers were excluded from the study because they held only a

3 The conditions of a learner's permit or provisional licence state that drivers must not: have any alcohol in their blood whilst driving, exceed the speed limit by more than 10km/h, or drive without displaying prescribed L or P plates on the front and rear of the vehicle. Additionally, drivers must carry their permit or licence at all times while driving, not incur four or more demerit points, and learners must be accompanied by a fully licensed driver.

4 A driver whose learner's permit or provisional licence is disqualified may subsequently appeal against the penalty of disqualification. Even if the appeal is successful, they are still required to attend DIP. Thus, not all offenders received the penalty of licence disqualification.

5 Drivers electing to pay an expiation fee (approximately $125) are not required to attend DIP.

learner's permit (*n*=13) before detection for the traffic offence(s) and subsequent licence disqualification, or were unlicensed (*n*=2). A further seven drivers were excluded because they did not complete the majority of the questionnaire (*n*=5), or provided obviously untruthful responses to the questionnaire (*n*=2).

The final sample of traffic offenders consisted of 336 drivers (273 males, 63 females) aged 16 to 24 years (*M*=18.5, *SD*=1.2). Approximately 46 per cent (*n*=154) of offenders were recruited from Hampstead, 20 per cent (*n*=69) from Noarlunga, 18 per cent (*n*=59) from Salisbury, and 16 per cent (*n*=54) from Oaklands Park.

The comparison group of university students consisted of 270 young drivers (78 males, 192 females) holding a current South Australian provisional driver's licence, aged 17 to 21 years (*M*=18.1, *SD*=0.7). All were undergraduate psychology students, enrolled at the University of Adelaide. They participated in the study to receive course credit.

The university students represent a comparable group of young drivers on a provisional licence with varying levels of unsupervised driving experience. However, the student group cannot necessarily be considered as representative of the general young driver population in South Australia. For example, one unavoidable difference is the level of education. In addition, unlike the general young driver population, a difference in sex composition might be expected because more females study psychology than males. However, sex differences do not present a problem as males and females can be examined separately.

5.2.2 Questionnaire

Participants completed a self-report questionnaire comprised of seven sections measuring demographic variables, personality traits, driving style, driving-related attitudes, mild social deviance, road safety-related attitudes, and crash and traffic offence history. This questionnaire was based on a questionnaire originally developed by Donovan and Marlatt (1982) and more recently adapted by Deery et al. (1998).

The questionnaire consisted of well-validated measures that have a demonstrated association with risky driving behaviour or crash involvement in the literature (e.g., Donovan et al., 1988; McMillen *et al.*, 1992b; Ulleberg & Rundmo, 2003; West et al., 1993; Wilson, 1991). However, the length of the questionnaire was reduced due to time constraints. DIP participants were allocated approximately 10 to 15 minutes at the beginning of DIP sessions to complete the questionnaire.

To reduce the length of the questionnaire, reliability analysis was undertaken on preliminary data from the student sample (n=199) to identify any items contributing to low internal consistency in each scale. Individual items were deleted if their omission increased Cronbach's alpha coefficient, a measure of internal consistency, for the scale. Additionally, four items were also omitted from the Verbal Hostility scale to reduce the number of items. This resulted in a slightly lower alpha level for the 9-item scale than the original 13-item scale. Thus, 53 items were omitted from the original 189-item questionnaire. A copy of the original 189-item questionnaire is included as Appendix C and the 136-item questionnaire is included as Appendix D. The number of items and range of scores for the scales in the questionnaire are presented in Table 5.1 in section 5.2.3.2.

The first section of the questionnaire sought information on a number of general demographic and background variables including age, gender, driving experience (i.e., age when first obtained learner's permit and provisional licence), and method used to successfully obtain a provisional driver's licence: competency based training or vehicle on-road driving test[6]. The offenders also provided information on their level of education and occupation. To assess annual driving exposure, participants reported how many kilometres they had driven in the last week. Information in this section was obtained to determine if these factors differed between

6 To obtain a provisional driver's licence in South Australia, drivers must either pass a vehicle on-road test (VORT) conducted by an authorised driving instructor or complete a competency based training (CBT) course commonly referred to as the "log book option". The latter option requires the driver to reach a level of competency progressively in a series of defined tasks that are "signed off" by a driving instructor when completed.

the offender and student groups and whether, consequently, subsequent analyses would require disaggregation by these factors (e.g., sex).

The second section of the questionnaire consisted of 72 true-false items measuring general personality traits. General assertiveness, or social boldness, was assessed by five items taken from the Rathus Assertiveness Schedule (Rathus, 1973). These specific items were originally included in Donovan and Marlatt's (1982) questionnaire because they had item-total correlations of .40 or greater and because they were significantly correlated with peer ratings of outspokenness. Nine items from a depression scale (Costello & Comrey, 1967) were included. This depression scale was designed to measure a general tendency to experience a depressive mood, rather than measuring a clinical depressive state by symptom ratings. Six items adapted from the Eysenck Personality Inventory assessed emotional adjustment (Howarth, 1976). Howarth (1976) found that the five items from the Neuroticism sub-scale and a single item from the Extraversion subscale defined a factor of general emotionality. To measure sensation seeking, the need for excitement and stimulation, the ten-item subscale of Thrill and Adventure Seeking and seven items from the Disinhibition subscale were incorporated in the questionnaire from Zuckerman's Sensation Seeking Scale (Form V: Zuckerman, 1971). Additionally, five subscales of the Buss-Durkee Hostility Inventory (1957) were included to measure the specific way respondents express hostility and aggression: assaultiveness or physical violence against others (nine items); indirect hostility or undirected aggression (five items); verbal hostility or negative affect expressed by speech (nine items); irritability, the expression of negative affect with little provocation (eight items); and resentment or jealousy and hatred of others over perceived mistreatment (four items). Individual items from the personality scales were not in successive groups, but distributed across this section.

The third section of the questionnaire contained a scale examining self-reported driving style. Thus, seven items from the Driving Style subscale of the

Driver Expectancy Questionnaire developed by Deery and Love (1996) measured the decision-making aspects of driving, that is, the way one chooses to drive. Each item contained a statement referring to a risky driving behaviour and participants were asked how well each statement "best described how you typically drive". Responses were scored on a five-point scale ranging from 1 = "not at all" to 5 = "all the time".

The fourth section incorporated 20 true-false items that measured a variety of driving-related attitudes and behaviours. Ten items were taken from a driving aggression scale developed by Parry (1968). The scale reflects a variety of spontaneous aggressive driving behaviours. Five items were included to measure an attitude of competitive speed (Goldstein & Mosel, 1958). Three items assessed the extent of cautious driving when upset or angry, referred to as "driving inhibition" by Donovan and Marlatt (1982). Finally, two items measured the extent to which driving reduces tension or increases levels of personal efficacy. The scale consisted of items Donovan and Marlatt assembled from a variety of sources (Mayer & Treat, 1977; Pelz & Schuman, 1971). Items from the four scales were distributed across the section.

The fifth section of the questionnaire consisted of eight items from the Social Motivation Questionnaire (SMQ) developed by West, Elander and French (1993) as a measure of mild social deviance. Mild social deviance is defined as the motivation to pursue self-interest at the expense of others but not to an extreme level of behaviour. Participants were asked: "How likely is it that you would do each of these things if you were completely certain of getting away with it?" Responses were scored on a three point scale labelled 1 = "not at all likely", 2 = "quite likely" and 3 = "very likely". The SMQ was originally developed for use in the United Kingdom. To reflect the Australian context, several changes were made: one item was omitted, two items were changed significantly and one item was altered slightly. Details of the adjustments to the SMQ are reported in Appendix E.

The sixth section of the questionnaire incorporated items measuring specific driving attitudes. Two items from the Young Driver Attitude Scale (YDAS) (Malfetti *et al.*, 1989) were included as measures of "attitude towards speeding" and "concern about hurting others". Ulleberg and Rundmo (2002) found that these items had the highest factor loadings of all YDAS items. Another item from Ulleberg and Rundmo's study (2002) measuring the "risk of dying in a crash" was also included as were two items from the Driver Skill Inventory developed by Lajunen & Summala (1995). Adapted from Hatakka et al. (1992) the first item measured one aspect of driving skill, hazard perception. The second item measured a "safe driving" motivational factor. According to Näätänen and Summala's (1974) model, both driving skill and motivational factors are key determinants of driver behaviour. Based on previous research (Wundersitz *et al.*, Unpublished), the final three items in this section were developed to measure attitudes towards drink driving, perceived "safe" driving by friends, and the perceived likelihood of detection by police when committing a traffic offence. Participants responded to all eight attitude-related items in this section on a five-point scale in Likert format, ranging from 1 = "strongly disagree" to 5 = "strongly agree".

In the final section of the questionnaire, drivers reported their crash and traffic offence history. Participants categorised any crashes as either personal injury, or property damage only, and indicated whether they were responsible for the crash. Offences were defined as the number of fines for moving traffic offences received when driving (i.e., not parking offences). In addition, offenders specified what type of traffic offence(s) resulted in their licence disqualification and whether they were involved in a crash when detected committing the offence(s). A measure identified as involving another high-risk behaviour (high alcohol use), was also included. Participants stated how many standard alcoholic drinks they would consume on a typical drinking occasion.

In sections two to five of the questionnaire, the items within each scale were summed to produce an overall score for the measure. For all other sections, the mean score for each item was used.

The questionnaire was pilot tested with a small sample of drivers (*n*=6) to ensure comprehensibility of the items.

5.2.3 Validation of Scales

5.2.3.1 Exploratory factor analysis

Exploratory factor analyses examined the internal structure of the scales to verify the number of factors underlying each scale. Nunnally and Bernstein (1994) caution that commonly endorsed items tend to form factors distinct from less commonly endorsed items, even when all items measure the same underlying unidimensional variable. Item-level factor analysis using traditional methods often produces at least some factors that are based entirely on item distribution similarity rather than content-based similarity (McPherson & Mohr, 2005). Thus, scales may appear to be multi-dimensional when they are not. To avoid such problems, O'Connor (2004) recommended adopting an alternate analytical procedure. Rather than using a matrix of Pearson correlations, factor analysis was conducted on a matrix of tetrachoric inter-item correlations for dichotomous data, and a matrix of polychoric correlations for items based on ordered categories. Factor analysis of tetrachoric and polychoric correlation matrices analyses the associations among latent response variables that are assumed to underlie the data (Panter *et al.*, 1997). These variables are assumed to be continuous and normally distributed. Tetrachoric and polychoric correlation matrices were calculated using the LISREL program (Joreskog & Sorbom, 2001).

Determining the correct number of factors to retain is essential in factor analysis. There is general consensus in the literature that the most sensible approach

to determining the number of factors is to make the decision based on the results from multiple methods and then examine the rotated solution to confirm that it is interpretable and plausible (Fabrigar *et al.*, 1999; Kline, 1994). Thus, the optimal number of factors to extract from the tetrachoric and polychoric correlation matrices was determined by applying four different rules: eigenvalues-greater-than-one, scree plot, parallel analysis, and Velicer's MAP criterion. Although popular, Kaiser's (1960) criterion concerning the retention of factors with eigenvalues greater than one has been found to consistently overestimate, but occasionally underestimate, the number of factors (Cattell, 1978; Zwick & Velicer, 1986). Cattell's (1966) "scree test" involving the examination of the scree plot of eigenvalues is another popular decision rule test. However, the scree test has been criticised because of its subjectivity and the reliability of scree plot interpretations is reported to be low (Streiner, 1998).

Although not as well known as other decision rules, parallel analysis and Velicer's (1976) Minimum Average Partial (MAP) criterion are statistically based tests that have increasingly been regarded by statisticians as superior to other procedures in deciding the number of factors (O'Connor, 2000; Wood *et al.*, 1996; Zwick & Velicer, 1982). Parallel analysis (Horn, 1965) involves extracting eigenvalues from random data that parallel the actual data in terms of the number of cases and variables. Essentially, parallel analysis determines the number of factors that account for more variance than the factors derived from random data. Based on current recommendations (Cota *et al.*, 1993), eigenvalues from the 95th percentile of the random data distribution are compared to the eigenvalues derived from the sample data. The MAP test is concerned with the relative amounts of systematic and unsystematic variance remaining in a matrix of partial correlations after extractions of increasing numbers of components (O'Connor, 2000). Components are no longer retained if there is more unsystematic than systematic variance. O'Connor (2000) notes that the best decision will be made when considering the results of both of these

methods together. This is because if the methods err, parallel analysis tends to over-extract factors while the MAP test tends to under-extract factors. SPSS syntax for parallel analysis and the MAP test were obtained from O'Connor (2000).

To determine the number of factors underlying each scale, the four decision rules were applied to tetrachoric and polychoric correlation matrices in SPSS. Principal-axis factoring (PAF) with Direct Oblimin rotation was then conducted. Factor solutions were assessed to determine if they were interpretable and theoretically meaningful. If there was any doubt, relevant individual items were inspected closely. The results of this analysis, including factor loadings and communalities for each scale, for the student group are presented in Appendix F and for young traffic offenders in Appendix G.

A one-factor solution was found for most scales, and for verbal hostility, three items were omitted to define an interpretable single factor solution. Further details of the factor analysis results are provided in section 6.3.1 for students and section 7.3.1 for offenders.

5.2.3.2 Reliability analysis

The reliability of measures used in the present study was established during development by their authors. However, when constructing the questionnaire, Donovan and Marlatt (1982) used shorter versions of some scales to minimise the length of the questionnaire. They warned that, as a result, the scales were potentially less reliable than the original versions. Thus, Cronbach's alpha coefficients were computed to assess the internal consistency or reliability of each scale.

Table 5.1 shows Cronbach's alpha coefficients for all scales in the questionnaire, combining student and offender data. Alpha coefficients are reported only for scales with five items or more. The internal consistency of most scales was acceptable with alpha in the range of .48 to .86. Alpha coefficients tend to increase as a function of the number of items (Nunnally, 1978). The item number sensitivity of

alpha coefficients may be responsible for the lower reliability of several scales with relatively few items.

In summary, findings from reliability analysis and exploratory factor analysis show that the majority of scales had a reasonable degree of internal coherence.

Table 5.1
The number of items, possible range of scores and alpha coefficients for questionnaire measures

Measures	No. of items	Range of scores	Cronbach's alpha[a]
Personality			
Assertiveness	5	5-10	0.48
Depression	9	9-18	0.81
Emotional adjustment	6	6-12	0.65
Sensation seeking	17	17-34	0.73
Mild social deviance	8	8-24	0.75
Hostility and aggression			
Assaultiveness	9	9-18	0.70
Indirect hostility	5	5-10	0.56
Verbal hostility	6	6-12	0.51
Irritability	8	8-16	0.58
Resentment	4	4-8	-
Driving-related			
Aggression	10	10-20	0.76
Competitive speed	5	5-10	0.71
Inhibition	3	3-6	-
Tension reduction	2	2-4	-
Driving style	7	7-35	0.86
Attitudes			
Speeding	1	1-5	-
Drink driving	1	1-5	-
Risk of dying in crash	1	1-5	-
Friends drive safely	1	1-5	-
Likelihood of being caught	1	1-5	-
Concern for hurting others	1	1-5	-
Driving skill	1	1-5	-
Safety motivation	1	1-5	-

[a] Cronbach's alpha not calculated for scales with less than five items.

5.2.4 Official Driver Records

To obtain official crash and traffic offence records, participants were asked to provide their driver's licence number. Just over 62 per cent (*n*=208) of offenders and 70 per cent (*n*=188) of students gave consent to release their driver records. Participants not consenting to the release of official driver records were still included in the study.

Driver licence numbers were used to search the Department for Transport, Energy and Infrastructure Traffic Accident Reporting System database (TARS) for any crashes on South Australian roads reported to police. All crashes in which anyone was injured, or there were property damages of $1000 or more, were required to be reported to police. From July 2003, property damage only crashes in which the total damage was less than $3000 were not recorded.

Driver licence numbers were also used to search the DRIVERS database, maintained by the Registration and Licensing section of the Department for Transport, Energy and Infrastructure, for traffic offences detected by police in South Australia. The DRIVERS database does not include infringements from speed cameras; thus, the number of traffic offences recorded will certainly be an underestimate of the true number of offences. To ensure all drivers were eligible to participate in the study (i.e., held a current South Australian provisional driver's licence), driver licence numbers were matched against licensing details.

Participant's driver records were tracked for crashes and traffic offences in the 12-month period following questionnaire administration to determine if the offenders were more likely than the students to be involved in subsequent crashes or re-offend. It is acknowledged that some drivers were disqualified for some, or even all of this period.

5.2.5 Procedure

Either the group facilitator or the author invited participants at DIP sessions to

complete a written questionnaire at the beginning of the session. This procedure was adopted to avoid any effects on attitudes or beliefs that may have been generated by discussions during the DIP session. The questionnaire took approximately 10 to 15 minutes to complete. The response rate among DIP participants was 87 per cent. The remaining 13 per cent either refused to participate, or arrived too late to the session to participate in the questionnaire.

University students were invited to participate in the study at the beginning of lectures. Posters and intranet messages requesting student participation were also displayed. The questionnaire was available to students on the Internet. Data from students went directly into a database maintained on a secure server by the School of Psychology. The online questionnaire was completed in the participant's own time.

An information sheet and consent form were provided to all who indicated they were willing to participate. All participants signed a printed consent form before beginning the questionnaire. For students, an electronic copy also accompanied the questionnaire on the website. Instructions at the beginning of the questionnaire informed participants of the nature of the research and assured complete confidentiality. A copy of the information sheet and consent form are included in Appendix C for students and Appendix D for offenders with the respective questionnaires.

5.2.6 Statistical Analyses

Statistical analyses were conducted to quantify differences in personality characteristics and driving-related attitudes and behaviours between the offender and student groups. Initially, the driver licensing characteristics of the offender and student groups were compared using chi-square analyses.

A significant difference in the gender compositions of the offender and student groups was identified, so it was deemed appropriate to account for sex by conducting two way ANOVAs (group x sex) for all personality, attitudinal, and driver record

measures. A two way ANOVA shows whether there are significant main effects of the independent variables (i.e., group and sex) and whether there are significant interaction effects between these variables. Cohen's *d*, a measure of effect size or the standardised difference between the two means, was calculated to assess the strength of differences between offenders and students among males and females separately. Cohen's *d* is defined as the difference between two means divided by the pooled standard deviation (Cohen, 1988). Using the conventions suggested by Cohen (1988), an effect size of $d = 0.2$ represents a small effect, $d = 0.5$ a medium effect, and $d = 0.8$ a large effect. In personality research, differences of
$d = 0.5$ are regarded as substantial.

For all analyses, a level of $p<.05$ was considered to be statistically significant. It is important to consider that when using this level of statistical significance, one out of every 20 statistical tests performed would be expected to be significant by chance.

Due to the nature of pen and paper surveys, as opposed to the Internet survey, there were missing responses to individual items in the offender group data. No major differences were found between the characteristics of respondents with missing data and those without. Thus, the missing responses were considered to be random. The proportion of missing values was very low but rather than omitting an entire case for the sake of one or two missing items within a scale, offenders' missing data for personality characteristics and attitude variables were imputed using the LISREL program. Algorithms were used to impute values according to the profiles of scores from similar cases with full sets of observations. The use of imputation allowed the analysis of a complete data set.

5.3 Results

In the following section, the offenders and students are compared on personality characteristics, attitudinal measures, alcohol use, and driving records. Demographic and driver licensing details are also compared between the two groups to provide

background information.

5.3.1 Demographic Characteristics

The demographic characteristics of the offender and student groups are presented in Table 5.2. All respondents were required to hold a provisional driver's licence and be aged 16 to 24 years. The offender group was slightly older than the student group and this difference was most evident among females. The offender group consisted of a notably greater proportion of males (81%) than the student group (29%). Offenders were less likely to be single than students. Socio-economic status differed by group. A greater percentage of offenders (30%) lived in low-income areas than students (16%), and conversely, more students (41%) lived in high-income areas than offenders (25%).

Table 5.2
Demographic characteristics of the offender and student groups

Demographic measure	Offender (*N*=336)	Student (*N*=270)
Mean age (years) (*SD*)	18.5 (1.2)	18.1 (0.7)
Male	18.4 (1.2)	18.3 (0.9)
Female	18.8 (1.3)	18.0 (0.5)
Sex (%)		
Male	81.3	28.9
Female	18.8	71.1
Marital status (%)		
Single	95.2	99.6
Defacto/married	4.8	0.4
Socio economic status of area of residence (%)		
Low income area	29.8	16.4
Middle income area	45.7	42.9
High income area	24.6	40.8

The method for estimating the crude measure of respondent's socio-economic status was accomplished by using the postcode of their main residence, in conjunction with the Adelaide Social Atlas, based on 2001 census information (Crettenden, 2002).

The social atlas mapped the percentage of households with a weekly income of $1500 or more for each census collection district in metropolitan Adelaide. The postcode areas were derived from aggregations of 1996 census collection district boundaries. Although they were not identical to official Australia Post boundaries, they were similar and useful as a proxy. For the purposes of this study, “high” socio-economic status was defined as those postcode areas in which 22 per cent or more of the households had a weekly income of $1500 or more, “middle” was 14 to 21.9 per cent, and “lower” was less than 14 per cent. A total of 79 participants’ postcodes were not coded because they were outside the Adelaide metropolitan area. This measure of socio-economic status is a crude one so further use of the measure was not pursued.

Table 5.3 shows the highest level of education completed and occupational status for offenders. Just over 36 per cent of offenders had not completed high school and had no further education. Around 32 per cent had completed, or were in the process of completing, further education by means of a trade, technical school, or university.

Table 5.3
Education level and occupations for the offender group (*N*=336)

Education level and occupation status	Number	Percentage
Education [a]		
Some high school	121	36.1
Year 12	106	31.6
Some trade/technical school	38	11.3
Certificate or diploma	33	9.9
Some university	34	10.1
University degree	3	0.9
Occupation [b]		
Managers and administrators	3	0.9
Professionals	1	0.3
Associate professionals	13	4.0
Tradespersons	99	30.6
Advanced clerical and service	3	0.9
Intermediate clerical, sales and service	28	8.6
Intermediate production and transport	17	5.2
Elementary clerical, sales and service	21	6.5
Labourers	18	5.6
Other	6	1.9
Student	103	31.8
Unemployed	12	3.7

[a] Information missing for one participant.
[b] Information missing for 12 participants.

Occupational status was coded according to the nine major occupation groups defined by the Australian Bureau of Statistics Australian Standard Classification of Occupations (McLennan, 1997). About one third of offenders were employed as tradespersons (31%). A similar proportion (32%) of offenders were students, 29 per cent (*n*=30) of them being university students. Less than four per cent were unemployed. This rate was lower than the South Australian rate of 6.5 per cent for the same period (*Labour force: January 2004*, 2004).

The type of traffic offence(s) detected by police that led to licence disqualification and subsequent attendance at DIP is shown in Table 5.4. These offences are based on respondents' self report, not official records, because official records do not explicitly indicate which traffic offences lead to DIP attendance. Many

respondents reported several offences so the total percentage of drivers does not sum to 100 per cent. The majority of respondents attending DIP reported detection by police (i.e., not a speed camera) for committing speeding offences (70%). Not displaying P-plates was also a commonly reported offence (27%). Drink driving was reported by only five per cent of offenders.

Approximately six per cent (*n*=20) reported being involved in a crash when reported for the offence(s) leading to DIP attendance. Just over 79 per cent of offenders reported that they were detected for one offence prior to DIP, and of those reporting a single prior offence, 72 per cent stated it was a speeding offence.

Table 5.4
Self-reported traffic offences leading to licence disqualification and DIP attendance

Traffic offence	Number	Percentage
Speeding	236	70.2
Not displaying P-plates	89	26.5
Dangerous/reckless/careless driving	25	7.4
Drink driving	18	5.4
Fail to wear seat belt	16	4.8
Disobey traffic signs or signals	9	2.7
Fail to give way/stop	8	2.4
Fail to keep left	4	1.2
Following too closely	3	0.9
Overtaking without due care	1	0.3
Other	11	3.3
Unknown	16	4.8
Total	436	129.9

Note: 436 responses from 336 offenders.

5.3.2 Driver Licensing Factors

Factors associated with obtaining a provisional driver's licence may distinguish young offenders from other young drivers. Driver licensing characteristics and driving experience are presented in Table 5.5. The South Australia Motor Vehicles Act permits people aged 16 years and over to obtain a learner's permit to drive after passing a theoretical driving test. The majority of offenders and students

acquired a learner's permit at the youngest possible age of 16 years. Female offenders were more likely to obtain a learner's permit at an older age than female students. At the time of data collection, regardless of the time spent with a learner's permit, novice drivers could apply for a South Australian provisional driver's licence at 16 years and 6 months of age (Section 75, Motor Vehicles Act, 1959). A greater proportion of male offenders held a learner's permit for less than 6 months compared to male students (83% vs. 60%).

Table 5.5
Driver licensing characteristics of the offender and student groups for males and females

Driver licence measures	Males				Females			
	Offender (*N*=273)	Student (*N*=78)	χ^2	*df*	Offender (*N*=63)	Student (*N*=192)	χ^2	*df*
Age obtained learner's permit [a] (%)								
16 years	81.3	76.9	1.2	3	71.4	79.2	16.4**	3
17 years	10.6	14.1			12.7	17.2		
18 years	5.5	5.1			9.5	3.6		
19 years or more	2.6	3.8			6.3	0.0		
Months with learner's permit [a] (%)								
6 months or less	83.1	67.9	8.6**	1	77.8	76.6	<0.1	1
7 months or more	16.9	32.1			22.2	23.4		
Method obtained provisional licence [b] (%)								
Competency based training	64.6	59.0	0.8	1	73.8	71.9	0.1	1
Vehicle on road test	35.4	41.0			26.2	28.1		
Age obtained provisional licence [a] (%)								
16.5 years	54.8	37.2	7.5	3	42.9	49.5	5.0	3
17 years	31.6	43.6			34.9	34.4		
18 years	6.6	9.0			14.3	14.1		
19 years or more	7.0	10.3			7.9	2.1		
Driving experience on provisional licence [a] (%)								
Less than 12 months	29.0	35.9	1.3	1	14.3	40.1	14.2**	1
12 months or more	71.0	64.1			85.7	59.9		

[a] Information was unknown for one participant; a male offender
[b] Information was unknown for four participants; two male offenders, two female offenders
*p<.05, **p<.01

There were no group differences for method of obtaining a provisional licence; a greater proportion of both offenders and students obtained a provisional licence using the competency based training method. More females used competency based training than males.

With respect to the age a provisional driver's licence was obtained, there was no difference by group for either males or females. However, for male offenders were more likely to obtain their provisional licence before 17 years of age than male students ($\chi^2(1)=7.5$, $p=.006$). The majority of both offenders and students reported at least 12 months of unsupervised driving experience on a provisional licence. Driving experience on a provisional licence only differed for females; 86 per cent of female offenders held a provisional licence for 12 months or more compared to 60 per cent of female students.

To summarise, the driver licensing characteristics of offenders and students were reasonably similar. One of the distinguishing factors was that male offenders spent significantly less time on a learner's permit than did male students. Although female offenders obtained a learner's permit at an older age than female students both groups retained the permit for a similar amount of time. Given that the female offender group was slightly older than the female student group, it was not surprising that female offenders reported more driving experience than female students.

5.3.3 Crash and Traffic Offence Records

Driver records were examined to confirm that those drivers in the young offender group were detected for more traffic offences than the student group, and to investigate whether offenders had greater crash involvement than students. To obtain a more comprehensive picture of driving history, both self-reported and official driver records were analysed.

5.3.3.1 Self-reported driver record

Both offenders and students reported the number, severity and responsibility for crashes in which they were driving, and the number of traffic offences detected by police. Note that a personal injury crash refers to a crash that "involved physical injuries to one or more people" in the crash. The estimated number of kilometres

driven in the past week was included as an approximate measure of driving exposure. A summary of the means, standard deviations and Cohen's *d*, explained in detail previously (see section 5.2.5), for all driver record and driving exposure measures can be seen in Table 5.6 by group and sex. The number of respondents for each measure varied due to missing data.

Table 5.6
Summary of means and standard deviations for self-reported driver record and driving exposure measures for males and females

	Males					Females				
	Offender (*N*=273)		Student (*N*=78)			Offender (*N*=63)		Student (*N*=192)		
Measure	Mean	*SD*	Mean	*SD*	*d* [a]	Mean	*SD*	Mean	*SD*	*d* [a]
Driver record										
Total no. of crashes	1.2	1.7	0.8	1.0	0.3	0.9	2.0	0.6	0.8	0.3
Personal injury	0.3	0.7	0.1	0.3	0.3	0.3	1.4	0.1	0.2	0.3
Property damage only	0.9	1.3	0.7	0.9	0.2	0.6	0.9	0.5	0.8	0.1
Responsible for a crash	0.7	1.1	0.4	0.7	0.3	0.4	0.7	0.4	0.7	0.0
Traffic offences	3.3	2.9	0.6	1.5	1.0	1.9	1.9	0.3	0.9	1.3
Driving exposure										
Estimated km/week	359.4	301.2	165.5	158.0	0.7	241.3	208.7	126.5	142.8	0.6

[a] A positive value indicates that offenders have a higher mean than students

Due to the different gender composition of the offender and student groups, two-way ANOVAs (group x sex) were performed to examine the main effects of group membership and sex, and any possible interactions between these two factors. Interaction effects occur when the impact of one factor depends on the level of the second factor. The ANOVA results can be seen in Table 5.7.

Offenders reported a greater total number of crashes and personal injury crashes than students. The only sex difference was for property damage only crashes; males reported more than females. No differences were found for responsibility for a crash. With regard to traffic offences, the interaction indicated that male offenders had

more traffic offences than male students and female offenders. The significant difference in traffic offences between groups and the corresponding large effect sizes were expected due to the selection criteria for the offender group.

Table 5.7
Summary of ANOVA and ANCOVA results (F-ratios) for self-reported driver record and driving exposure measures

	ANOVA			ANCOVA (km covariate)		
Measure	Group	Sex	Interaction	Group	Sex	Interaction
Driver record						
Total no. of crashes [a]	6.5*	3.8	0.1	2.3	1.3	0.1
Personal injury	12.7**	<0.1	0.2	6.1*	0.3	0.8
Property damage only	1.5	6.4*	0.4	0.3	3.4	<0.1
Responsible for a crash[a]	1.5	1.7	1.7	0.6	0.9	1.1
Traffic offences [b]	102.9**	17.4**	6.7*	79.5**	15.6**	7.0*
Driving exposure [c]						
Estimated km/week	43.6**	11.3**	2.9	-	-	-

[a] ANOVA *N*=594, *df*=1,590; ANCOVA *N*=550, *df*=1,545.
[b] ANOVA *N*=578, *df*=1,574; ANCOVA *N*=538, *df*=1,533.
[c] ANOVA *N*=558, *df*=1,554.
**p*<.05, ***p*<.01

For driving exposure, offenders reported driving more than twice as many kilometres in the last week than students and males reported driving more kilometres than females. While the students were not expected to drive as much as the offenders, who were predominantly employed, the magnitude of the difference in driving exposure was not anticipated. The large group difference in driving exposure may be partially attributed to the different way the question was asked of each group. Students were asked to specify how many kilometres they had driven in the last week for each day of the week, during the day and at night. Due to constraints on the length of the offender questionnaire, offenders were asked simply how many kilometres they

had travelled in the last week. It is plausible that the offenders overestimated their driving exposure because they were not required to give a detailed estimate.

Assuming that there is a real difference in driving exposure between the two groups, the difference in the number of self-reported crashes and traffic offences may not be attributable to only group membership or sex, but to the difference in driving exposure. To account for driving exposure, a two-way analysis of covariance (ANCOVA) was undertaken for each of the driver record variables with the number of kilometres driven per week as the covariate. Since 48 respondents (37 male offenders, 10 female offenders, 1 female student) did not estimate the number of kilometres driven, the number of respondents in each ANCOVA was less than in the original ANOVA. To detect any effects associated with different numbers in each analysis, secondary two-way ANOVAs were performed using the same respondents as in the ANCOVA analyses. The results were very similar, so the original two-way ANOVA results are reported in Table 5.7 with the ANCOVA results. Because the difference in driving exposure between the two groups may be an artefact of the different ways the question was asked, it is important that results from the ANCOVA analyses are interpreted cautiously.

If the differences in driving exposure are real, the results suggested that once the variance attributed to driving exposure was removed, the number of self-reported crashes no longer differed significantly between groups and sex differences disappeared for property damage only crashes. Statistically significant group differences were still evident for the number of traffic offences (η^2=0.13) and self-reported personal injury crashes, although the effect size was small (η^2=0.01).

The difference between groups for self-reported personal injury crashes may be attributed to the selection criteria for offenders. Twenty participants reported that they were required to attend DIP as the result of a crash (the level of crash severity was not specified). To eliminate the potential influence of selection criteria, the

ANCOVA for self-reported personal injury crashes was repeated excluding the twenty drivers involved in a crash. The group difference bordered on statistical significance and the effect size remained small (F (1, 527)=3.7, p=.056, η^2=0.01).

5.3.3.2 Official driver record

The official driver records of consenting offenders and students were examined to compare crash involvement and number of traffic offences as detected by police. The association between self-reported and official driver records prior to initial data collection was also assessed. It is possible that drivers who have recorded some traffic offences or crashes would be less likely to release driver records than drivers with no traffic offences or crashes recorded. Therefore, it is important to note that more students (70%) provided access to their official driver records than did offenders (62%, $\chi^2(1)=3.9$, p=.047).

Despite not all young drivers providing official records, there were significant positive correlations between self-reported and official records for both offenders and students. Pearson product-moment correlations were calculated. Spearman's rho correlations were also calculated in case the assumption of a normal distribution was violated. For students, correlations above .30 were observed for crashes (r= .36, p<.01; ρ= .48, p<.01) including personal injury (r= .62, p<.01; ρ= .47, p<.01) and property damage crashes (r= .47, p<.01; ρ= .41, p<.01), responsibility for a crash (r= .35, p<.01; ρ= .33, p<.01), and traffic offences (r= .59, p<.01; ρ= .49, p<.01). Similarly, offenders had significant positive correlations between self-reported and official records for crashes (r= .49, p<.01; ρ= .58, p<.01), including personal injury (r= .15, p<.05, ρ= .42, p<.01) and property damage crashes (r= .48, p<.01; ρ= .52, p<.01), responsibility for a crash (r= .44, p<.01; ρ= .47, p<.01), and traffic offences (r= .61, p<.01; ρ= .58, p<.01).

A summary of the means, standard deviations and Cohen's *d* for all driver record measures by group and sex is presented in Table 5.8. In comparison to self-reported driver records, the number of crashes and traffic offences in official records was much smaller. Official crash records most likely underestimated the number of actual crashes experienced by young drivers because a crash resulting in less than $1000 damage did not need to be reported to police by drivers. A reason for the discrepancy in traffic offence records is probably that speed camera offences, a common traffic offence, were not recorded in official records.

Table 5.8
Summary of means and standard deviations for official driver record measures for males and females prior to the survey

	Males					Females				
	Offender (*N*=169)		Student (*N*=48)			Offender (*N*=39)		Student (*N*=140)		
Driver record measure	Mean	*SD*	Mean	*SD*	*d* [a]	Mean	*SD*	Mean	*SD*	*d* [a]
Total no. of crashes	0.5	0.8	0.3	0.5	0.3	0.2	0.4	0.1	0.4	0.3
Personal injury	0.1	0.3	0.0	0.0	0.4	0.1	0.2	<.01	0.2	0.1
Property damage only	0.4	0.7	0.3	0.5	0.2	0.2	0.4	0.1	0.3	0.3
Responsible for a crash	0.3	0.6	0.1	0.3	0.4	0.1	0.3	0.1	0.3	0.0
Traffic offences	2.2	1.7	0.3	0.7	1.2	1.3	0.5	0.1	0.2	4.1

[a] A positive value indicates that offenders have a higher mean than students.

Table 5.9 shows the results for two-way ANOVAs (group x sex) performed on official driver record measures to address the different sex composition of the groups. Similar to the findings for self-reported driver records, offenders recorded more crashes than students (small effect size), and, not surprisingly, many more traffic offences (large effect size). Contrary to self-reported driver records, there was no difference between offenders and students for personal injury crashes. Drivers are obligated by law to report any crashes resulting in personal injury to police. However, fewer crashes resulting in personal injury were reported to police than self-reported by

the drivers. It is plausible that the inability of official records to differentiate between the groups for personal injury crashes is due to the small number of personal injury crashes reported in official records. Consequently, the low number of recorded crashes would reduce the statistical power of the analysis. Alternatively, respondents may not have understood what "crashes that involve personal injury" meant.

Sex differences were similar to those identified by self-report; males recorded more crashes (approached statistical significance for self-reported records), property damage only crashes, and traffic offences than females.

Analyses that accounted for driving exposure were not performed due to the low number of recorded driving incidents.

Table 5.9
Summary of ANOVA results (F-ratios) for official driver record measures prior to survey

Driver record measure	ANOVA [a]		
	Group	Sex	Interaction
Total no. of crashes	4.3*	5.5*	0.6
Personal injury	2.5	<0.1	1.2
Property damage only	2.2	6.4*	0.1
Responsible for a crash	3.7	3.5	1.7
Traffic offences	123.0**	15.5**	6.3*

[a] ANOVA N=396, df=1,392.
*p<.05, **p<.01

In summary, both self-reported and official driver records indicated that offenders were more likely to be crash involved and detected for committing traffic offences than students. When driving exposure was taken into account (self-reported data only) offenders were still more likely to be involved in personal injury crashes but the effect for the total number of crashes disappeared. However, findings related to driving exposure should be interpreted cautiously due to a methodological issue

associated with this measure. Nonetheless, there is some evidence supporting the notion that the offender group are at higher risk in traffic than the student group.

5.3.4 Personality Characteristics and Attitudes

To develop a profile of the offenders, their mean scores on a number of personality and attitudinal measures were compared to student mean scores. Table 5.10 shows the means, standard deviations and Cohen's *d* of each measure for offenders and students by sex. To address the different sex compositions of the groups, two-way ANOVAs (group x sex) were conducted to examine the main effects of group membership and sex, and any possible interactions between these two factors. The ANOVA results are presented in Table 5.11.

With respect to the driving-related measures, the greatest group difference was for driving-related aggression, with offenders reporting more driving aggression than students. Several significant interactions were found. For tension reduction, an interaction indicated that male offenders reported more driving to reduce tension or to increase personal efficacy than male students. The effect size of this difference was medium. For driving inhibition, an interaction indicated that female students reported higher levels than female offenders, while male offenders were more inhibited than male students. However, effect sizes indicate that these differences were small. Even though offenders were predominantly caught for speeding offences, they reported lower scores on competitive speed than students. There were no group differences for risky driving style.

Table 5.10

Summary of means and standard deviations for personality and attitudinal measures for males and females

	Males					Females				
	Offender (*N*=273)		Student (*N*=78)			Offender (*N*=63)		Student (*N*=192)		
Measures	Mean	*SD*	Mean	*SD*	*d* [a]	Mean	*SD*	Mean	*SD*	*d* [a]
Personality										
Assertiveness	7.9	1.3	7.0	1.4	0.7	8.0	1.3	7.4	1.4	0.4
Depression	10.2	1.8	10.6	2.4	-0.2	10.4	2.0	10.2	2.1	0.1
Emotional adjustment	7.3	1.4	8.0	1.8	-0.5	8.2	1.7	8.5	1.6	-0.2
Sensation seeking	27.1	3.2	27.3	3.5	-0.1	25.3	3.2	25.6	3.7	-0.1
Mild social deviance	12.4	3.1	13.8	3.4	-0.4	11.3	2.8	12.9	3.1	-0.5
Hostility and aggression										
Assaultiveness	13.8	2.1	13.1	2.1	0.3	12.4	2.1	11.8	2.1	0.3
Indirect hostility	7.6	1.2	8.2	1.5	-0.5	8.9	1.3	9.0	1.2	-0.1
Verbal hostility	9.5	1.5	9.6	1.5	-0.1	8.9	1.5	8.9	1.5	0.0
Irritability	11.3	1.9	11.8	2.0	-0.3	11.5	1.9	11.9	1.9	-0.2
Resentment	5.6	1.2	5.5	1.2	0.1	5.4	1.1	5.3	1.3	0.1
Driving-related										
Aggression	13.4	2.5	12.1	2.2	0.5	12.6	2.5	11.8	1.9	0.4
Competitive speed	7.6	1.7	8.0	1.4	-0.2	6.3	1.5	6.8	1.5	-0.3
Inhibition	4.4	1.1	4.1	1.3	0.3	4.5	1.2	4.8	1.2	-0.2
Tension reduction	3.3	0.8	2.8	0.9	0.6	3.0	0.9	2.9	0.9	0.1
Risky driving style	19.4	6.2	18.2	4.7	0.2	16.5	4.7	15.9	4.3	0.1
Attitudes [b]										
Speeding acceptable	2.8	1.3	3.0	1.2	-0.2	2.4	1.2	2.4	1.2	0.0
Drink driving acceptable	2.5	1.6	1.8	1.2	0.5	2.4	1.7	1.7	1.2	0.5
Low risk of dying in crash	1.9	1.2	1.5	0.9	0.4	1.7	1.2	1.2	0.6	0.6
Friends don't drive safely	3.2	1.2	2.9	1.1	0.3	2.8	1.2	2.4	1.2	0.3
Low likelihood of being caught	2.5	1.2	2.9	1.1	-0.3	2.2	1.3	2.5	1.1	-0.3
Lack of concern for hurting others	1.9	1.3	1.5	0.9	0.3	1.1	0.6	1.2	0.5	-0.2
Poor driving skill	2.0	1.1	2.0	1.0	0.0	2.1	1.1	2.0	0.8	0.1
Low safety motivation	2.1	1.1	1.9	0.9	0.2	2.5	1.1	1.9	0.9	0.6

Note: For each measure, higher scores indicate higher levels of the variable, except for emotional adjustment where higher scores indicate lower levels of adjustment.

[a] A positive value indicates that offenders have a higher mean than students; a negative value indicates that students have a higher mean than offenders.

[b] For each attitude measure, higher scores indicate non-safety orientated attitudes.

Table 5.11
Summary of ANOVA results (F-Ratios) for personality and attitudinal measures

Measures [a]	Main effects		
	Group	Sex	Interaction
Personality			
Assertiveness	33.9**	3.6	1.9
Depression	0.4	0.6	1.8
Emotional adjustment	10.1**	17.2**	1.6
Sensation seeking	0.6	27.6**	<0.1
Mild social deviance	25.0**	11.4**	0.2
Hostility and aggression			
Assaultiveness	10.8**	40.6**	0.1
Indirect hostility	7.6**	69.6**	3.7
Verbal hostility	0.1	18.7**	0.2
Irritability	5.8*	0.7	0.1
Resentment	0.5	1.6	<0.1
Driving-related			
Aggression	23.3**	6.0*	1.3
Competitive speed	9.4**	72.5**	0.2
Inhibition	<0.1	12.9**	5.1*
Tension reduction	12.2**	3.0	3.9*
Risky driving style	3.2	26.5**	0.3
Attitudes			
Speeding acceptable	0.6	20.7**	0.3
Drink driving acceptable	26.6**	0.7	<0.1
Low risk of dying in crash	20.2**	7.6**	<0.1
Friends don't drive safely	10.4**	15.5**	0.5
Low likelihood of being caught	11.0**	7.7**	0.4
Lack of concern for hurting others	3.8	35.4**	4.2*
Poor driving skill	0.9	0.2	0.4
Low safety motivation	18.9**	2.5	3.8

[a] ANOVA N=606, df=1,602.
*p<.05, **p<.01

The attitudinal measures specific to road safety suggested that offenders were less likely than students to hold safety-oriented attitudes. Offenders reported a more favourable attitude towards drink driving, were less apprehensive about the risk of dying in a crash, were less likely to report friends driving safely, and were less motivated to drive safely than students. A significant interaction was evident for concern about hurting others in a crash, with male offenders being less concerned than

female offenders. In comparison to students, offenders perceived that there was a greater risk of detection for a traffic offence, most likely because they were caught committing traffic offences. Of these differences in attitudes, attitude towards drink driving, the risk of dying in a crash, and safety motivation (for females only) were of a medium effect size; the remainder were small.

Although not a primary focus of the study, a number of sex differences were found. With respect to personality variables, males reported higher motivation for sensation seeking and mild social deviance than females. Males were also more emotionally well adjusted than females. As for hostility measures, males expressed hostility more overtly with high levels of assaultiveness and verbal hostility, while females expressed hostility more indirectly. Furthermore, males reported higher levels of driving-related aggression, competitive speed, had a riskier driving style, and were less inhibited when driving than females. For attitudinal measures, males had less safety-oriented attitudes than females; they had more favourable attitudes towards speeding, were less concerned about dying or hurting others in a crash, were less likely to report friends driving safely, and perceived there was a lower risk of detection when committing a traffic offence.

5.3.5 Alcohol Consumption

Just over 88 per cent of offenders reported drinking alcohol compared to 90 per cent of students. Respondents who reported drinking alcohol were asked how many standard alcoholic drinks they would consume on a typical drinking occasion. The response categories and the distribution of standard alcoholic drinks consumed by group and sex is given in Table 5.12.

Table 5.12
Number of standard alcoholic drinks consumed per occasion by group and sex

Number of drinks	Males (%)		Females (%)	
	Offender (*N*=227)	Student (*N*=72)	Offender (*N*=57)	Student (*N*=172)
1-2 drinks	11.0	13.9	17.5	22.7
3-4 drinks	17.2	18.1	24.6	35.5
5-6 drinks	17.2	25.0	24.6	23.3
7-9 drinks	22.9	20.8	12.3	16.3
10+ drinks	31.7	22.2	15.8	2.3

Offenders consumed more alcoholic drinks per occasion than students ($\chi^2(4)=42.4$, $p<.001$). To account for the greater number of males in the offender group, separate analyses for males and females were performed. Females' alcohol consumption differed by group membership ($\chi^2(4)=16.9$, $p=.002$) but males did not ($\chi^2(4)=3.9$, $p=.414$). Female offenders reported consuming more drinks than female students. For example, 16 per cent of female offenders reported drinking ten or more standard alcoholic drinks per occasion compared to 2 per cent of female students ($\chi^2(1)=12.1$, $p<.001$).

5.3.6 Driver Record Follow-Up

Official driver records for the 12-month period following the initial survey were examined to determine whether young offenders continued to record more crashes and traffic offences than the student group. The percentage of young drivers with at least one crash or traffic offence in the 12 month period can be seen in Figure 5.1 by group and sex. Both male and female offenders continued to be detected for more traffic offences than the respective male and female student groups ($\chi^2(1)=14.7$, $p<.001$, $\chi^2(1)=6.0$, $p=.014$, respectively). There were no group differences for crashes among males or females although there was a trend among male offenders for greater

crash involvement than male students ($\chi^2(1)=0.2$, $p=.640$, $\chi^2(1)=0.1$, $p=.757$, respectively).

Some young offenders had their provisional driver's licence disqualified during the 12-months following the initial survey. Consequently, not all offenders were driving during the entire follow-up period and, therefore, had less opportunity to be crash involved or to commit traffic offences. To account for potentially reduced driving exposure, traffic offences were reanalysed excluding drivers disqualified for more than one month during the follow-up period ($n=53$). Similar results were found for males ($\chi^2(1)=9.8$, $p=.002$), but for females, the results were no longer statistically significant ($\chi^2(1)=3.1$, $p=.076$). Male offenders reported greater driving exposure than male students. However, the difference in driving exposure was not sufficient to explain the greater proportion of traffic offences among male offenders.

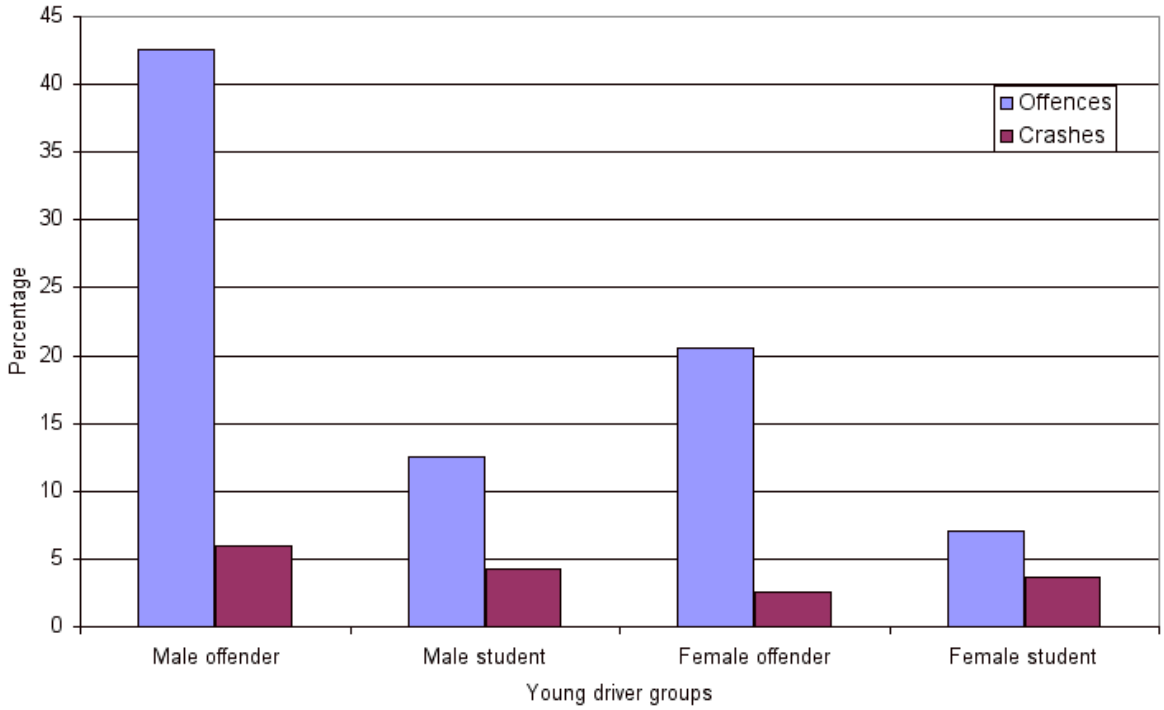

Figure 5.1. Percentages of young drivers with at least one crash or traffic offence during the 12-month follow-up by group and sex

Ignoring sex differences, almost 39 per cent of offenders (72 males, 8 females) were detected for at least one traffic offence in the following year in contrast to nine

per cent of students (6 males, 10 females; $\chi^2(1)=48.2$, $p<.001$). In comparison, information from the DRIVERS traffic offence database indicated that 15 per cent of young drivers (aged 16 to 24 years) on a provisional licence in South Australia, during 2004, committed at least one traffic offence in that year[7]. Thus, while students were detected for fewer offences than other provisional drivers, offenders recorded about 2.6 times as many.

Approximately 5.3 per cent of offenders recorded at least one crash in the following 12 months, compared to 3.7 per cent of students ($\chi^2(1)=0.6$, $p=.455$). Both offenders and students recorded less crash involvement than the general population of young South Australian provisional licence drivers (5.7%) in 2004[8].

To examine official driver records during the 12-month follow-up period in detail, the mean number of crashes and traffic offences for offenders and students were compared (see Table 5.13). Given the small number of crashes, the severity of crashes is not reported in the table. Two-way ANOVAs (group x sex) were conducted to account for the different sex compositions of the groups. The results are given in Table 5.14.

7 Information obtained from DRIVERS database, maintained by Registration and Licensing, Department for Transport, Energy and Infrastructure (18 October, 2005).

8 Information obtained from Traffic Accident Reporting System (TARS) database, maintained by Traffic Information Management Systems, Department for Transport, Energy and Infrastructure (8 September, 2005). Only crashes in which the Provisional licence holder was the driver of a car, or car derivative were included.

Table 5.13
Summary of means and standard deviations for official driver record measures for males and females during the 12-month follow-up

	Males					Females				
	Offender (*N*=169)		Student (*N*=48)			Offender (*N*=39)		Student (*N*=140)		
Driver record measure	Mean	*SD*	Mean	*SD*	*d* [a]	Mean	*SD*	Mean	*SD*	*d* [a]
Total no. of crashes	0.07	0.27	0.04	0.20	0.12	0.03	0.16	0.04	0.19	-0.05
Responsible for a crash	0.04	0.19	0.00	0.00	0.24	0.03	0.16	0.03	0.17	0.00
Traffic offences	0.75	1.16	0.13	0.33	0.60	0.26	0.60	0.09	0.41	0.37

Note: Two decimal places were given in this table because there were very few crashes or traffic offences.
[a] A positive value indicates that offenders have a higher mean than students; a negative value indicates that students have a higher mean than offenders.

Contrary to official driver records before the initial survey, there were no differences for the total number of crashes or responsibility for the crash by either group or sex in the following 12 months. However, consistent with official driver records prior to the survey, the mean number of traffic offences differed between the two groups, and the effect sizes were medium to large. An interaction effect indicated that male offenders had more traffic offences than male students and female offenders.

Table 5.14
Summary of ANOVA results (F-ratios) for official driver record measures during the 12-month follow-up

	ANOVA [a]		
Driver record measure	Group	Sex	Interaction
Total no. of crashes	0.1	0.7	0.4
Responsible for a crash	0.7	0.2	0.9
Traffic offences	15.1**	6.7*	5.1*

[a] ANOVA *N*=396, *df*=1,392.
*p<.05, **p<.01

To account for potentially reduced driving exposure, crash and offence records were reanalysed excluding offenders who had their licence disqualified for more than a month during the follow-up year (n=53). Offenders recorded more traffic offences than students F (1, 339) = 12.5, p<.001, η^2 = .04 and there was no difference for crashes F (1, 339) = <0.1, p=.909, η^2 = 0. The finding for traffic offences is important because it suggests that even though the offenders participated in an intervention program (the effect of this intervention is unknown at present), this group is still more likely to be detected committing traffic offences than students.

5.4 Discussion

The analyses presented in this chapter have provided a profile of the personality characteristics, attitudes, driving behaviours, and driver records of young traffic offenders, a group caught engaging in risky driving behaviour, in relation to a comparison group of young drivers who were university students.

Initial examination of driver history, both self-report and official records, provided evidence that the young offender group were at a higher risk of crashing than the student group. When the greater driving exposure of offenders was taken into consideration (self-reported data only), offenders were still more likely to be involved in more serious or personal injury crashes but the effect for the total number of crashes disappeared. However, due to a methodological issue associated with the driving exposure measure, this finding should be interpreted with caution. The finding for personal injury crashes can be partly attributed to the offender selection criteria; some drivers (n=20) were required to attend a DIP session after serious crash involvement (the result of committing a traffic offence). Offenders also recorded many more traffic offences than students, an obvious finding given the selection criteria of the offender group.

Thus, there is some evidence supporting the assumption that the offender group were at higher risk in traffic than the student group.

5.4.1 Personality Characteristics

Personality traits, by definition, are relatively stable over time and cannot be manipulated by modest psychological means over a short period. However, understanding the personality profiles of young offenders will assist in matching interventions to their needs. Examination of personality factors in the present study indicated that offenders, in comparison to students, were characterised by high levels of assertiveness and were emotionally well adjusted (the latter for males). Although included under the heading "personality", the measure of depression reflected a depressed mood rather than a clinical form of depression. Nonetheless, there was no difference in the level of depression between the two groups.

Male offenders were more emotionally well adjusted than male students. Considering that the offender group were primarily caught for speeding, this finding is somewhat consistent with findings from a recent longitudinal study of young Australian drivers that examined emotional adjustment and speeding offences (Smart *et al.*, 2005). Smart and colleagues (2005) reported that young drivers with multiple speeding offences were more emotionally well adjusted (low anxiety and depression) than those without speeding offences. Lajunen (2001) offers a plausible explanation based on similar findings among crash involved drivers. While low levels of emotional stability may adversely effect driving (see Mayer & Treat, 1977), high levels, expressed as overconfidence or lack of concern, may actually encourage risky driving. In the present study, offenders were less concerned about hurting others in a crash, although the effect size was small. Nevertheless, offenders appeared to have normal personality profiles; they were not experiencing personal or emotional difficulties as measured by these variables. The combination of these characteristics suggest that offenders feel that they are in personal control of their lives and have the

ability to alter their behaviour if they wish.

Young drivers may engage in risky driving behaviour to satisfy a need for stimulation or excitement (e.g., Beirness & Simpson, 1988; Rimmö & Aberg, 1999; Rimmö & Aberg, 1996; Stevenson *et al.*, 2001). Indeed, young traffic offenders have been found to have high levels of sensation seeking (Renner & Anderle, 2000; Trimpop & Kirkcaldy, 1997). Contrary to this research, young offenders in the present study were not motivated to seek thrills or excitement any more than the comparison group.

Also contradicting previous research, mild social deviance, a measure of antisocial motivation, was found to be lower in offenders than students. This surprising finding contradicts studies that have reported a relationship between mild social deviance and self-reported higher driving speeds, traffic violations and crash involvement (Lawton et al., 1997b; West et al., 1993; West & Hall, 1997).

To summarise, in contrast to the students, the profile of personality characteristics for offenders suggest that they are both socially and personally well adjusted, at least on the measures employed in this study.

5.4.2 Hostility and Driving Aggression

An important finding from this study was that there were group differences on some measures related to hostility and aggression. Offenders expressed hostility overtly (i.e., higher levels of assaultiveness) while students expressed hostility indirectly and with little provocation (i.e., irritable). Thus, offenders were no more hostile or aggressive than students were but they expressed hostile feelings by more physical means that may harm others. The tendency to express hostility overtly or physically has been associated with young drivers who self report engaging in risky driving behaviour such as speeding or dangerous overtaking (e.g., Begg & Langley, 2004; Deery et al., 1998; Ulleberg & Rundmo, 2003) and was also found to increase

the likelihood of aggressive driving behaviour and crash involvement (Lajunen & Parker, 2001; Wilson & Jonah, 1988).

Indeed, offenders reported higher levels of driving-related aggression than students, and male offenders reported higher levels of driving to reduce tension than did male students. Findings of more aggressive behaviour in the driving context among offenders is consistent with previous research that has associated driving aggression with increased young driver crash risk and traffic offences (e.g., Begg & Langley, 2004; Deery et al., 1998). Moreover, the reported higher levels of driving-related aggression in offenders, relative to university students, is consistent with a study by Miles and Johnson (2003). Note that Miles and Johnson (2003) found multiple traffic offenders reported more aggressive driving behaviour than students but the present study reported similar finding for predominantly first time offenders. The size of this effect was similar in both studies, but it was not large. Unlike Miles and Johnson's study, the present study controlled for divergent age distributions by examining only young drivers (aged 25 years and under) and also accounted for sex differences.

It is important to note that personality traits (i.e., hostility) are resistant to change, but behavioural manifestations of these traits in the driving context (i.e., driving aggression, using driving to reduce tension) have been learned and are, therefore, more amenable to change. Indeed, there have been reports of successful psychological interventions to reduce driving anger and, subsequently, driving aggression. For example, Deffenbacher and colleagues (2000) reported positive results for relaxation and cognitive restructuring interventions. However, as the difference in driving-related aggression between offenders and students in the present study was not large, such an intensive intervention may not be necessary for these young offenders.

It has been shown that individuals with a predisposition for hostility (verbal),

in combination with a state of aggressiveness (i.e., angry mood), usually in response to other drivers or frustrating situations, were likely to exhibit driving aggression (Lajunen & Parker, 2001). Therefore, instead of psychological interventions, it may be beneficial for offenders to discuss ways of expressing anger and aggression other than on the road and to discuss effective strategies to manage hostile feelings and anger arising from situations when driving. Developing effective strategies to deal with hostile feelings and tension would be particularly relevant to male offenders who reported using driving as an outlet to express these feelings. The inability to deal with such feelings and the resultant misuse of driving to release tension has previously been associated with crash involvement among young males (Donovan et al., 1983; Schuman et al., 1967).

In summary, the driving behaviour of young traffic offenders did not appear to be motivated by sensation seeking, or to serve as a response to personal or emotional problems. Rather, it appeared to function as a means of releasing tension and aggression in drivers with a predisposition for overt hostility.

5.4.3 Driving-Related Attitudes

Driving style is the manner in which people choose to drive (e.g., driving speed, how closely one follows behind the car in front), and these choices may reflect individual attitudes and beliefs of drivers (Elander *et al.*, 1993). A risky driving style has previously been associated with high-risk young drivers (Baxter et al., 1990; Deery et al., 1998). Given that offenders were detected committing traffic offence(s), it was surprising that offenders were no more likely to report a risky driving style than students. Furthermore, the majority of offenders were detected for speeding offences so it was unexpected that they had lower scores on competitive speed (i.e., using speed to be competitive or aggressive when driving) than students and that there was no difference in their attitude toward the acceptability of speeding. The latter observation does not support Sarkar and Andreas' (2004) finding that young traffic

violators viewed speeding less seriously than high school students.

Reasons for these results remain speculative, but it is possible that the offender's attitude towards speeding was influenced by actually being caught speeding and receiving a penalty. The observation that offenders perceived a greater likelihood of detection when committing a traffic offence than students is consistent with this interpretation. Alternatively, the driving behaviour of the two young driver groups may be similar, a possibility supported by the finding that risky driving style did not differ between the two groups. However, the offenders were actually *caught* committing traffic offences while the risky driving behaviour of students was not detected as frequently. This reasoning is consistent with Steinberg's (2004) view that heightened risk-taking is normative for young drivers during adolescence.

The greatest contrasts between the two groups were found for some of the road-safety-related attitudinal measures. As predicted, offenders had significantly less safety-oriented attitudes towards road safety issues than students; they were more sympathetic to drink driving, perceived a lower risk of dying in a crash, and had a lower safety motivation. Although only a small difference was found, offenders reported that their friends did not drive safely and male offenders expressed a lack of concern for hurting others in a crash compared to male students. Together, these attitudes suggested that the offenders: perceived risky behaviour (drink driving) as acceptable, did not perceive the risk or consequences of crashing as serious, and had low motivation to alter their behaviour. Moreover, their social norms indicated that unsafe driving was common among their peers, suggesting that offenders might be more likely to exhibit unsafe driving. This pattern of attitudes is broadly consistent with previous research that has shown that non-safety-oriented attitudes are prevalent among high-risk young drivers (e.g., Beirness & Simpson, 1988; Ulleberg & Rundmo, 2002).

The existence of attitudes promoting engagement in risky driving behaviour

suggests that a change in offenders' attitudes is desirable. However, changing attitudes is clearly not an easy task and some researchers (e.g., Burgess & Webley, 1999) suggest that attitude change is more likely to follow behaviour change, rather than vice versa.

5.4.4 Sex Differences

Consistent with previous research, young male and female drivers differed on a number of personality characteristics, driving-related attitudes, and behaviour; males reported higher levels of sensation seeking (Jonah, 1997; Zuckerman, 1984), mild social deviance (West et al., 1993; West & Hall, 1997), overt hostility (Buss & Durkee, 1957), driving aggression (Parry, 1968), competitive speed (Mayer & Treat, 1977), and risky driving behaviour (Arnett et al., 1997). Males also exhibited more non-road safety oriented attitudes (Stradling & Meadows, 2000) than females. Given the characteristics and attitudes associated with males, it was not surprising that they had more self-reported and officially recorded crashes and traffic offences than females.

Two theoretical perspectives have attempted to explain the higher rates of risk taking and aggression in young males, particularly overt physical aggression and its prevalence in driving-related behaviour. The first focuses on social roles while the second centres on evolutionary development. From the social role model perspective, young males may be aggressive because of an individual's social learning experiences and social pressure (Eagly & Wood, 1999). Role socialisation rewards males for being assertive and dominant, and this behaviour may be carried into the driving context (Krahe & Fenske, 2002). Alternatively, male aggression and risk taking may be "shaped by evolutionary forces to provide a fitness value" (Nell, 2002) (p. 75). Engaging in these behaviours, young males establish a reputation for strength that makes them attractive mating partners and wards off potential male rivals.

Consumption of high levels of alcohol has been considered part of a general

risk-taking propensity related to the lifestyle of high-risk young drivers (Gregersen & Berg, 1994; Jonah, 1986) and has also been associated specifically with risky driving behaviour among young drivers (e.g., Horwood & Fergusson, 2000). Interestingly, female offenders reported higher alcohol use than female students, consistent with some previous studies (Dobson *et al.*, 1999; Shope et al., 2001b). Even though males reported higher alcohol use than females, there were no group differences. The finding for females suggests that even though they might be characterised by less risky attributes and more safety oriented attitudes than males, those females that are at a higher risk of crashing can be identified by high alcohol consumption.

5.4.5 Psychological Profile of Offenders

The findings from this study suggest that the young offenders, a group shown to have a poor driving record, were personally well-adjusted but with some driving-related aggressiveness, relative to students. This profile of characteristics shows that offenders were not an extreme group of seriously disturbed young drivers but relatively normal in psychological terms.

Studies that have identified a number of these characteristics (e.g., sensation seeking, competitive speed, mild social deviance, risky driving style) in groups of traffic offenders (Deery & Love, 1996; Donovan et al., 1985; Wilson, 1991) examined populations of more serious traffic offenders (i.e., convicted drink driving offenders, multiple offenders). It appears that there is a continuum of psychological well-being operating among traffic offenders, with the degree of personality dysfunction being related to the severity and types of traffic offences committed. In the present study, young offenders were predominantly detected for speeding offences and may have committed only a single traffic offence. Thus, the results apply to these specific types of offenders (i.e., not drink driving recidivists, multiple offenders etc.). To further explore the concept of a continuum of psychological functioning, future research

could examine the personality characteristics and attitudes of young traffic offenders by traffic offence type.

The finding that young offenders were not psychologically deviant is consistent with an Austrian study that examined a similar type of young traffic offender (Renner & Anderle, 2000). The young Austrian traffic offenders were assigned to a psychological training course; the majority attending the course committed speeding offences and 80 per cent were first time offenders. In comparison to students, young traffic offenders scored higher on extraversion and venturesomeness but the authors concluded that overall young offenders conformed to normal personality functioning rather than deviant.

In summary, the risky driving behaviour of offenders (evident in their driver records) did not appear to be motivated by sensation seeking, or serve as a means of coping with personal or emotional problems. Rather, it appeared to function as a means of releasing tension and aggression in drivers with a predisposition for overt hostility. Offenders higher offence rate may have also functioned as a means of impressing their friends who they reported did not drive safely. Alternatively, it may have served a purpose not explored in the present study, such as an instrument for establishing self-identity or independence.

5.4.6 Follow-Up Driver Record

At the time the initial survey was conducted, offenders had recorded more crashes and traffic offences than students. The difference in driver records between groups, particularly for traffic offences, was most likely a function of the selection criteria for the groups. Examination of driver records in the following 12 months revealed that offenders continued to be detected by police for more traffic offences than students. Given that all drivers in the offender group committed at least one traffic offence, it is important to remember that not all offenders persisted in re-offending; 39 per cent recorded a subsequent traffic offence. Although purely

speculative, this reduction may have been attributable to offenders' participation in the intervention program. Alternatively, it may be the result of increased driver maturity or driving experience. It is also possible that the reduction in traffic offences was simply the result of regression toward the mean. Nevertheless, the proportion of re-offenders was much greater than the proportion found for all young South Australian provisional licence holders, aged 16-24 years, in 2004 (39% vs. 15%).

Although offenders were found to have had more crashes than students prior to the initial survey, in the following 12 months, they were no more likely to be involved in a crash or be deemed responsible for a crash. However, there was a trend among male offenders for greater crash involvement than male students. Again, one might speculate that the intervention program had some effect on the crash involvement of offenders. It is also plausible that no difference was found during the follow up period because few young drivers recorded any crashes. Crashes are infrequent events and the 12-month follow up period was somewhat limited. Furthermore, the low number of crashes may be compounded by the use of official driver records that tended to underestimate crash involvement. Other researchers have observed the same problems with crash data when examining individual drivers; crash data lacks stability and statistical power (Ranney, 1994). Further research might work towards overcoming some limitations of crash data by following the crash (and traffic offence) records of these drivers for a number of years. Note that some offenders were disqualified during the following 12-month period but further analyses indicated that this reduced driving exposure did not appear to have any effect on the results.

Nonetheless, the group of young traffic offenders in the present study continued to be detected for traffic offences (i.e., some offenders became multiple offenders), and there was a trend among males for greater crash involvement than students. Therefore, there is justification for this high-risk group to continue to be

targeted with interventions matched to their motivations and needs as identified in this study.

5.4.7 Limitations

Several limitations of the current study necessitate some caution when interpreting the findings. The comparison group may not be representative of the general young driver population in South Australia. The offender and student groups differ in their social background; obviously, students had a higher level of education than offenders. Nevertheless, the student group does represent a comparable group of young drivers on a provisional licence, thus providing a match for licence conditions. Moreover, there were few differences between the groups on background variables other than sex (which did not present a problem).

Another limitation is that in the absence of information on the normative levels of the measures in the general driving population, it cannot be established whether the levels of characteristics or attitudes of the student group are similar to the general driving population. Thus, offenders can only be characterised relative to the students. Certainly, higher levels of some of the personality characteristics examined may be found in young drivers (both offenders and students) than drivers in general.

A further limitation of the study is the self-reported nature of the data. Although validated scales were used whenever possible, many of the measures of individual differences were based on self-report, providing an opportunity for drivers to give a “good” or socially desirable account of themselves.

The failure to find differences between the groups for several measures may be attributable to insensitive measures. Due to time constraints, some of these measures were shorter than the original scales. However, despite fewer items in each scale, most alpha coefficients were satisfactory.

Another limitation is that the measure of driving exposure relied on self-report

estimates rather than actual kilometres driven. Even though the estimated number of kilometres driven was a crude measure, it provided a more accurate estimate of driving exposure than the elapsed time since obtaining a drivers licence because it accounted for wide individual variability in actual time spent driving. However, as discussed earlier, the different methods of asking participants to estimate the distance they had driven in the past week may have contributed to the large difference in driving exposure between the two groups.

Finally, all of the offenders participated in the Driver Intervention Program (DIP), a discussion group based intervention that aimed to reduce young driver crashes. It is possible that participating in the DIP session might have influenced the subsequent driver behaviour (i.e., traffic offences and crashes) of offenders.

5.4.8 Summary

The analyses presented in this chapter have provided some evidence that the profile of individual personality characteristics, attitudes, and driving behaviours of young traffic offenders, drivers caught engaging in risky driving behaviour, differs from that of a comparison group of young drivers. However, the magnitude of these differences was not strong, and overall, the profile suggested young traffic offenders had relatively normal personality profiles.

Of note, there were some differences on measures related to aggression. Young offenders reported higher levels of driving-related aggression than did students and young male offenders reported higher levels of driving to reduce tension than did young male students. In addition, offenders generally had less safety-oriented attitudes towards road safety issues than the student group. Female offenders also reported higher alcohol use than female students.

The fact that offenders were not distinguishable from students on a number of measures suggests that there is substantial within-group variability. Several studies provide evidence of subgroups within the young driver population, that is, subgroups

of young drivers defined by a combination of characteristics (Deery et al., 1998; Ulleberg, 2001).

The next chapter attempts to identify and validate young driver subtypes in the student sample, based on the characteristics and attitudes examined in this chapter. In addition, Chapter 7 examines whether there are subtypes of drivers with a higher risk of crashing among the young traffic offender group.

CHAPTER 6 IDENTIFYING YOUNG DRIVER SUBTYPES[9]

6.1 Introduction

Young drivers are not a homogenous group. Developing effective interventions and other road safety countermeasures for them is, therefore, difficult. Interventions may become more useful if they are tailored to the needs of specific subgroups of young drivers who are at high-risk of crash involvement. The concept of subgroups of "young problem drivers" has been proposed and there is some limited evidence supporting the existence of such groups.

The characteristics defining high-risk young driver subtypes are likely to include personality factors, motivations, driving related attitudes, and driving behaviours. A review of personality and road safety literature in Chapter 4 showed that some selected personality and attitudinal factors were associated, to varying degrees, with risky driving behaviour and crash involvement among young drivers. In Chapter 5, a profile of young drivers was developed based on the characteristics of young traffic offenders who were caught engaging in risky driving behaviour. However, a single profile conceals the diversity of this population and many of these characteristics co-occur in individuals and interact with other factors.

Several studies have identified high-risk driver subtypes based on a combination of these personality measures and attitudes, using multivariate techniques such as cluster analysis. However, these studies were based on samples of mainly male adult drivers already considered to be at high-risk for crashes, such as convicted drink driving offenders (Donovan & Marlatt, 1982; McMillen et al., 1992b; Wells-Parker *et al.*, 1993) and drivers detected for multiple traffic offences, or involved in multiple crashes (Donovan et al., 1988; Wilson, 1991). Nevertheless, the

[9] This chapter contains material that was presented in a somewhat different form in: "Wundersitz, L., & Burns, N. (2005). Identifying young driver subtypes: Relationship to risky driving and crash involvement. In Dorn, L. (Ed) Driver Behaviour and Training: Volume II (pp. 155-168). Aldershot: Ashgate."

results from these studies suggest similar combinations of personality traits are related to risky driving and crash involvement. For example, Donovan et al. (1988) and Wilson (1991) both found a high-risk driver subtype characterised by driving-related aggression, hostility, sensation seeking, competitive speed and driving to reduce tension; and a second cluster with similar attributes combined with high levels of emotional instability and depression.

Three more recent studies (Beirness, 1993; Deery et al., 1998; Ulleberg, 2001) have attempted to identify subtypes from young novice driver populations and they reported high-risk profiles with some shared characteristics. High-risk subtypes were characterised by high levels of sensation seeking and driving-related aggression, and they reported risky driving behaviour and poor driving records. Some high-risk subtypes also reported emotional problems. However, these drivers had limited driving experience, the method for determining the number of clusters in these studies differed, and each study used different personality variables. Cluster analysis has been criticised for its subjectivity and its sensitivity to the choice of variables and different clustering methods. Thus, more research is needed to confirm the validity of high-risk young driver subtypes.

To guide the development of road safety interventions, the present study aimed to ascertain which personality characteristics define high-risk young drivers and to identify subtypes in the young driver population. To validate and understand the characteristics defining young driver subtypes, it is important to replicate a study that identified young driver subtypes and to extend the generalisability of findings. A decision was made to replicate the study by Deery et al. (1998), a study that identified subtypes of novice young Australian drivers. Consequently, a cluster analysis was performed on the same personality variables as used in the study by Deery et al. (1998), to identify clusters or subtypes among a young driver population with some unsupervised driving experience. The cluster solution was validated against a number

of demographic, attitudinal, and behavioural measures not included in the original cluster analysis.

To improve the validation of young driver subtypes, and increase the level of driving experience, this study has introduced several changes to the sampling design used by Deery et al (1998). The major differences between the two studies are outlined. Firstly, to ensure all participants had some unsupervised driving experience, they were required to hold a provisional drivers licence. Instead of recruiting participants from licensing centres immediately after undertaking their provisional licence test, participants were recruited from a population of university students with varied driving experience and driving exposure. Second, in contrast to Deery et al's study, drivers were not paid for their participation, thus, eliminating some biases associated with monetary incentives. Instead, participants received course credit.

This study also initiated several methodological changes. The questionnaire was Internet based, rather than using pen and paper. Consequently, participants could complete the questionnaire at a time convenient to them. To determine whether crash and traffic offence driver records were associated with greater driving exposure, rather than cluster membership, a measure of driving exposure (estimated kilometres driven in the last week) was added to the questionnaire. Finally, in addition to self-reported crashes and traffic offences, the official driver records of consenting participants were examined both before and after questionnaire completion.

6.2 Methodology

6.2.1 Participants

The participants in this study were the same group of university students described in Chapter 5 (see section 5.2.1 for details). To summarise, the sample consisted of 270 young drivers (192 females, 78 males) aged 17 to 21 years (*M*=18.1,

SD=0.7). Participants were required to hold a current South Australian provisional driver's licence ensuring all had some unsupervised driving experience.

6.2.2 Questionnaire

Participants completed an extensive self-administered Internet based questionnaire measuring demographic information, personality characteristics, driving related attitudes and behaviours, and self-reported driving record. The self-report questionnaire was based on a questionnaire originally developed by Donovan and Marlatt (1982) and more recently adapted by Deery et al. (1998) to identify subtypes among young novice drivers. The questionnaire used in this study is the same as the questionnaire described in Chapter 5 but there are a number of additional items and scales (i.e., the questionnaire described in Chapter 5 is a shorter version of this questionnaire). The questionnaire used in this stuidy was comprised of 189 questions and divided into eight sections. A copy of the questionnaire is presented in Appendix C. Participants took approximately 30 to 40 minutes to complete the questionnaire.

The questionnaire is described here briefly but the reader is referred to in Chapter 5 (section 5.2.2) for further details about each scale. The first section of the questionnaire sought information on a number of general demographic and background factors including driving exposure (estimated number of kilometres driven and time spent driving in the last week).

The second section of the questionnaire consisted of 107 true-false items measuring general personality traits: assertiveness (10 items; Rathus, 1973), depression (10 items, mood rather than clinical symptoms; Costello & Comrey, 1967), emotional adjustment (6 items; Howarth, 1976), sensation seeking (full 10-item subscales of Thrill and Adventure Seeking and Disinhibition scales; Zuckerman, 1971), and five measures hostility/aggression expression: assaultiveness (10 items), indirect hostility (9 items), verbal hostility (13 items), irritability (11 items), and resentment (8 items) (Buss & Durkee, 1957). In addition, a ten-item measure of locus

of control, that is, a person's belief about the nature of the world was included in this questionnaire. Five internal and five external items were derived from an abbreviation (Valecha & Ostrom, 1974) of Rotter's (1966) scale.

In a following section of the questionnaire, 31 true-false items measured a variety of driving-related attitudes and behaviours: driving aggression (12 items; Parry, 1968), an attitude of competitive speed (6 items; Goldstein & Mosel, 1958), driving inhibition (3 items; Donovan & Marlatt, 1982), and the extent to which driving was used to reduce tension (4 items; Mayer & Treat, 1977; Pelz & Schuman, 1971). An additional six-item measure of the perceived causality of, or responsibility for, a crash (Goldstein & Mosel, 1958) was included in this questionnaire. Donovan and Marlatt (1982) noted that this scale might be interpreted as measuring locus of control in a specific driving-related context. Two of the items attribute responsibility for a crash externally while the four remaining items attribute responsibility for a crash to personal or internal control.

The remaining sections of the questionnaire (sections 3 and 5-8) were comprised of measures that were excluded from the cluster analysis used to define the young driver clusters. These measures functioned as external variables to test the validity of the cluster solution and included: a measure of mild social deviance (9 items; West et al., 1993), self-reported driving style or risky driving (9 items; Deery & Love, 1996), eight separate items measuring specific driving attitudes, and alcohol consumption which is another measure of high-risk behaviour.

The third section of the questionnaire was an addition to the previous questionnaires used by Donovan and Marlatt (1982) and Deery et al. (1998) and the questionnaire described in Chapter 5. The Excitement Seeking subscale from the Revised NEO Personality Inventory (Form S; Costa & McCrae, 1991) was included to provide an alternative measure of sensation seeking. Excitement seeking is one of six facets from the NEO Inventory measuring the personality factor "Extraversion".

High scorers on this subscale crave excitement and stimulation (Costa & McCrae, 1991). Participants responded to the eight items on a five-point Likert scale ranging from 1 = “strongly disagree” to 5 = “strongly agree”.

Participants self-reported their driving history (i.e., crashes and traffic offences) to determine whether membership in a high-risk group was associated with previous crashes and traffic offences. Descriptive statistics for all the scales used in the cluster analysis and the subsequent cluster validation are summarised in Table 6.1 in Section 6.3.1.

6.2.3 Official Driver Records

Participant’s driver records were tracked for any crashes and traffic offences occurring in the 12-month period following questionnaire administration to determine if high-risk subtypes were more likely than other subtypes to be involved in subsequent crashes or re-offend. About 70 per cent (*N*=188) of respondents gave consent to release their driver records. It is acknowledged that some drivers were disqualified for some, or even all of this period. The method of obtaining official driver records is described in detail in Chapter 5 (see section 5.2.4).

6.2.4 Procedure

The procedure used to recruit the university students to participate in the study is described in the previous chapter (see section 5.2.5).

6.2.5 Statistical Analyses

Exploratory factor analyses examined the internal structure of the scales to verify the number of factors underlying each scale. Rather than using a matrix of Pearson correlations, factor analysis was conducted on matrices of tetrachoric and polychoric inter-item correlations (Flora & Curran, 2004). For a detailed description of the factor analysis methodology, see section 5.2.3.1 in the previous chapter. Cronbach’s alpha coefficients were calculated to assess the internal consistency or

reliability of items within each scale. Results from these two analyses are given in section 6.3.1.

6.2.5.1 Cluster analysis

Cluster analysis is a multivariate statistical procedure that can identify homogenous subgroups of cases in a sample based on selected characteristics. It seeks to both minimise within-group variation and maximise between-group variation. In the present study, cluster analysis was used to identify subtypes among a sample of young drivers. Cluster analysis uses “distance” from the mean to group together participants with similar profiles, or patterns of scores, on the variables measured. In this study, the cluster analysis was based on scores derived from general personality measures, hostility and aggression measures, and driving-related attitudes using the squared Euclidean distance measure (the sum of the squared differences between matching variables for each case). Standardised scores of the variables were used to avoid the problem of comparing Euclidean distances based on different measurement scales (Everitt, 1993).

Using the FASTCLUS procedure of SAS, Ward’s method for hierarchical clustering determined the number of subgroups, or clusters present in the data (Everitt, 1993). Ward’s method is designed to optimise the minimum variance within clusters criterion (Ward, 1963). This method functions by fusing groups or cases that result in the minimum increase in the error sum of squares, defined as the sum of distances from each participant’s profile to the centroid (i.e., the cluster centre mean) of its parent cluster (Donovan & Marlatt, 1982). Ward’s method has been widely used in the social sciences (e.g., Blashfield, 1980; Deery et al., 1998; Donovan et al., 1988).

Determining the optimal number of clusters in cluster analysis is still an unresolved issue, although both heuristic procedures and formal tests have been proposed. On the recommendation of Everitt, Landau and Leese (2001), the results of

several techniques were synthesised to determine the number of clusters in the current data set, rather than relying on a single rule. Milligan and Cooper (1985) compared 30 formal methods for determining the number of clusters. Three of the procedures that they identified as performing well in their simulation study were used in the present study: the Pseudo F statistic developed by Calinski and Harabasz (1974), the Cubic Clustering Criterion (CCC) (Sarle, 1983), and the statistic referred to as *Je(2)/Je(1)* (Pseudo t^2 statistic) by Duda and Hart (1973). The Ball and Hall (1965) method and an Isomap clustering visualisation were also used. A brief explanation of these procedures is provided in Appendix H.

Although hierarchical clustering methods such as Ward's are useful in determining the number of clusters present in the data, they are unable to separate clusters created at previous steps because they only pass through the data once (Gower, 1967). Thus, these methods cannot produce a cluster solution with optimal between clusters heterogeneity. Furthermore, outliers and ordering effects may also adversely influence Ward's method (Aldenderfer & Blashfield, 1984).

K-means clustering, an iterative partitioning method, produces *k* clusters by minimising the sum of the squared distances from the cluster means; that is, the procedure attempts to minimise the variance within each cluster. Unlike hierarchical agglomerative methods, which calculate and store matrices of similarities between cases, iterative methods work directly upon raw data. Consequently, larger data sets can be handled. Furthermore, iterative methods make more than one pass through the data and can compensate for poor initial partition of the data (Aldenderfer & Blashfield, 1984). However, the initial partition of the data or number of clusters must be specified *a priori*. Thus, in the final analysis, *k*-means clustering classified participants into the number of clusters initially identified by Ward's clustering technique. Cases were then assigned to the cluster with the nearest centroid (cluster centre mean). New cluster centroids were calculated after each complete pass through

data, until no more cases changed clusters. The clusters were exhaustive and mutually exclusive.

To validate the cluster solution, significance tests were performed to compare the clusters on relevant variables *not* used to generate the initial cluster solution. Aldenderfer and Blashfield (1984) argued that external validation is one of the best ways to validate a cluster solution but noted that this approach had been used infrequently despite its potential importance.

6.3 Results

6.3.1 Validation of Scales

Exploratory factor analysis examined the internal structure of the scales and reliability analysis assessed the internal consistency of each scale. In general, results indicated that the majority of scales had a reasonable degree of coherence. The results from principal-axis factoring, including factor loadings and communalities for each scale, are presented in Appendix F. Factor analysis was not completed for two scales (depression and driving aggression) because the polychoric correlation matrices were not positive definite. Instead, Pearson correlation matrices were used in the analysis of these scales. A one-factor solution was found for the majority of scales. Although the decision rules suggested a two-factor solution for several scales (i.e., assertiveness, indirect hostility, verbal hostility), the second factors were not interpretable so a one-factor solution was deemed acceptable. Descriptive statistics and alpha coefficients for scales with five items or more are presented in Table 6.1.

Table 6.1

Number of items, mean scores and Cronbach's alpha for all questionnaire measures (N=270)

Measures	No. of items	Range of scores	Mean	SD	Cronbach's alpha [a]
Personality					
Assertiveness	10	10-20	13.81	2.00	0.49
Depression	10	10-20	11.76	2.42	0.85
Emotional adjustment	6	6-12	8.32	1.70	0.65
Externality	5	5-10	6.90	1.32	0.51
Internality	5	5-10	7.23	1.31	0.45
Sensation seeking	20	20-40	30.48	3.96	0.76
Hostility and aggression					
Assaultiveness	10	10-20	13.42	2.30	0.68
Indirect hostility	9	9-18	14.29	1.87	0.56
Verbal hostility	13	13-26	20.14	2.61	0.65
Irritability	11	11-22	16.50	2.44	0.64
Resentment	8	8-16	11.06	1.98	0.63
Driving-related					
Aggression	12	12-24	15.27	2.29	0.71
Competitive speed	6	6-12	8.73	1.81	0.68
Externality	2	2-4	2.21	0.44	-
Internality	4	4-8	6.89	0.84	-
Inhibition	3	3-6	4.61	1.28	-
Tension reduction	4	4-8	5.49	1.45	-
Driving style	9	9-45	20.54	5.13	0.80
Mild social deviance	9	9-27	14.35	3.36	0.76
Excitement seeking	8	8-40	29.92	5.29	0.66
Attitudes					
Speeding	1	1-5	2.56	1.20	-
Drink driving	1	1-5	1.69	1.19	-
Risk of dying in crash	1	1-5	1.31	0.68	-
Peer influence	1	1-5	2.54	1.17	-
Likelihood of being caught	1	1-5	2.64	1.12	-
Concern for hurting others	1	1-5	1.26	0.65	-
Driving skill	1	1-5	2.00	0.88	-
Safety motivation	1	1-5	1.86	0.90	-

[a] Cronbach's alpha not calculated for scales with less than five items.

According to Nunnally's (1978) criteria, the alpha coefficient obtained for a scale should be equal or higher than 0.70 if a set of items are to make up a scale. The internal consistency of most scales was acceptable with alpha in the range of .70 to .85. However, some scales (i.e., assertiveness, internality) had a reliability level below the lowest acceptable level (α = .50). Alpha coefficients tend to increase as a function of the number of items comprising the scale (Nunnally, 1978). Thus, given the same average inter-item correlation, a satisfactory alpha can be more easily gained with many rather than few items. This item number sensitivity of alpha coefficients may be responsible for the lower reliability of several scales with relatively few items.

6.3.2 Cluster Profiles

Examination of several methods for determining the number of clusters (CCC, Pseudo F, Pseudo t^2, Ball & Hall, Isomap) from Ward's cluster analysis suggested that two, four or seven cluster solutions were viable. Specific results from these methods and visualisation can be seen in Appendix H. After inspecting the individual cluster profiles, a four-cluster solution was retained because all four clusters were theoretically meaningful and interpretable. The four-cluster solution was then forced into the final *k*-means cluster analysis. The standardised cluster means of the variables in the *k*-means analysis are presented in Table 6.2. The means in this table are standardised scores with higher scores indicating higher levels of the variable with the exception of emotional adjustment.

The patterns of cluster means indicated that Cluster 1, representing the largest proportion of the sample (32%), was the most inhibited while driving and reported the highest level of driving-related internality (i.e., perceived events to be within their personal control). They also had the lowest scores for driving-related aggression, competitive speed, driving to reduce tension, and for each of the five measures of hostility. The personality measures indicated that they had the lowest levels of sensation seeking, were emotionally well adjusted, and had low levels of depression.

Based on this description, young drivers in Cluster 1 would be expected to have a low risk of crashing.

Table 6.2
Mean standardised scores on the measures defining the young driver clusters

Measures	Cluster			
	1 (*n*=86)	2 (*n*=54)	3 (*n*=66)	4 (*n*=64)
Driving-related				
Aggression	-0.69	0.13	0.87	-0.07
Competitive speed	-0.66	0.05	0.52	0.31
Externality	-0.34	0.03	0.04	0.40
Internality	0.40	0.02	0.08	-0.63
Inhibition	0.32	-0.07	-0.54	0.20
Tension reduction	-0.27	0.20	0.29	-0.10
Personality				
Assertiveness	-0.14	-0.47	0.45	0.12
Depression	-0.41	1.44	-0.36	-0.29
Emotional adjustment	-0.30	1.09	-0.15	-0.36
Externality	-0.66	0.60	-0.21	0.61
Internality	0.11	-0.24	0.34	-0.30
Sensation seeking	-0.63	-0.10	0.24	0.68
Hostility & aggression				
Assaultiveness	-0.67	0.47	0.73	-0.25
Indirect hostility	-0.68	0.44	0.51	0.02
Verbal hostility	-0.65	0.32	0.76	-0.17
Irritability	-0.68	0.97	0.35	-0.27
Resentment	-0.65	1.21	<0.01	-0.15

Note: For each measure, higher scores indicate higher levels of the variable, except for emotional adjustment where higher scores indicate lower levels of adjustment.

Individuals in Cluster 2 (20% of the sample) were characterised by the highest levels of depression, emotional maladjustment, irritability and resentment. They also reported relatively high levels of assaultiveness, indirect hostility, and an external locus of control (i.e., perceived events to be out of their personal control). However, they scored moderately on most driving-related measures. Cluster 2 was the least assertive of all clusters.

Cluster 3 consisted of 24 per cent of the sample and was the highest risk young driver group. These individuals were characterised by the highest scores on measures of driving-related aggression, competitive speed, driving to reduce tension, assertiveness, and three measures of hostility: assaultiveness, indirect hostility and verbal hostility. This cluster also exhibited a moderate level of sensation seeking, the lowest level of driving-related inhibition and an internal locus of control.

Individuals in Cluster 4 (24% of the sample) were characterised by the highest levels of sensation seeking and externality, and relatively high levels of competitive speed. They also reported low levels for each of the five hostility and aggression measures and were emotionally well adjusted.

6.3.3 Cluster Validation

Aldenderfer and Blashfield (1984) maintain that one of the best ways to validate a cluster solution is to compare clusters on relevant variables not used to generate the initial cluster solution. Thus, the generality of the four-cluster solution based on personality and driving-related attitudinal measures was validated against a number of demographic, behavioural, and attitudinal measures not included in the original cluster derivation (see Table 6.3).

To measure the strength of association between cluster membership and the measures used for external validation, η^2 was calculated. The η^2 statistic estimates the proportion of variance in the dependent variable explained by cluster membership. Cohen's (1988) criteria for qualitative evaluation of effect sizes was employed whereby η^2 of 0.01-0.04 is considered a small effect, 0.05-0.14 a moderate effect, and greater than 0.14 a large effect.

A multivariate analysis of variance (MANOVA) was performed on the measures of specific attitudes towards road safety. Using Wilks' statistic, a significant effect of cluster membership was found for the attitude measures F (24, 751) = 2.93,

$p<.001$, $\eta^2=0.08$. Since the result from the MANOVA was statistically significant, one-way analyses of variance (ANOVAs) assessed the difference among the clusters for each individual attitude measure. ANOVAs and chi-square tests were conducted on each of the remaining dependent variables to examine whether cluster membership had any effect. Significant ANOVA results were explored with Tukey HSD ($\alpha=.05$) *post-hoc* tests.

Statistically significant differences between clusters were found for a number of variables (see Table 6.3). A significant effect of cluster membership was found for driving style (i.e., risky driving), mild social deviance, excitement seeking and the number of alcoholic drinks consumed per occasion. Significant differences were also found for attitudes towards speeding, perceived likelihood of detection when committing a traffic offence, concern for hurting others in a crash, driving skill, and safe-driving motivation. Furthermore, η^2 indicated that driving style, mild social deviance, excitement seeking, attitude towards speeding, and quantity of alcoholic drinks consumed per occasion provided the best way to differentiate between young driver subtypes.

The cluster analysis based on personality traits and driving-related attitudes suggested Cluster 3 was the most high-risk driver subgroup. *Post-hoc* tests confirmed these results (see Table 6.4). Individuals from Cluster 3 were significantly more likely to have a riskier driving style than did each of the other clusters. Cluster 3 also reported higher levels of excitement seeking and a more favourable attitude towards speeding than both Cluster 1 and Cluster 2.

Cluster 1 was the least deviant or lowest risk of all groups. This cluster generally had the most safety-oriented attitudes. *Post-hoc* tests showed that Clusters 2, 3 and 4 all had a riskier driving style and were more socially deviant than Cluster 1.

Table 6.3

Descriptive statistics for young driver clusters based on attitudinal and behavioural measures

Measures	Cluster 1 (*n*=86)	2 (*n*=54)	3 (*n*=66)	4 (*n*=64)	*F* (3,266)	η^2
Driving style[a]	16.71 (3.75)	20.72 (4.17)	24.08 (4.91)	21.91 (4.34)	40.17**	0.31
Mild social deviance[b]	12.95 (2.52)	15.39 (3.72)	14.92 (3.34)	14.77 (3.50)	8.28**	0.09
Excitement seeking[c]	27.92 (5.73)	28.65 (5.27)	31.48 (4.43)	32.08 (4.18)	11.90**	0.12
Attitudes[d]						
Speeding	1.93 (0.99)	2.50 (1.15)	3.05 (1.18)	2.95 (1.13)	16.31**	0.16
Drink driving	1.64 (1.17)	1.63 (1.09)	1.61 (1.16)	1.88 (1.32)	0.72	0.01
Risk of dying in crash	1.24 (0.69)	1.37 (0.78)	1.24 (0.53)	1.44 (0.71)	1.38	0.02
Peer influence	2.40 (1.26)	2.56 (1.16)	2.67 (1.17)	2.59 (1.05)	0.74	0.01
Likelihood of being caught	2.33 (0.99)	2.72 (1.14)	2.82 (1.15)	2.83 (1.18)	3.61*	0.04
Concern for hurting others	1.14 (0.44)	1.26 (0.62)	1.24 (0.68)	1.44 (0.83)	2.63*	0.03
Driving skill[e]	1.87 (0.82)	2.04 (0.87)	1.86 (0.78)	2.28 (0.98)	3.48*	0.04
Safety motivation	1.64 (0.67)	2.00 (1.08)	1.98 (0.92)	1.91 (0.96)	2.68*	0.03
Alcohol use						
Drink alcohol (%)	80.2	87.0	92.4	93.8	-	-
Drinks per occasion[f]	3.10 (1.11)	3.59 (1.19)	3.98 (1.19)	3.94 (1.19)	8.24**	0.09
Licensing						
Months on L-plates (% 6mths or less)	67.9	75.0	83.1	74.6	-	-
Age obtained P-plates (% <17 yrs)	41.9	37.0	54.5	50.0	-	-
Method P-plates (% Logbook)	75.6	64.8	62.1	67.2	-	-
Driving experience (% 12 months+)	53.6	59.6	69.2	63.5	-	-
Demographic						
Age (years)	18.0 (0.65)	18.2 (0.88)	18.1 (0.54)	18.1 (0.63)	0.56	0.01
Sex (% Male)	19.8	27.8	37.9	32.8	-	-
Socio-ec. status (% Low income area)	11.5	32.7	12.7	11.3	-	-

Note: Means with standard deviations in parentheses. Higher scores of each variable indicate greater levels of the behaviour.

[a] Range of scores 9-45.

[b] Range of scores 9-27.

[c] Range of scores 8-40.

[d] Range of scores 1-5. For each attitude measure, higher scores indicate non-safety orientated attitudes.

[e] Higher scores indicate lower perceived level of driving skill.
[f] Range of scores 2-6. Non-drinking participants excluded (remaining *N*=244).
**p*<.05, ***p*<.01

The scores on the variables for Clusters 2 and 4 were generally between the high-risk cluster (Cluster 3) and the low-risk cluster (Cluster 1). Thus, the profiles of these clusters suggest they are "medium risk" groups relative to the other clusters. *Post-hoc* tests indicated that young drivers in Clusters 2 and 4 were only statistically different from each other on the excitement seeking measure. Cluster 4 had higher levels of excitement seeking than Clusters 1 and 2. Cluster 4 had less-favourable attitudes towards road safety than Cluster 1; they had a lower perceived risk of detection if committing a traffic offence, were less concerned about hurting others in a crash, and were less motivated to drive safely. Of note, young drivers in Cluster 4 also reported a lower level of driving skill (hazard perception) than the low-risk group (Cluster 1) and the high-risk group (Cluster 3).

Table 6.4
Results for post-hoc Tukey tests for cluster validation measures

	Clusters					
Measures	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
Driving style	<.001	<.001	<.001	<.001	ns	.022
Mild social deviance	<.001	.001	.004	ns	ns	ns
Excitement seeking	ns	<.001	<.001	.012	.001	ns
Attitudes						
Speeding	.017	<.001	<.001	.038	ns	ns
Likelihood of being caught	ns	.034	.032	ns	ns	ns
Concern for hurting others	ns	ns	.028	ns	ns	ns
Driving skill	ns	ns	.023	ns	ns	.031
Safety motivation	ns	ns	ns	ns	ns	ns
Alcohol use						
Drink alcohol	ns	ns	ns	ns	ns	ns
Drinks per occasion	ns	<.001	<.001	ns	ns	ns

Note: ns = not significant

Cluster 3 and Cluster 4 had the greatest percentage of young drivers who reported drinking alcohol (92% and 94% respectively, $\chi^2(3)=8.05$, $p=.045$). Furthermore, high alcohol use, known to be another high-risk behaviour, was shown by *post-hoc* tests to be more prevalent in Clusters 3 and 4 than Cluster 1. The greatest percentage of males was found in Cluster 3 (38%). However, gender differences between clusters were not statistically significant ($\chi^2(3)=6.59$, $p=.086$). A crude measure of socio economic status (see section 5.3.1) indicated that Cluster 2 had a statistically significantly greater proportion (33%) of young drivers living in a low-income area ($\chi^2(3)=12.96$, $p=.005$).

Cluster membership did not have a statistically significant effect on variables associated with young driver licensing and driving experience. However, trends indicated that the high-risk cluster was more likely than other clusters to hold a learner's permit for less than 6 months ($\chi^2(3)=4.49$, $p=.213$), receive a provisional licence at a younger age (i.e., 16 years) ($\chi^2(3)=4.69$, $p=.196$), and to have 12 months or more driving experience ($\chi^2(3)=4.01$, $p=.261$). There was a trend for drivers in the low-risk cluster to be more likely than the other clusters to gain their provisional licence via the logbook method ($\chi^2(3)=3.60$, $p=.308$).

6.3.4 Crash and Traffic Offence Driver Records

6.3.4.1 Self-reported driver records

One-way ANOVAs examined whether driving record variables (crashes and traffic offences) varied as a function of cluster membership (see Table 6.5). The ANOVA assumption of equal variances was violated for some of the measures, so a non-parametric test (Kruskal-Wallis) was also performed to confirm the robustness of results. For each of the measures, the non-parametric test gave a similar result so the original ANOVA results are given in Table 6.5. Note that one driver was omitted

from the analysis because they reported an obviously untruthful high number of crashes and traffic offences.

The number of traffic offence detections varied according to cluster membership. The results of *post-hoc* tests (Tukey HSD, α=.05), shown in Table 6.6, revealed that the high-risk group (Cluster 3) reported detection for more traffic offences than the low-risk group (Cluster 1). There were no statistically significant differences between cluster membership and any of the self-reported crash variables. However, the total number of crashes approached statistical significance (p=.062, η^2= .03) and *post-hoc* tests indicated that Cluster 3 reported more crashes than Cluster 1. A significant effect of cluster membership was found for the number of kilometres driven per week. *Post-hoc* tests indicated that Cluster 3 reported driving significantly more than the other clusters.

Table 6.5
Descriptive statistics for young driver clusters based on self-reported driving record measures

Measures	Cluster					
	1 (n=86)	2 (n=54)	3 (n=66)	4 (n=64)	F (3,265)	η^2
Driving record						
Total no. of crashes	0.49 (0.85)	0.67 (0.80)	0.86 (1.11)	0.57 (0.64)	2.47	0.03
Personal injury	0.02 (0.15)	0.06 (0.23)	0.11 (0.31)	0.08 (0.33)	1.39	0.02
Property damage only	0.47 (0.82)	0.61 (0.76)	0.76 (0.98)	0.49 (0.59)	1.92	0.02
Responsible for a crash	0.38 (0.71)	0.50 (0.67)	0.53 (0.86)	0.38 (0.55)	0.81	0.01
Traffic offences	0.19 (0.54)	0.41 (1.41)	0.71 (1.23)	0.37 (1.15)	2.98*	0.03
Driving exposure						
Total km/week	115.6 (152.5)	112.6 (115.5)	203.8 (174.1)	120.6 (116.6)	6.14**	0.07

Note: One driver from Cluster 4 is missing.
*p<.05, **p<.01

The difference in the number of traffic offences between clusters may not be attributable to different personality subtypes but to the difference in driving exposure.

To account for driving exposure, a one-way analysis of covariance (ANCOVA) was undertaken for the number of detected traffic offences with the number of kilometres driven per week as the covariate. The results indicated that once the variance attributed to driving exposure was removed, the number of traffic offences no longer differed significantly between clusters, F (3, 263) = 2.05, p=.107, η^2 = .03.

Table 6.6
Results for post-hoc Tukey tests for self-reported driving record measures

	Clusters					
Measures	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
Driving record						
Total no. of crashes	ns	.044	ns	ns	ns	ns
Traffic offences	ns	.017	ns	ns	ns	ns
Driving exposure						
Total km/week	ns	.001	ns	.004	ns	.006

Note: ns = not significant

6.3.4.2 Official driver records

Official driver records were examined to determine whether membership in the high-risk cluster was associated with crashes and traffic offences both before and after questionnaire administration. Around 70 per cent of young drivers consented to the release of their official driver records and there was no difference in the proportion of young drivers giving consent between clusters.

The mean number of crashes and traffic offences from official driver records, prior to study participation, are shown in Table 6.7 by young driver subtypes. One-way ANOVAs were performed to determine any significant effect of cluster membership. As the ANOVA assumption of equal variances was violated for some of the measures, a non-parametric test (Kruskal-Wallis) was also performed. For most of the measures, the non-parametric test gave a similar result, so the original ANOVA results are given in Table 6.7. Two exceptions were personal injury crashes

($\chi^2(3)=7.87$, $p=.049$) and traffic offences ($\chi^2(3)=5.91$, $p=.116$). Consequently, to eliminate the heterogeneity of variance for these measures, a square root transformation was performed before conducting the ANOVA.

Table 6.7
Descriptive statistics for young driver clusters based on official driving records

Driver record measures	Cluster 1 (*n*=66)	2 (*n*=40)	3 (*n*=44)	4 (*n*=38)	*F* (3,184)	η^2
Total no. of crashes	0.15 (0.44)	0.13 (0.34)	0.23 (0.48)	0.16 (0.44)	0.45	0.01
Personal injury [a]	0.00 (0.00)	0.08 (0.27)	0.00 (0.00)	0.05 (0.32)	1.81	0.03
Property damage only	0.15 (0.44)	0.05 (0.22)	0.23 (0.48)	0.11 (0.31)	1.58	0.03
Responsible for a crash	0.08 (0.32)	0.10 (0.30)	0.14 (0.35)	0.11 (0.31)	0.32	0.01
Traffic offences [b]	0.06 (0.24)	0.13 (0.34)	0.30 (0.73)	0.05 (0.23)	3.23*	0.05

[a] Square root transformation of this variable was not significant; F (3, 184) = 2.26, p=.083, η^2 = .04
[b] Square root transformation of this variable was not significant; F (3, 184) = 2.57, p=.056, η^2 = .04.
*p<.05

While young driver subtypes differed by the number of self-reported traffic offences, for official driving records the difference approached statistical significance (square root transformation p=.056). None of the official crash record measures differed by young driver subtype. This result may be partially attributable to the tendency for official driver records to underestimate crashes and traffic offences. In comparison to self-reported driver records (see Table 6.5), fewer crashes and traffic offences were reported to police and reported in official records. Reasons for this are discussed in section 5.3.3.2. Consequently, the lower number of crashes reduces the statistical power of the analyses.

Official driver records for the 12-month period following questionnaire administration were examined to determine whether membership in the high-risk cluster predicted subsequent crashes and traffic offences. One-way ANOVAs were conducted to determine whether the mean number of crashes and traffic offences

recorded in official driver records differed as a function of cluster membership (see Table 6.8). Given the small number of crashes, the severity of crashes was not reported. The ANOVA assumption of equal variances was violated for one driver record measures, thus, a non-parametric test (Kruskal-Wallis) was performed. The two statistical tests gave similar results so the original ANOVAs are reported in Table 6.8. The high-risk cluster did not differ from any of the other clusters in terms of any driver record measures.

Table 6.8
Descriptive statistics for young driver clusters based on official driver records during the 12-month follow up

Driver record measure	Cluster 1 (*n*=66)	2 (*n*=40)	3 (*n*=44)	4 (*n*=38)	*F* (3,184)	η^2
Total no. of crashes	0.02 (0.12)	0.08 (0.27)	0.02 (0.15)	0.05 (0.23)	0.99	0.02
Responsibility for a crash	0.00 (0.00)	0.05 (0.22)	0.00 (0.00)	0.05 (0.23)	1.94	0.03
Traffic offences	0.14 (0.55)	0.05 (0.22)	0.16 (0.37)	0.03 (0.16)	1.18	0.02

6.4 Discussion

This study aimed to ascertain which personality characteristics and attitudes define young drivers at a higher risk of crashing and to validate young driver subtypes previously identified in the literature. Cluster analysis identified four separate and meaningful young driver subtypes based on measures of personality and driving related attitudes and behaviours. The clusters were found to differ in terms of driving style, social deviance, excitement seeking, specific driving-related attitudes, alcohol use, and traffic offence record. This outcome confirms that young drivers should not be considered as a homogenous group.

Results from the analysis suggested that one cluster of young drivers was more likely to represent a road safety risk than the other groups. This high-risk cluster (Cluster 3) could be termed “hostile/aggressive” with the highest levels of overt hostility (i.e., assaultiveness and verbal hostility), indirect hostility and driving-related aggression. This cluster was assertive and used driving to reduce tension and frustration but was least likely to drive cautiously when upset (low driving inhibition). This cluster also reported positive scores on sensation seeking and excitement seeking, had high levels of competitive speed, a positive attitude towards speeding, and the most risky driving style. Young drivers in Cluster 3 perceived events to be attributable to their own behaviour (internal locus of control) and had the highest level of confidence in their driving skill despite a poor driving record. They reported the most traffic offences but the difference between clusters was not statistically significant after controlling for driving exposure.

An important point to consider is that the driving exposure of individuals in this study (i.e., estimated number of kilometres driven) is not a random factor but an individual choice. The significantly greater driving exposure reported by Cluster 3 may be associated with certain characteristics of these high-risk drivers, and accounting for driving exposure may remove some of the variation associated with these drivers. For example, high driving exposure may be associated with driving for social purposes or pleasure, and driving for these purposes is known to be more prevalent among young drivers (see Stradling & Meadows, 2000). Driving for social or joyriding purposes has been associated with increased young driver crash involvement (Clarke et al., 2006; Ulleberg & Rundmo, 2002).

Individuals in Cluster 3 also engaged in another high-risk behaviour: drinking large quantities of alcohol. This finding is consistent with Jessor and Jessor’s (1977) Problem Behaviour Theory (PBT). According to this theory, risky driving is a component of an emerging deviant lifestyle among young adults and correlates highly

with other problem or risky behaviours (Beirness & Simpson, 1988; Wilson & Jonah, 1988).

Two other clusters appeared to represent a moderate road safety risk (Clusters 2 and 4). The first of the “medium risk” subtypes, Cluster 4, was characterised as being a “thrill seeking” group. This cluster reported high levels of sensation seeking and relatively high levels of competitive speed. These individuals also had the highest levels of excitement seeking, a personality measure known to be very similar to some aspects of sensation seeking (Costa & McCrae, 1991). Sensation seeking, a measure of thrill seeking, has been found to be highest in the 16 to 19 year old age group (Arnett, 1994; Jonah, 1997) and found to correlate with a number of risky driving behaviours including drink driving, speeding, and self-reported traffic violations (Arnett, 1990; Burns & Wilde, 1995). Cluster 4 reported a riskier driving style than the low-risk group (Cluster 1) and had the least safety oriented attitudes. Although their driving record was not bad, this cluster reported a lower level of driving skill than both the low and high risk groups and perceived events to be out of their own personal control (externality).

Cluster 2 may be conceptualised as an “emotional” subtype. Unlike the other three clusters, Cluster 2 was emotionally maladjusted or unstable. Emotional instability has been identified in the literature as a factor associated with increased risk of crash involvement (Harano, 1974; Mayer & Treat, 1977). Consistent with Beirness’s (1993) profile of emotionally unstable “problem” drivers, this cluster demonstrated high levels of depression, irritability, resentment, and social deviance. They also viewed significant events to be out of their personal control. Together, these attributes suggest young drivers in this subtype were experiencing personal problems or were under personal stress. According to Donovan, Umlauf, Queisser and Salzburg (1986), depression associated with risky driving may be a more transient rather than an enduring trait. Furthermore, this group was hostile (indirect, verbal and

assaultiveness) but appeared to be unable to express themselves; they were the least assertive. They may have expressed their frustrations through driving, evidenced by a relatively high level of driving to reduce tension.

The largest cluster, Cluster 1, can be regarded as a well-adjusted group characterised by low levels of hostility, driving aggression, depression, and sensation seeking, and high levels of emotional adjustment. This subtype demonstrated positive attitudes towards road safety, reported few traffic offences, consumed little alcohol, had the least risky driving style, and was the least socially deviant. Most previous studies investigating driver subtypes have found at least one well-adjusted cluster and this has usually been the largest group, even in studies of drivers already defined as high-risk. Thus, not all young drivers have attributes predisposing them to be a road safety risk.

A cluster membership effect was not found for any of the variables associated with young driver licensing and driving experience. This finding suggests that the differences between the young driver subtypes were not attributable to differences in age or duration of licensure.

6.4.1 Young Driver Subtypes in Comparison to Previously Identified Young Driver Subtypes

The somewhat arbitrary nature of cluster analysis has attracted criticism. However, by selecting similar variables and replicating a clustering methodology previously used among a young driver population, the results from this study allow validation of the young driver subtypes identified in previous research. Deery and colleagues (1998) identified five subtypes of novice drivers, of which two were labelled high-risk. In contrast, the present study identified only one high-risk group (Cluster 3) but it was very similar to one of the high-risk subtypes identified by Deery et al. (their Cluster 1). Shared characteristics include high levels of driving-related aggression, competitive speed, assaultiveness, indirect and verbal hostility, sensation

seeking, driving to reduce tension, and low driving inhibition. Furthermore, both the high-risk clusters exhibited a risky driving style, engaged in other risky behaviour (high alcohol use) and reported the most traffic offences.

The personality characteristics of the high-risk subtype in the current study and Deery et al's (1998) similar high-risk subtype (Cluster 1) are also consistent with a high-risk subtype of male drivers with multiple traffic offences or crashes (Cluster 2 in Donovan et al., 1988) and a medium-risk subtype of male drink driving offenders (Cluster 1 in Donovan & Marlatt, 1982). Of interest, high-risk subtypes identified in the two latter studies were significantly younger than other subtypes defined as low-risk.

In the present study, the number of traffic offences no longer differed between clusters once driving exposure was considered. However, there was a notable trend in that the high-risk subtype self-reported more crashes and traffic offences than other subtypes. In contrast, Deery et al's (1998) study found a difference between subtypes for traffic offences and crashes. However, it was their other high-risk subtype (Cluster 5), characterised by emotional instability, hostility, and driving related aggression, which reported more crashes and traffic offences than other subtypes. Their second high-risk subtype was not replicated in the present study.

Although Deery et al. (1998) found traffic offences varied as a function of cluster membership, they did not control for driving exposure. Indeed, very few drivers reported traffic offences, most likely due to very limited driving experience; 20 per cent of participants only just received their learner's permit while the remainder obtained a provisional licence on the day of recruitment for the study. Deery et al. attempted to control for driving exposure when examining the crash history of drivers but inadequate measures of driving exposure were used (i.e., age and licence type). Clearly, there are variations in the number of kilometres driven by those of the same age and licence type. The lack of adequate control for driving

exposure and the limited driving experience of participants in Deery et al's study, suggest that the associations they found between young driver subtypes and reported driving history are perhaps not robust.

These limitations were overcome in the present study but only a weak association was found between the high-risk subtype and driver record variables. Examination of official driver records indicated that there was no difference by cluster membership for any of the driver record measures in the 12 months following questionnaire administration, although the number of traffic offences measure approached statistical significance. It is most likely that there was little difference during the follow up period because very few young drivers recorded crashes or traffic offences. The low number of crashes and offences may be attributed to the use of official driver records during the 12-month period; fewer crashes and traffic offences were reported in official records compared to driver's self-reported driving history. In addition, the low number of crashes and traffic offences may also be attributed to the limited 12-month follow up period.

Another plausible reason for the limited association between young driver subtypes and driving record variables (and the difference between the subtypes derived in this study and other young driver subtypes), may be the greater proportion of females (71%) in the present study. This was most likely a reflection of the composition of the sexes in the population sampled (i.e., undergraduate psychology students). Females are less likely to engage in risk taking (e.g., Zuckerman, 1994) and commit traffic offences (e,g., Waller et al., 2001) than are males. Consequently, it is likely that fewer driving incidents are recorded, resulting in reduced statistical power. Unfortunately, cluster analysis could not be performed for males and females separately to investigate this theory because the number of males was too small for meaningful statistical analyses; *k*-means cluster analysis assumes a relatively large sample, $N > 200$, (Garson). Ulleberg (2001) was able to perform separate analyses by

gender and found young driver clusters had the same profile on traffic related measures for both males and females, suggesting that the same personality characteristics may underlie both male and female risk taking.

Of the two subtypes in the current study categorised as medium risk, Cluster 2 strongly resembled a medium risk “emotional” young driver subtype found by Deery et al. (1998; Cluster 2). Cluster 4 mirrored a “thrill seeking” subtype identified among male drivers involved in multiple crashes or multiple traffic offences (Cluster 2: Donovan et al., 1988).

It is more difficult to directly compare the subtypes derived in this study with the young driver subtypes identified in the Norwegian study (Ulleberg, 2001) because different variables were used. However, driving related aggression, sensation seeking, a risky driving style, and non-safety oriented attitudes appear to be common characteristics of high-risk young drivers noted in each of the three studies examining young driver subtypes.

The largest subtype of young drivers was considered well adjusted and low risk in traffic, consistent with findings from other studies of young driver subtypes (Beirness, 1993; Deery et al., 1998; Ulleberg, 2001). Therefore, it is conceivable that high-risk young driver subtypes may be easier to identify using personality characteristics and attitudes among young driver populations known to engage in risky driving (i.e., caught for traffic offences, involved in crashes).

6.4.2 Limitations

There are some limitations of this research. Firstly, as mentioned previously, the somewhat arbitrary nature of cluster analysis has attracted criticism. However, by selecting similar variables and replicating a clustering methodology used for the student young drivers, the results from this study were able to validate the existence of young driver subtypes.

A second limitation of the study is the self-report data. Many of the personality and attitudinal measures on which the cluster analysis was based were self-reported. Consequently, drivers had an opportunity to give socially desirable responses.

6.4.3 Summary

In summary, cluster analysis derived four meaningful subtypes of young drivers of which one subtype was more likely to represent a road safety risk than the others. This finding provides support for the existence of a subgroup of high-risk young drivers, based on personality measures and attitudes. The high-risk subtype was considered “hostile/aggressive” and was characterised by high levels of driving-related aggression, overt hostility and indirect hostility. This subtype was assertive, used driving to reduce tension, and reported the lowest tendency to drive cautiously when upset (low driving inhibition). High levels of competitive speed, positive scores on sensation seeking and excitement seeking, a risky driving style, a favourable attitude towards speeding, and high alcohol consumption also characterised this subtype.

The finding of underlying personality characteristics and attitudes common to other high-risk young driver subtypes provides further evidence of the existence of young driver subtypes. These characteristics were also consistent with high-risk subtypes identified among drink driving offenders and drivers with multiple crashes and traffic offences.

There was only a weak association between the high-risk subtype and driver records; the high-risk subtype reported the most traffic offences but the difference between subtypes was not statistically significant after controlling for driving exposure. It is plausible that the present study did not replicate Deery et al’s (1998) second high-risk subtype and findings of differences in driver records across clusters because the present study consisted of a greater proportion of females than males. It is

plausible that high-risk subtypes might be easier to identify among groups of young drivers already known to be risky drivers (i.e., traffic offenders, young drivers involved in crashes). However, to the best of our knowledge, no studies have attempted to perform cluster analyses on a high-risk young driver population.

Thus, the next chapter attempts to identify young driver subtypes, specifically subtypes of young drivers at a higher risk of crashing, among a group of young traffic offender, drivers who have been detected engaging in risky driving behaviour, as defined by the law.

CHAPTER 7 IDENTIFYING SUBTYPES OF YOUNG TRAFFIC OFFENDERS

7.1 Introduction

The findings from Chapter 5 indicated that young traffic offenders were not very distinguishable from a comparison group of students on a number of different personality and attitudinal measures, apart from some specific road safety-related attitudes and small differences for some aggression related measures. Thus, offenders did not appear to be a psychologically deviant group. However, there may be subgroups of drivers with a higher risk of crashing *within* this group of young traffic offenders.

In Chapter 6, the existence of subtypes within a sample of young South Australian drivers (i.e., university students) was established. Cluster analysis revealed that one subtype of young drivers was more likely to represent a road safety risk than the other subtypes. This high-risk subtype (Cluster 3), considered "hostile/aggressive", was characterised by high levels of driving-related aggression, overt hostility and indirect hostility. This subtype was assertive, used driving to reduce tension and frustration, and reported the lowest tendency to drive cautiously when upset (low driving inhibition). This subtype also reported high levels of

competitive speed, positive scores on sensation seeking and excitement seeking, a risky driving style, a positive attitude towards speeding and high alcohol consumption. Although this subtype reported the most traffic offences, the difference between subtypes was not statistically significant after controlling for driving exposure. Some characteristics of this high-risk young driver subtype were consistent with the attributes of other high-risk young driver subtypes found in the literature (Deery et al., 1998; Ulleberg, 2001): driving related aggression, sensation seeking, risky driving style, and non-safety oriented attitudes.

While high-risk subtypes were identified among young drivers from the general driving population, this chapter examines the existence of subtypes within a young traffic offender population. One would expect to identify high-risk subtypes in a young traffic offender population because these drivers have been caught committing one or more traffic offences, that is, engaging in risky driving as defined by the law. If there are common characteristics underlying high-risk young drivers, then the attributes previously found in high-risk young driver subtypes will characterise the high-risk subtypes identified in the young traffic offender sample.

Thus, the main purpose of this study was to determine whether distinct subtypes could be identified among young traffic offenders and to ascertain any personality characteristics defining these subtypes. In addition, this study aimed to determine the extent to which the characteristics of young offender subtypes were comparable to the characteristics identified in other young driver subtypes in the literature.

To identify young offender subtypes and to compare them to the young driver subtypes derived from the student population (see Chapter 6), a cluster analysis was performed on a similar set of personality variables to that used in the previous study. To investigate whether any of the young offender subtypes identified differed from each other, the cluster solution was validated against a number of demographic, attitudinal and behavioural measures not included in the original cluster analysis.

This study is the first, of which I am aware, to attempt to define subtypes within a population of young traffic offenders (predominantly first time, not serious offenders). The identification and validation of different subtypes within the young offender population will assist in the development of post-licensing interventions and the appropriate targeting of public education initiatives for these specific groups of drivers.

7.2 Methodology

The participants in this study were the same young traffic offenders described in Chapter 5 (see section 5.2.1 for details) who were recruited from the Driver Intervention Program (DIP). The sample of traffic offenders consisted of 336 drivers (273 males, 63 females) aged 16 to 24 years (*M*=18.5, *SD*=1.2). All participants were required to hold a current South Australian provisional driver's licence at the time the traffic offence was detected (leading to attendance at DIP). Further details about the participants and detailed descriptions of the questionnaire and procedure have been provided in Chapter 5 (see section 5.2) and will not be repeated here.

Cluster analysis, a multivariate statistical procedure, was used to identify subtypes among the sample of young traffic offenders. For a comprehensive description of cluster analysis, refer to Chapter 6 (see section 6.2.5.1).

7.3 Results

7.3.1 Validation of Scales

Exploratory factor analysis examined the internal structure of the scales (refer to section 5.2.3.1 for a full description of this procedure). The results from the principal-axis factoring, including factor loadings and communalities for each scale, are presented in Appendix G. A one-factor solution was found for most scales but the decision rules suggested a two-factor solution for several scales (assaultivenesss, sensation seeking, verbal hostility). The second factors were, however, not

interpretable for assaultivenesss and sensation seeking so a one-factor solution was accepted. For verbal hostility, three items were omitted to define an interpretable single factor solution.

Reliability analysis assessed the internal consistency of each scale. Descriptive statistics and alpha coefficients for scales with five items or more are presented in Table 7.1.

Table 7.1
Number of items, mean scores and Cronbach's alpha for all questionnaire measures (N=336)

Measures	No. of items	Range of scores	Mean	SD	Cronbach's alpha [a]
Personality					
Assertiveness	5	5-10	7.94	1.30	0.43
Depression	9	9-18	10.26	1.81	0.76
Emotional adjustment	6	6-12	7.49	1.48	0.61
Sensation seeking	17	17-34	26.74	3.25	0.69
Hostility and aggression					
Assaultiveness	9	9-18	13.54	2.19	0.65
Indirect hostility	5	5-10	7.85	1.34	0.49
Verbal hostility	6	6-12	9.40	1.53	0.51
Irritability	8	8-16	11.34	1.87	0.55
Resentment	4	4-8	5.54	1.13	-
Driving-related					
Aggression	10	10-20	13.27	2.52	0.75
Competitive speed	5	5-10	7.38	1.71	0.74
Inhibition	3	3-6	4.41	1.14	-
Tension reduction	2	2-4	3.24	0.87	-
Driving style	7	7-35	18.89	6.01	0.88
Mild social deviance	8	8-24	12.22	3.07	0.76
Attitudes					
Speeding	1	1-5	2.74	1.26	-
Drink driving	1	1-5	2.48	1.64	-
Risk of dying in crash	1	1-5	1.89	1.22	-
Peer influence	1	1-5	3.14	1.23	-
Likelihood of being caught	1	1-5	2.42	1.25	-
Concern for hurting others	1	1-5	1.76	1.24	-
Driving skill	1	1-5	2.06	1.09	-
Safety motivation	1	1-5	2.18	1.08	-

[a] Cronbach's alpha not calculated for scales with less than five items.

The internal consistency of most scales was acceptable with alpha coefficient above the lowest acceptable level (α = .50). Furthermore, the alpha for many scales was around or above .70, the level suggested as acceptable by Nunnally's criteria (1978), with the highest reaching an alpha level of .88. However, the scales measuring

assertiveness and indirect hostility had a reliability level below the lowest acceptable level. Alpha coefficients tend to increase as a function of the number of items (Nunnally, 1978). Thus, given the same average inter-item correlation, a satisfactory alpha can be more easily gained with many, rather than few items. This item number sensitivity of alpha coefficients may be responsible for the lower reliability of several scales with relatively few items. Thus, the majority of scales had a reasonable degree of internal coherence.

7.3.2 Cluster Profiles

Examination of several methods for determining the number of clusters (CCC, Pseudo F, Pseudo t^2, Ball & Hall, Multidimensional scaling, Isomap) from Ward's cluster analysis suggested three, four or five cluster solutions were viable. The specific results from these methods and visualisations can be seen in Appendix H. After inspecting the individual cluster profiles, a four-cluster solution was retained because all four clusters were theoretically meaningful and interpretable. The four-cluster solution was then forced into the final *k*-means cluster analysis. This cluster solution was not definite or exact, but was the most consistent and interpretable solution. The standardised cluster means of the variables in the *k*-means analysis are presented in Table 7.2.

The patterns of cluster means indicated that Cluster 1, representing 32 per cent of the sample was characterised by the highest levels of competitive speed, assertiveness, sensation seeking and verbal hostility. They also reported relatively high levels of driving related aggression, driving to reduce tension, and assaultiveness. However, this cluster had a low level of depression and was emotionally well adjusted. Based on this description, Cluster 1 was expected to be a young driver subtype with a relatively high risk of crashing.

Individuals in Cluster 2 (20% of the sample) were characterised by the highest level of indirect hostility, and moderate levels of irritability and resentment. However,

they reported low levels of driving-related aggression, competitive speed, and driving to reduce tension. This cluster also exhibited the lowest level of assertiveness, sensation seeking, and assaultiveness, and was emotionally maladjusted. The profile suggests that this young offender cluster would have a relatively low risk of crashing.

Cluster 3 consisted of 15 per cent of the sample and was the highest risk young offender group. Cluster 3 was similar but not identical to Cluster 1. Consistent with Cluster 1, individuals in Cluster 3 were characterised by high levels of driving-related aggression, driving to reduce tension and assaultiveness, and had relatively high levels of competitive speed, sensation seeking and verbal hostility. They were also the least inhibited while driving. In contrast to Cluster 1, Cluster 3 was the most depressed and least emotionally adjusted group with very high levels of irritability and resentment.

Table 7.2
Mean standardised scores on the measures defining the young offender clusters

Measures	Clusters			
	1 (*n*=107)	2 (*n*=68)	3 (*n*=51)	4 (*n*=110)
Driving-related				
Aggression	0.48	-0.45	0.92	-0.61
Competitive speed	0.77	-0.59	0.37	-0.55
Inhibition	-0.16	-0.01	-0.22	0.27
Tension reduction	0.30	-0.29	0.31	-0.25
Personality				
Assertiveness	0.40	-0.84	-0.38	0.30
Depression	-0.35	0.03	1.66	-0.45
Emotional adjustment	-0.34	0.85	1.03	-0.67
Sensation seeking	0.34	-0.55	0.31	-0.13
Hostility & aggression				
Assaultiveness	0.62	-0.59	0.68	-0.56
Indirect hostility	-0.04	0.62	0.15	-0.41
Verbal hostility	0.56	-0.33	0.38	-0.52
Irritability	0.03	0.21	1.23	-0.73
Resentment	-0.16	0.28	1.20	-0.58

Note: For each measure, higher scores indicate higher levels of the variable, except for emotional adjustment where higher scores indicate lower levels of adjustment.

Cluster 4, representing the largest proportion of the sample (33%) was the most inhibited while driving and, similar to Cluster 2, reported low levels of driving related aggression, competitive speed, and driving to reduce tension. In contrast to Cluster 2, they had very low scores for all five measures of hostility. The personality measures indicated they had high levels of assertiveness, the lowest level of depression and were the most emotionally well-adjusted group. This cluster was interpreted as a low risk young offender group.

7.3.3 Cluster Validation

One of the best ways to validate a cluster solution is to compare clusters on relevant variables not used to generate the initial cluster solution (Aldenderfer & Blashfield, 1984). Thus, the generality of the four-cluster solution based on personality and driving-related attitudinal measures was validated against a number of demographic, behavioural and attitudinal measures not included in the original cluster derivation (see Table 7.3).

The η^2 statistic was calculated to measure the strength of association between cluster membership and the measures used for external validation. The η^2 statistic estimates the proportion of variance in the dependent variable explained by cluster membership. Cohen's (1988) criteria for qualitative evaluation of effect sizes was employed whereby η^2 of 0.01-0.04 is considered a small effect, 0.05-0.14 a moderate effect, and greater than 0.14 a large effect.

A multivariate analysis of variance (MANOVA) was performed on the measures of specific attitudes towards road safety. Using Wilks' statistic, a significant effect of cluster membership was found for the attitude measures F (24, 934) = 2.90, p<.001, η^2=0.07. The MANOVA result was statistically significant so one-way analyses of variance (ANOVAs) were conducted to determine any differences

between the clusters for each individual attitude measure. ANOVAs and chi-square tests were performed on each of the remaining dependent variables to examine whether cluster membership had any effect. Significant ANOVA results were explored with Tukey HSD (α=.05) *post-hoc* tests.

Statistically significant differences between clusters were found for a number of variables (see Table 7.3). The findings show a significant effect of cluster membership for driving style, mild social deviance, sex, and the number of alcoholic drinks consumed per occasion. Significant differences were also found for attitudinal measures: attitude towards speeding, perceived risk of dying in a crash, likelihood of detection when committing a traffic offence, and safe driving motivation. Furthermore, η^2 indicated that driving style, mild social deviance, and quantity of alcoholic drinks consumed per occasion provided the best means to differentiate between the young offender subtypes. These variables were also some of the best at distinguishing between the student subtypes.

The cluster analysis using personality and driving-related attitudinal measures suggested Cluster 3 and Cluster 1 were the most high-risk young offender subgroups, respectively. *Post-hoc* tests on the cluster validation measures confirmed these results (see Table 7.4). Individuals from Clusters 3 and 1 reported a significantly riskier driving style, higher levels of mild social deviance, and a more favourable attitude towards speeding than both Clusters 2 and 4. Clusters 3 and 1 were less motivated to drive safely than Cluster 4. In addition, Cluster 3 perceived that there was a lower likelihood of detection when committing a traffic offence than Cluster 2, and Cluster 1 perceived there was a lower risk of dying in a crash than Cluster 4. There were no significant differences between Clusters 1 and 3.

Table 7.3
Descriptive statistics for young traffic offender clusters based on attitudinal and behavioural measures

Measures	Clusters					
	1 (*n*=107)	2 (*n*=68)	3 (*n*=51)	4 (*n*=110)	*F* (3,332)	η^2
Driving style[a]	22.45 (5.28)	15.78 (3.89)	22.37 (7.05)	15.74 (4.22)	49.12**	0.31
Mild social deviance[b]	13.34 (3.03)	10.85 (1.97)	14.04 (3.39)	11.15 (2.70)	23.69**	0.18
Attitudes[c]						
Speeding	3.03 (1.11)	2.47 (1.33)	3.29 (1.21)	2.38 (1.23)	9.87**	0.08
Drink driving	2.46 (1.50)	2.69 (1.77)	2.76 (1.69)	2.23 (1.65)	1.77	0.02
Risk of dying in crash	2.18 (1.21)	1.84 (1.24)	2.06 (1.43)	1.57 (1.01)	5.05**	0.04
Friends drive safely	3.24 (1.20)	3.06 (1.18)	3.39 (1.44)	2.97 (1.16)	1.76	0.02
Likelihood of being caught	2.44 (1.14)	2.03 (1.09)	2.65 (1.43)	2.55 (1.30)	3.24*	0.03
Concern for hurting others	1.84 (1.17)	1.78 (1.37)	1.75 (1.26)	1.69 (1.22)	0.27	<0.01
Driving skill[d]	2.05 (1.08)	2.00 (1.01)	2.18 (1.23)	2.06 (1.09)	0.27	<0.01
Safety motivation	2.34 (1.10)	2.16 (1.05)	2.47 (1.21)	1.91 (0.96)	4.43**	0.04
Alcohol use						
Drink alcohol (%)	93.4	80.3	89.4	81.3	-	-
Drinks per occasion[e]	4.95 (1.19)	3.66 (1.21)	4.61 (1.43)	3.97 (1.37)	15.27**	0.14
Licensing						
Months on L-plates (% 6mths or less)	87.6	79.7	82.0	78.3	-	-
Age obtained P-plates (% <17 yrs)	55.1	47.8	56.9	50.9	-	-
Method P-plates (% Logbook)	67.0	69.1	57.1	67.9	-	-
Driving experience (% 12 months+)	72.4	81.3	72.0	72.6	-	-
Demographic						
Age (years)	18.3 (1.1)	18.8 (1.3)	18.4 (1.1)	18.6 (1.4)	2.39	0.02
Sex (% Male)	91.6	64.7	86.3	79.1	-	-
Socio-ec. status (% Low income area)	24.2	31.1	42.9	28.6	-	-

Note: Means with standard deviations in parentheses. Higher scores of each variable indicate greater levels of the behaviour.
[a] Range of scores 7-35.
[b] Range of scores 8-24.

[c] Range of scores 1-5. For each attitude measure, higher scores indicate non-safety orientated attitudes.
[d] Higher scores indicate lower perceived level of driving skill.
[f] Range of scores 2-6. Non-drinking participants excluded (remaining *N*=284).
**p*<.05, ***p*<.01

Table 7.4
Results for post-hoc Tukey tests for cluster validation measures

	Clusters					
Measures	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
Driving style	<.001	ns	<.001	<.001	ns	<.001
Mild social deviance	<.001	ns	<.001	<.001	ns	<.001
Attitudes						
Speeding	.017	ns	.001	.002	ns	<.001
Risk of dying in crash	ns	ns	.001	ns	ns	ns
Likelihood of being caught	ns	ns	ns	.036	.035	ns
Safety motivation	ns	ns	.017	ns	ns	.011
Alcohol use						
Drinks per occasion	<.001	ns	<.001	.002	ns	.034

Note: ns = not significant

Clusters 2 and 4 were the lowest risk groups. *Post-hoc* tests indicated that young offenders in Clusters 2 and 4 were only statistically different from each other on one measure; Cluster 4 had a lower perceived risk of detection if committing a traffic offence.

Clusters 1 and 3 had the greatest percentage of young offenders who reported drinking alcohol (93% and 89% respectively, $\chi^2(3)=9.09$, $p=.028$). Furthermore, high alcohol use, known to be another high-risk behaviour, was shown by *post-hoc* tests to be more prevalent in Clusters 1 and 3 than Clusters 2 and 4. A significantly greater proportion of males were found in the two high-risk clusters ($\chi^2(3)=20.91$, $p<.001$). The crude measure of socio economic status indicated that Cluster 3 had the highest proportion (43%) of drivers living in a low-income area. However, this difference was not statistically significant ($\chi^2(3)=4.96$, $p=.174$).

Cluster membership did not have a statistically significant effect on variables associated with young offender licensing and driving experience.

7.3.4 Crash and Traffic Offence Records

7.3.4.1 Self-reported driver record

One-way ANOVAs examined whether driver record measures varied as a function of cluster membership (see Table 7.5). As the ANOVA assumption of equal variances was violated for some of the measures, a non-parametric test (Kruskal-Wallis) was also performed to confirm the robustness of results. For most of the measures, the non-parametric test gave a similar result so the original ANOVA results are given in Table 7.5. One exception was property damage only crashes ($\chi^2(3)=5.17$, $p=.160$). Therefore, to eliminate the heterogeneity of variance for this measure, a square root transformation was performed before conducting the ANOVA.

Table 7.5
Descriptive statistics for young offender clusters based on self-reported driving record measures

Measures	Clusters					
	1 (*n*=107)	2 (*n*=68)	3 (*n*=51)	4 (*n*=110)	*F* (3,321)	η^2
Driving record						
Total no. of crashes	1.39 (1.98)	0.85 (1.23)	1.79 (2.70)	0.79 (1.12)	5.01**	0.04
Personal injury	0.43 (0.98)	0.16 (0.51)	0.47 (1.40)	0.17 (0.49)	2.88*	0.03
Property damage only[a]	0.96 (1.34)	0.69 (0.91)	1.32 (1.88)	0.62 (0.83)	4.34**	0.04
Responsible for a crash	0.65 (1.08)	0.58 (0.87)	0.94 (1.55)	0.48 (0.79)	2.19	0.02
Traffic offences	3.38 (2.58)	2.11 (2.08)	4.61 (3.73)	2.49 (2.08)	10.08*	0.09
Driving exposure						
Total km/week	382.2 (335.1	305.2 (298.8)	423.0 (280.8)	278.6 (220.5)	3.56*	0.04

[a] Square root transformation of this variable was not significant; F (3, 321) = 2.43, p=.065, η^2 = .02.
*p<.05, **p<.01

A significant difference by cluster membership was noted for the total number of crashes, personal injury crashes, and traffic offences. The number of traffic offences was the only driving record measure that had a moderate effect size. Thus, it was the best driving record measure to differentiate between the subtypes. There was no cluster effect for property damage only crashes (square root transformation) or responsibility for a crash.

Post-hoc tests (Tukey HSD, α=.05), shown in Table 7.6, revealed that one of the high-risk groups, Cluster 3, reported more crashes and traffic offences than the low-risk groups (Clusters 2 and 4). The other high-risk group, Cluster 1, also reported more traffic offences than Cluster 2. A significant effect of cluster membership was noted for the number of kilometres driven per week. *Post-hoc* tests indicated that Cluster 3 reported driving significantly more than Cluster 4. It is interesting that, despite Cluster 2 having the greatest percentage of drivers with more than one year of driving experience, Cluster 3 reported the greatest driving exposure.

The difference in the number of crashes and traffic offences between clusters may not be attributable to different personality subtypes but to the difference in driving exposure. To account for driving exposure, a one-way analysis of covariance (ANCOVA) was undertaken for each significant driving record measure with the number of kilometres driven per week as the covariate. Since 47 offenders did not estimate the number of kilometres driven, the number of offenders in each ANCOVA was less than in the original ANOVA. To detect any effects associated with different numbers in each analysis, secondary one-way ANOVAs were performed using the same offenders as in the ANCOVA analyses. The results were similar for most driver record measures so the original one-way ANOVA results are reported in Table 7.5. However, the number of personal injury crashes no longer differed between clusters, suggesting that the reduction in numbers reduced the power of the statistical test (F (3, 278) = 1.96, p=.120, η^2 = .02).

The results indicated that once the variance attributed to driving exposure was removed, a significant effect by cluster membership was still evident for the total number of crashes F (3, 277) = 3.06, p=.029, η^2 = .03 and traffic offences F (3, 277) = 9.98, p<.001, η^2 = .10. Given the non-significant results for the secondary ANOVA analysis of personal injury crashes, it was not surprising that there was no difference between clusters when controlling for driving exposure, F (3, 277) = 1.30, p=.273, η^2 = .01.

Table 7.6
Results for post-hoc Tukey tests for self-reported driver record measures

	Clusters					
Measures	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
Driving record						
Total no. of crashes	ns	ns	ns	.025	ns	.006
Personal injury	ns	ns	ns	ns	ns	ns
Property damage only	ns	ns	ns	.033	ns	.006
Traffic offences	.010	ns	ns	<.001	ns	<.001
Driving exposure						
Total km/week	ns	ns	ns	ns	ns	.039

Note: ns = not significant

7.3.4.2 Official driver record

Official driver records were examined to determine whether membership in high-risk clusters was associated with crashes and traffic offences both before and after questionnaire administration. Approximately 62 per cent of young offenders provided official driver records and more offenders in low-risk clusters were willing to provide official records than offenders from high-risk clusters (Clusters 2 and 4, 66% and 67% respectively; Clusters 1 and 3, 58% and 53% respectively, $\chi^2(1)=3.9$, p=.047).

Table 7.7 shows the mean number of crashes and traffic offences from official driver records for young offender subtypes, before questionnaire administration.

Contrary to self-reported driver records, the young offender subtypes did not differ by any of the official driver record measures. This result may be partially attributable to the tendency for official records to underestimate crashes and traffic offences. In comparison to the self-reported driver records (see Table 7.5), fewer crashes and traffic offences were recorded in official records. Reasons for this were discussed in section 5.3.3.2. The observation that young offenders from high-risk subtypes were less likely to provide official driver records than those from low-risk subtypes may also be a contributing factor to the lack of association between young offender subtypes and official records.

Table 7.7
Descriptive statistics for young offender clusters based on official driver records

Driving record measure	Cluster 1 (*n*=62)	2 (*n*=45)	3 (*n*=27)	4 (*n*=74)	*F* (3,204)	η^2
Total no. of crashes	0.47 (0.82)	0.44 (0.62)	0.48 (0.80)	0.34 (0.69)	0.48	0.01
Personal injury	0.05 (0.22)	0.11 (0.38)	0.07 (0.40)	0.09 (0.34)	0.39	0.01
Property damage only	0.42 (0.82)	0.33 (0.52)	0.41 (0.64)	0.24 (0.64)	0.88	0.01
Responsible for a crash	0.32 (0.67)	0.31 (0.56)	0.33 (0.62)	0.19 (0.46)	0.85	0.01
Traffic offences	1.87 (1.09)	1.80 (1.62)	2.41 (1.58)	2.27 (1.98)	1.49	0.02

Official driver records for the 12-month period following questionnaire administration were examined to determine whether membership in high-risk clusters predicted subsequent crashes and offences. The percentage of young drivers in each cluster with at least one crash or traffic offence in the 12 month follow up period can be seen in Figure 7.1. There was no significant cluster effect for either crashes ($\chi^2(3)=3.5$, $p=.319$) or traffic offences ($\chi^2(3)=3.7$, $p=.292$).

Some young drivers had their provisional licence disqualified during the 12-month follow up. Consequently, not all young offenders were driving during the

entire follow-up period and, therefore, had less opportunity to be crash involved or commit traffic offences. To account for potentially reduced driving exposure, driver records were reanalysed excluding offenders who had their licence disqualified for more than a month during the follow-up period (*n*=53). Similar to the results including young drivers with a disqualified provisional licence, there was no difference across clusters for either crashes ($\chi^2(3)=1.6$, $p=.657$) or traffic offences ($\chi^2(3)=3.8$, $p=.289$).

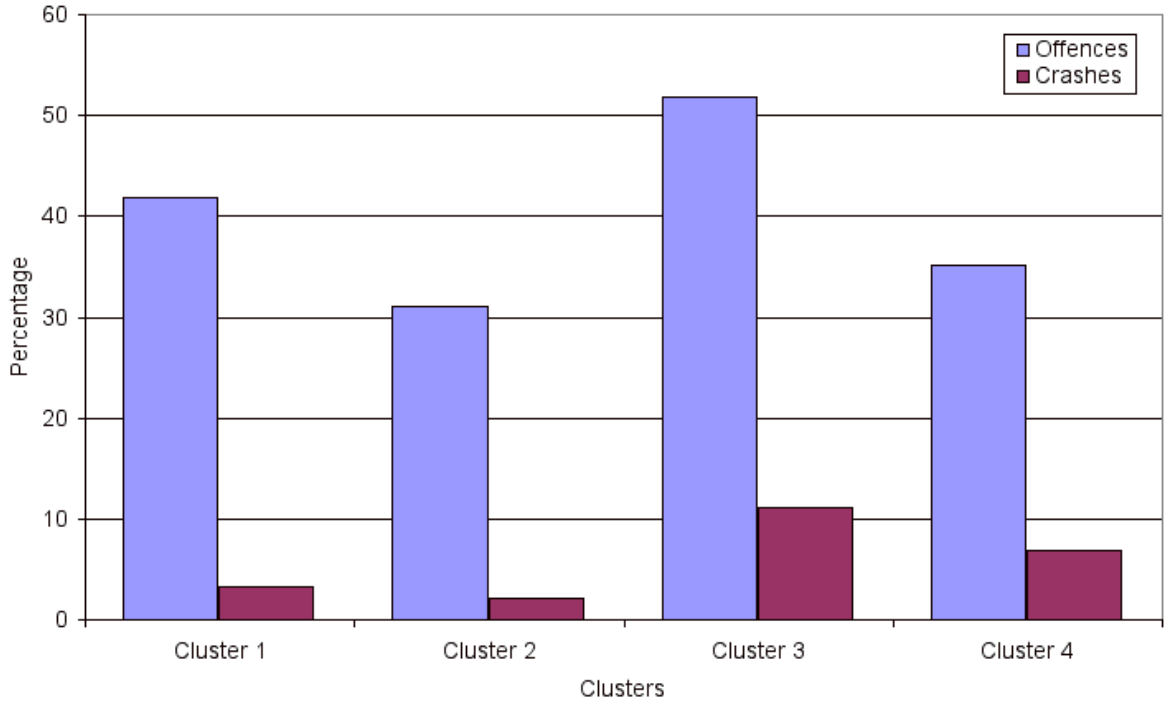

Figure 7.1. Percentage of young offender clusters with at least one crash or offence during the 12-month follow-up

One-way ANOVAs were performed to determine whether the mean number of crashes and traffic offences recorded in official records differed as a function of cluster membership (see Table 7.8). Given the small number of crashes, the severity of crashes was not reported. The ANOVA assumption of equal variances was violated for all driver record measures thus, a non-parametric test (Kruskal-Wallis) was performed. As the two statistical tests gave similar results, the original ANOVAs are reported in Table 7.8. The two high-risk clusters were not differentiated from the low-

risk clusters in terms of the mean number of crashes or responsibility for the crash as deemed by police.

There was no difference by cluster membership for subsequent traffic offences although there was a trend for the two high-risk groups to have a higher mean number of offences than the low-risk groups. Based on trends, of the two high-risk groups, young offenders in Cluster 3 were more likely to re-offend but those in Cluster 1 were more likely to re-offend multiple times.

Reanalysis of the data, excluding disqualified drivers, yielded similar non-significant results for all driver record measures.

Table 7.8
Descriptive statistics for young offender clusters based on official driving records during the 12-month follow up

Measures	Cluster					
	1 (*n*=62)	2 (*n*=45)	3 (*n*=27)	4 (*n*=74)	*F* (3,204)	η^2
Total no. of crashes	0.03 (0.18)	0.02 (0.15)	0.15 (0.46)	0.07 (0.25)	1.70	0.02
Responsibility for a crash	0.02 (0.13)	0.00 (0.00)	0.04 (0.19)	0.07 (0.25)	1.60	0.02
Traffic offences	0.87 (1.41)	0.42 (0.75)	0.70 (1.03)	0.59 (0.96)	1.60	0.02

7.4 Discussion

This study aimed to identify subtypes amongst young traffic offenders and ascertain which personality characteristics defined high-risk young offenders. Cluster analysis identified four separate and meaningful subtypes based on measures of personality characteristics and driving-related attitudes. The clusters were found to differ in terms of driving style, social deviance, specific driving-related attitudes, high alcohol use, and crash and traffic offence history. This outcome shows that young offenders are not a homogenous group.

Results from the analysis suggested that two of the young offender clusters were more likely to represent a road safety risk than the other clusters. The most notable differences were between the two high-risk subtypes (Clusters 1 and 3) and the two low-risk subtypes (Clusters 2 and 4). It is probably most interesting to review and focus on these high-risk subtypes. Essentially, Cluster 1 may be conceptualised as a “thrill seeking, hostile” subtype while Cluster 3 was an “emotionally distressed, hostile” subtype.

Cluster 1 was characterised by a high degree of thrill seeking evident in the highest reported levels of sensation seeking and a risk-enhancing attitude of competitive speed. This subtype held a favourable attitude towards speeding and had little concern for their personal crash risk; they perceived there was a low risk of dying in a crash. Furthermore, this subtype expressed hostility overtly by both physical and verbal means and used driving to reduce these feelings of hostility and tension. Thus, it was not surprising that this subtype reported high levels of driving related aggression and a low inclination to drive cautiously when upset (i.e., low driving inhibition). The finding that drivers with a predisposition for sensation seeking are associated with driving related aggression is consistent with previous research (Arnett et al., 1997; Tasca, 2000).

Cluster 3, the other high-risk cluster, reported some similar attributes to Cluster 1. For example, individuals in Cluster 3 were characterised by high levels of sensation seeking and competitive speed, although not quite to the same extent as Cluster 1. Moreover, they also reported a positive attitude towards speeding, expressed hostility overtly (assaultiveness and verbal hostility), and exhibited the most aggression when driving.

Despite the similarities, the high-risk subtypes differed substantially in terms of personal adjustment. While Cluster 1 was assertive and emotionally stable, Cluster 3 was characterised by poor emotional adjustment and had the highest depression

score. Furthermore, this “emotionally distressed” subtype not only expressed hostility overtly, but also with little provocation (irritability) and was resentful over perceived mistreatment. The attributes of this subtype are consistent with “personal maladjustment theory”. According to this theory, crash involved drivers are more likely to be under great personal stress and experiencing a difficult period in their life (Selzer *et al.*, 1968). A low level of assertiveness in this subtype may have lead to frustration, as they were unable to express their personal stress effectively. Individuals in Cluster 3 reported the most driving to reduce tension, indicating that driving was used as a means of coping with personal problems. However, they were the least likely to drive cautiously when upset. The acquisition of coping skills to reduce personal stress may be a useful intervention for this subtype of young offenders.

Given the attributes of these two high-risk groups, it was not surprising that they reported the riskiest driving style, the highest levels of social deviance, and the least road safety orientated attitudes. Young offenders in the high-risk groups were also more likely to take part in another high-risk behaviour, high alcohol use. Furthermore, these high-risk subtypes, particularly Cluster 3, reported more crashes and traffic offences prior to questionnaire administration than the low-risk groups, even when controlling for their greater driving exposure. Interestingly, offenders in Cluster 3 perceived there was a low probability of detection by police when committing a traffic offence despite being detected by police for more traffic offences than any other group.

Despite differences between subtypes for prior self-reported driver record, there was no difference by cluster membership for crashes and traffic offences in the 12-month follow up period (although there was a trend for the high-risk groups to have more traffic offences than the low risk groups). It is plausible that no difference was found during the follow up period because few young offenders recorded crashes or traffic offences. The low number of crashes and offences may be attributed to the

use of official records during the 12-month follow up; fewer crashes and traffic offences were reported in official records compared to offender's self-reported driving history. In support of this argument, prior to the study, self-reported driver record differed by young offender subtype but official driver records did not. Furthermore, the small number of crashes and traffic offences may also be attributed to the limited 12-month follow up period. Although not within the scope of this study, further research could follow the crash and traffic offence records of these drivers for a number of years to allow comprehensive validation of these subtypes.

Some offenders were disqualified during the 12-month follow up but further analyses indicated that reduced driving exposure did not appear to have any effect on the number of post-crashes and offences.

The combination of the psychological, social and behavioural characteristics in the high-risk young offender subtypes is consistent with "problem behaviour theory" (Jessor & Jessor, 1977). Problem behaviour theory suggests that clusters of problem behaviours are interrelated and reflect a common underlying propensity for problem behaviour or a deviant lifestyle (Jessor, 1987; Jessor & Jessor, 1977). Given this, risky driving is a component of an emerging deviant lifestyle among young adults and correlates highly with other problem behaviours including problem drinking, illicit drug use, and antisocial behaviour (Beirness & Simpson, 1988; Wilson & Jonah, 1988). Certainly, the two high-risk groups reported the most risky driving style, anti-social motivation, and high alcohol use. These three measures were also the strongest in differentiating between subtypes. Interventions aimed only at reducing risky driving may be ineffective in managing a broader range of problem behaviours or risk taking. Comprehensive interventions that target lifestyle may be useful for these subtypes of young offenders as recommended by Jessor (1987).

Problem behaviour theory also provides a motivation for engaging in high-risk driving behaviour; it proposes that problem behaviour is learned because it serves a

purpose and assists in the attainment of goals (Jessor, 1987). For example, speeding may be perceived to serve the purpose of reducing travelling time or satisfy the desire for thrills and excitement. In the present study, both high-risk groups had a predisposition for sensation seeking and may have engaged in risky driving to seek excitement.

Other possible motivations for risky driving in the young offenders that were not explored in this study may include attempting to defy authority, assert independence or impress peers. Steinberg (2004) suggested that risky driving is normative for adolescents. However, the identification of subtypes with different levels of risky driving in this study suggests that this is not true for all young drivers.

Most previous studies investigating driver subtypes have found at least one well-adjusted cluster and this has usually been the largest group, even in studies of drivers already defined as high-risk. This was the first study to identify subtypes of *young traffic offenders* and consistent with previous studies of traffic offenders, two low-risk groups were identified (representing 53% of the sample when combined). Cluster 4, the largest and lowest risk subtype, was generally well adjusted with high levels of assertiveness and low levels of all five measures of hostility, sensation seeking, mild social deviance, risky driving behaviour, and was the most inhibited while driving. Moreover, this subtype had positive attitudes towards road safety, consumed little alcohol, and reported few prior traffic offences or crashes. Likewise, Cluster 2 possessed similar attributes and attitudes to Cluster 4 but was also characterised by some emotional instability, indirect hostility and low assertiveness. Nevertheless, this cluster was relatively well adjusted. Thus, this study provides further evidence that not all young drivers have attributes predisposing them to be a road safety risk. Moreover, these findings suggest that even though these young drivers have been caught engaging in risky driving behaviour, they are not necessarily all high-risk drivers.

The young traffic offenders were predominantly male and the two high-risk subtypes consisted of substantially more males than the low risk subtypes, particularly in Cluster 1. Given that males, particularly young males, have typically been associated with taking greater risks in the driving situation, demonstrating more aggressive driving behaviour (Catchpole & Styles, 2005; Lawton *et al.*, 1997a; Parry, 1968), and being more socially deviant (Lawton et al., 1997b; West et al., 1993), these findings are not surprising.

A cluster membership effect was not found for any of the variables associated with young driver licensing and driving experience, a finding also evident in the student group (see Chapter 6). This finding suggests that these variables are not useful in identifying high-risk young offender subtypes.

7.4.1 Young Offender Subtypes in Comparison to Previously Identified Young Driver Subtypes

Similar to the findings for the student sample (see Chapter 6), in the present study four subtypes of young traffic offenders were identified. However, the composition of the characteristics defining the four subtypes differed between the two samples of young drivers. Two high-risk subtypes were found among the young offenders while one high-risk subtype was found among the student drivers. The young offender subtypes were more similar to the young driver subtypes derived by Deery et al. (1998), than were the student subtypes. Four of the five subtypes (Clusters 1, 2, 4 and 5) identified by Deery et al., (1998) were similar to the young offender subtypes found in this study. Of the subtypes Deery et al. (1998) identified, two were deemed high-risk (Clusters 1 and 5), one low risk (Cluster 4), and one emotional and inhibited (Cluster 2). The fifth subtype (Cluster 3) was labelled “moderate” after scoring moderately on most personality characteristics and attitudes. The meaningfulness of this subtype was questionable because the subtype was

characterised by few obvious attributes apart from contradictory high levels of both an external and internal locus of control.

In the present study, the “emotional, hostile” high-risk young offender subtype was consistent with one of Deery et al’s (1998) high-risk subtypes (their Cluster 5) and also with a high-risk subtype identified among novice drivers from the general driving population in Norway (Cluster 5; Ulleberg, 2001). Moreover, the emotional subtype was similar to other emotional driver subtypes identified among adult drink drivers and multiple crash/traffic offenders (Donovan et al., 1988; Wilson, 1991). An emotional subtype was found in the student sample but it was not deemed a high-risk group. Given that personality characteristics remain relatively stable over time, the fact that similar characteristics appear to define both young and adult high-risk subtypes suggests that young high-risk drivers will continue to be high-risk drivers. Further research could explore this possibility by following the driver records of young drivers in the high-risk subtypes for a longer period than one year.

The “thrill seeking, hostile” young offender subtype (Cluster 1) was similar to the single high-risk subtype identified in the student sample (Cluster 3), and other high-risk subtypes identified among novice young drivers (Cluster 1; Deery et al., 1998) (Cluster 2; Ulleberg, 2001). Shared characteristics included high levels of driving-related aggression, competitive speed, sensation seeking, assaultiveness, verbal hostility, driving to reduce tension, and low levels of driving inhibition. Moreover, all of these high-risk young offender subtypes exhibited a risky driving style, participated in other risky behaviour (high alcohol use), and, for the students and young offenders, viewed speeding behaviour as acceptable.

A history of crashes and traffic offences was more common for the high-risk young offender subtypes than the low-risk subtypes, even when considering the greater driving exposure of high-risk subtypes. This finding was consistent with previous studies that found a poor driving record was associated with high-risk young

driver subtypes (Deery et al., 1998; Ulleberg, 2001), although only one of these studies (Ulleberg, 2001) adequately controlled for driving exposure. In contrast, the high-risk student subtype was not associated with a poor driving record when controlling for driving exposure.

A plausible reason for the similarities between the young offender subtypes and other young driver subtypes found in previous studies, may be the greater proportion of males in the offender sample. Previous studies examining offender populations have been comprised of mainly males while other studies of general young driver populations (Deery et al., 1998; Ulleberg, 2001) have consisted of approximately equal proportions of males and females. In contrast, the young driver student sample consisted of a greater proportion of females (71%). Typically, females are less likely to engage in risk taking (e.g., Zuckerman, 1994) and commit traffic offences (e.g., Waller et al., 2001) than are males.

7.4.2 Limitations

There are several limitations associated with this research: the arbitrary nature of cluster analysis and self-reported nature of the personality and attitudinal measures. These limitations are addressed in Chapter 6 (see section 6.4.2). Another limitation of this research is that it is possible participating in the intervention (i.e., DIP session) may have influenced subsequent driver behaviour (i.e., traffic offences and crashes) and that the impact of the intervention may affect drivers from certain subtypes differently. The impact of the intervention on young traffic offender's behaviour, if any, is unknown and beyond the scope of this study.

7.4.3 Summary

The cluster analysis and subsequent external validation of the clusters suggested that two subtypes of young traffic offenders (i.e., Clusters 1 and 3) were more likely to represent a road safety risk than the other subtypes. These high-risk

young offender subtypes used risky driving as a means of satisfying a need for thrills or excitement (Clusters 1 and 3) and to cope with personal stress (Cluster 3). The type of interventions required to assist these high-risk groups may need to be long term and attempt to change lifestyle issues (i.e., high alcohol use, social deviance), provide treatment for depression or substance abuse, and equip young drivers with better coping skills to counter driving induced aggression or stress.

The identification of characteristics common to the high-risk young offender subtypes and other high-risk young driver subtypes provide further validation of the existence of high-risk young driver subtypes. These attributes are consistent with research identifying other high-risk subtypes among adult drink driving offenders and multiple crash/traffic offenders. Given that personality characteristics remain relatively stable over time and that similar characteristics appeared to define both young and adult high-risk subtypes, the findings from this study suggest that young high-risk drivers will continue to be middle-aged high-risk drivers. Further research could explore this possibility by following the driver records of high-risk young driver subtypes for a longer period.

The identification and validation of subtypes within young driver populations has a number of practical implications for interventions that might otherwise be overlooked if the focus was on young drivers as a whole. Specifically, post-licensing interventions and public education initiatives may be more effective when matched to the particular motivational needs of high-risk young driver subtypes. These implications are discussed in Chapter 8.

CHAPTER 8 SUMMARY AND CONCLUSIONS

8.1 Introduction

In Australia and other developed countries, young drivers are more likely to be involved in fatal and injury crashes than older, more experienced drivers (e.g., Clarke et al., 2002, *Young people and road crashes*, 2004). The main factors contributing to young driver crash involvement are age and inexperience. This thesis focused on age-related factors. There is evidence of the existence of a subgroup of young drivers at a higher risk of crash involvement (see Chapter 1). Thus, the aim of this thesis was to examine some characteristics of young drivers (aged 16 to 24 years) that identify those with an elevated risk of crash involvement.

This thesis began by examining whether prior driving behaviour, reflected in driver records, could identify young drivers at a higher risk of crashing. A review of the literature (Chapter 2) suggested that driver records, particularly traffic offences, could be of some value in identifying high-risk drivers, particularly drivers culpable for a fatal crash. However, the evidence was not as clear on young drivers. The first study examined whether driver records could identify high-risk young drivers, that is, young drivers culpable for a fatal crash (Chapter 3). In this analysis, official driver records for both crashes and traffic offences, of drivers involved in a multiple vehicle fatal crash were tracked over a period of five years prior to the fatal crash (N=388). This analysis was repeated for a subset of young drivers, aged 16 to 24 years (n=82), involved in a multiple vehicle fatal crash.

The second study (Chapter 5) developed a detailed profile of the characteristics and attitudes of a group of young drivers detected engaging in risky driving, young traffic offenders (N=336), in relation to a comparison group of young drivers (i.e., university students, N=270). The profile was based on a variety of selected personality characteristics and driving-related attitudes found to be associated

with risky driving and young driver crash risk in the literature (see Chapter 4). Driver records (i.e., crashes and traffic offences) both prior to and one year following questionnaire administration were also examined.

The third and fourth studies identified, and validated against external criteria, the presence of driver subtypes in two different groups of young drivers. The subtypes were based on questionnaire measures of personality characteristics and driving-related attitudes that had been used in a previous study (see Deery et al., 1998) and were found to be associated with an elevated crash risk (Chapter 4). High-risk young driver subtypes were identified among the sample of young drivers (i.e., university students, *N*=270) in Chapter 6 and among the sample of young traffic offenders (*N*=336) in Chapter 7.

This final chapter begins by giving a brief summary of the findings of the first study in which the driver offence records of young South Australian drivers were examined to determine whether driver history could identify drivers culpable for a fatal crash, that is, high-risk young drivers. The psychological profile of young traffic offenders, a group shown to be at a higher risk of crashing, is then examined followed by a discussion of interventions that might be suitable for these young traffic offenders as a group. Next, the findings from the two studies that identified driver subtypes among different young driver populations are summarised and compared. Moreover, the ways in which knowledge of the personality characteristics and attitudes of specific subgroups of high-risk young drivers can be used to develop and enhance interventions and road safety campaigns is discussed. Finally, limitations associated with the studies presented in this thesis are reviewed and further avenues of research are outlined.

8.2 Driver Records and High-Risk Young Drivers

Based on the premise that drivers culpable for a multiple vehicle fatal crash are high-risk drivers, analyses in Chapter 3 examined whether these drivers were

identifiable by their past driving behaviour as reported in official driver records. The driver records (i.e., crashes and traffic offences) of all drivers involved in a multiple fatal crash from 1999 to 2002 (*n*=388) were tracked for five years prior to the fatal crash.

Contrary to previous findings, it was shown that neither the number of prior traffic offences nor crashes were associated with multiple vehicle fatal crash culpability for drivers of all ages. In terms of the *type* of driving incident, prior drink driving offences was the only type of incident associated with culpability for a fatal crash. Drivers with a prior drink driving offence were over three times more likely to be a culpable for the fatal crash, although few drivers actually reported any drink driving offences. This relationship endured even when controlling for years of driving experience. A strong association between drink driving offences and driver culpability for casualty and fatal crashes is reported in the literature (Longo, 2001; Perneger & Smith, 1991). Note that in the present study, younger drivers (aged less than 25 years), along with older drivers (aged over 60 years), were found to be more likely to be culpable for the fatal crash, consistent with previous research (e.g., Williams & Shabanova, 2003).

An analysis of the utility of driver records in predicting driver culpability was repeated for a subset of younger drivers aged 16 to 24 years (*n*=82). Of all the driver record variables, demographic factors, and fatal crash characteristics examined, only an alcohol level at or above 0.05 mg/L recorded at the time of the crash was associated with younger driver culpability. This association was also found when examining drivers of all ages. Alcohol consumption before the crash has consistently been associated with driver culpability for casualty and fatal crashes (Longo, 2001; Perneger & Smith, 1991; Rajalin, 1994), although few studies have specifically examined younger drivers. It is possible, of course, that a positive alcohol reading recorded at the time of the crash influenced the assignment of driver culpability.

Of note, there was a trend for young culpable drivers to record more prior drink driving offences. However, very few drink driving offences were recorded and this difference was not statistically significant. The fact that none of the driver record variables was useful in identifying high-risk young drivers (i.e., young drivers culpable for a fatal crash) is inconsistent with previous findings (Elliot *et al.*, 2001; Harrington, 1972). There are several possible reasons as to why few significant relationships were found between driver records and fatal crash culpability. Firstly, the low number of prior driving incidents, particularly crashes, reduced statistical power. In the case of the subset of younger drivers, the sample size was reduced so there were even fewer recorded driving incidents and, consequently, statistical power was reduced further. Given the trend for young culpable drivers to record more drink driving offences, it would be useful to examine the driver records of a greater number of drivers involved in a fatal crash, and follow these driver records for a similar substantial period.

Secondly, it could be that drivers involved in a fatal crash may not have differed by driver culpability status because even non-culpable drivers may have been partially responsible for the crash. In the case of non-culpable younger drivers, fatal crash involvement may not have simply reflected driving exposure but may have resulted from less proficiency at avoiding a crash; most likely attributable to inexperience and lack of defensive driving skills (see Catchpole et al., 1994b). Some studies suggest that young traffic offenders might be a better high-risk young driver group to investigate in future studies because traffic offences are a better approximation of intentional driving behaviour (e.g., Rajalin, 1994). Alternatively, variables other than driver records, such as personality factors and attitudes, may be more useful in identifying young drivers at a higher risk of crashing.

Several potential methodological issues and limitations associated with driver culpability and driver records were identified including: the differential assessment of

driver culpability, the absence of a driving exposure measure, and factors contributing to incomplete driver records. However, none of these factors appeared to present a serious problem in this study.

In summary, none of the driver record variables examined in this study were able to identify high-risk young South Australian drivers, defined as drivers culpable for a fatal crash. The remainder of this thesis was designed to investigate whether personality characteristics, motivations and attitudes could identify high-risk young drivers. These characteristics and attitudes were examined to provide a profile of young traffic offenders' psychological functioning, relative to a comparison group of young drivers. Most importantly, this thesis examined whether these personality and attitudinal measures could define subtypes of young drivers at a higher risk of crashing, particularly among young traffic offenders.

8.3 Young Traffic Offender Profile

The research reported in Chapter 5 was designed to identify the individual characteristics and motivations of a group of young drivers detected engaging in risky driving, as defined by the law. The characteristics of young traffic offenders (*N*=336) were compared to the characteristics of a control group of young drivers (university students, *N*=270). The young traffic offenders were recruited from an intervention program designed for drivers aged 25 years and under who had breached the conditions of their South Australian learner's permit or provisional licence and were subsequently disqualified from driving. Only drivers who held a provisional licence were included in the study; they were predominantly first time offenders detected for a speeding offence. This study was important because it investigated the personality factors and attitudes of young high-risk drivers in more depth than previous studies.

A summary of the personality factors, driving-related attitudes, and behaviours characterising this group of young traffic offenders, relative to the students, is given in the next section. This is followed by a discussion of interventions that might be

suitable for these young traffic offenders.

8.3.1 Characteristics of the Young Traffic Offenders

Examination of driver records indicated that the traffic offenders were more likely than students to be involved in a crash and be detected for a traffic offence. When driving exposure was taken into account (self-reported data only) offenders were still more likely to report personal injury crashes and detections for traffic offences but the effect for crashes of all severities disappeared. However, this finding should be interpreted with caution because of a methodological limitation associated with the driving exposure measure; the two groups were asked about driving exposure at differing levels of detail. Nevertheless, driving history suggested that the young offender group was at a higher risk in traffic (crashes and traffic offences) than the student group.

The profile of characteristics for young traffic offenders indicated that they were not a psychologically dysfunctional group but were personally well-adjusted and generally did not differ greatly from the students. However, there were notable differences on some measures related to aggression, consistent with findings from other studies on young drivers (e.g., Begg & Langley, 2004; Miles & Johnson, 2003). Young offenders reported higher levels of driving-related aggression than did students, and young male offenders reported higher levels of driving to reduce tension than did young male students.

The greatest contrasts between the two groups were found for some of the road safety-related attitudinal measures. Consistent with previous research that has shown that non-safety oriented attitudes are prevalent among high-risk young drivers (Beirness & Simpson, 1988; Ulleberg & Rundmo, 2002), offenders perceived risky behaviour (i.e., drink driving) as acceptable, did not perceive the risk or consequences of crashing as serious, and had low motivation to alter their behaviour. Moreover, their social norms suggested unsafe driving was common among their peers. Despite

this, young offenders were no more likely to report a risky driving style.

Several measures did not distinguish young traffic offenders from the students (i.e., sensation seeking, depression, verbal hostility, resentment, driving inhibition, risky driving style) and some measures showed a relationship in the opposite direction to that which was expected (i.e., emotional adjustment, mild social deviance, indirect hostility, irritability, competitive speed). Previous studies that identified a number of these characteristics in groups of traffic offenders (Deery & Love, 1996; Donovan et al., 1985; Wilson, 1991), had examined populations of more serious traffic offenders (i.e., convicted drink driving offenders, multiple offenders). Thus, the findings from this study provide support for the argument that there is a continuum of psychological well-being among traffic offenders, with the degree of personality dysfunction being related to the severity and type of traffic offences committed. In the present study, the young offenders were predominantly caught speeding and may have committed only a single offence. Thus, the results apply to these specific types of offenders (i.e., not to drink driving recidivists, multiple offenders, etc.).

Further research could examine the personality characteristics and attitudes of young traffic offenders by traffic offence type. Drivers detected committing more serious traffic offences (e.g., drink driving) might have different attributes to drivers detected committing more minor traffic offences (i.e., failure to display P-plates). This analysis would only be possible if official driver records clearly state which traffic offence resulted in licence disqualification. Of note, however, is that many of the personality measures were not associated with the young offenders as a group but they were useful in defining high-risk young driver subtypes *within* the young offender group (see section 8.4.2). These findings suggest that the young traffic offenders *as a group* were not as high-risk drivers as were specific subgroups of high-risk young drivers *within* this group.

Consistent with previous research (e.g., Arnett et al., 1997; Jonah, 1997; West

& Hall, 1997), there were gender differences on a number of personality characteristics; males typically reported more attributes associated with higher crash risk than did females. Males also exhibited more non-road safety oriented attitudes and reported a riskier driving style than females. Consequently, it was not surprising that males reported more crashes and traffic offences than females.

Consumption of high levels of alcohol has been considered part of a general risk-taking propensity related to the lifestyle of high-risk young drivers (Gregersen & Berg, 1994; Jonah, 1986) and has also been associated specifically with risky driving behaviour among young drivers (e.g., Horwood & Fergusson, 2000). Interestingly, female offenders reported higher alcohol use than female students, a finding consistent with some previous studies (Dobson *et al.*, 1999; Shope *et al.*, 2001b). Although males reported consuming more alcohol than females, no group difference was found for males. This finding suggests that even though females might be characterised by less risky attributes and more safety-oriented attitudes than males, those females at a higher risk of crashing are likely to engage in high alcohol consumption. Although offenders as a group did not appear to lead a deviant lifestyle, interventions incorporating lifestyle issues such as excessive alcohol intake may be especially beneficial for females.

8.3.2 Discussion of Interventions for Young Traffic Offenders

The profile of characteristics for young traffic offenders, a group caught engaging in risky driving behaviour, indicated that they were not a psychologically dysfunctional group and generally did not differ greatly from the comparison group of university students. The greatest difference between groups was found for some road-safety-related attitudinal measures; offenders were more likely to have attitudes promoting engagement in risky driving behaviour. This finding indicates that a change in traffic offender's attitudes is desirable. Nonetheless, changing attitudes is clearly not a simple undertaking and some researchers suggest that attitude change is

more likely to follow behaviour change, rather than vice versa (e.g., Burgess & Webley, 1999).

The social norms of offenders suggested that they perceived unsafe driving to be common among their peers. A review of factors that were successful in changing social norms and behaviours in the public health areas of tobacco smoking and HIV-AIDS prevention, found that developing, clarifying, and sustaining healthy norms through effective communication strategies were important (Barokas, 1995). Moreover, specific behaviours need to be targeted and that any misperceptions regarding the risky behaviour require correction. For example, a recent study evaluated a campaign that used a "social norms strategy", that is, a strategy communicating the accurate, positive norms already existing in the population, to correct misperceptions about the frequency of drink driving among young drivers (Linkenbach & Perkins, 2005). They reported positive changes in attitudes and a reduction in self-reported risky behaviour. However, changes in actual drink driving behaviour (i.e., alcohol related crashes) were not examined. A campaign that focuses on correcting the misperception that unsafe driving is prevalent among young drivers, assuming it is a misperception, may produce positive results for this group of young traffic offenders.

The combination of young traffic offenders' personality, attitudinal, and behavioural characteristics suggests that they feel they are in personal control of their lives and have the ability to alter their behaviour if they wish. However, offenders' attitudes suggest that they are not motivated to change their behaviour. According to Ajzen (1991), an individual's perception that they have the opportunity and resources to perform certain behaviours facilitates behaviour change. Thus, post-licensing interventions based on the premise that young drivers should make their own individual decisions and conclusions about what and how their driving behaviour might change may be more beneficial for this group of young drivers than traditional

approaches in which young drivers are told by authorities how to drive safely. Such an intervention typically takes the form of group discussions whereby participants are encouraged by facilitators to conceptualise issues through their own experiences so that they might question their own driving behaviour. By placing the decision making process under their personal control, young drivers might be more motivated to change their behaviour. This strategy of self-assessment/realisation has had some success among professional drivers; drivers who determined their own need for behaviour change reduced their crashes by 50 per cent compared to controls (Brehmer *et al.*, 1993).

The young traffic offenders studied here were recruited from a discussion based intervention program guided by these principles. The program was designed for drivers aged 25 years and under who had breached the conditions of their South Australian learner's permit or provisional licence and were subsequently disqualified from driving. Participation in the course was voluntary but an expiation fee was imposed if the individual chose not to attend. Thus, in South Australia a mechanism is already in place to address high-risk young drivers. However, this intervention could be refined and tailored to match the characteristics and needs of participants, based on the profile identified (for a discussion see Wundersitz & Hutchinson, 2006). For example, to address elevated levels of driving-related aggression and the use of driving to release frustration and tension, it may be beneficial for these drivers to discuss ways of expressing anger and aggression other than on the road. It might also be advantageous for offenders to discuss effective strategies to manage hostile feelings and anger arising when driving.

Psychological interventions concentrating on specific behaviour change might be useful for some high-risk young drivers. However, for the group of predominantly first time traffic offenders examined in this study, the difference between offenders and students was not large, so such psychological interventions would not be

necessary. Psychological interventions might be considered for higher-risk subgroups.

In summary, young traffic offenders may benefit from group discussion based interventions that give them personal control over the process of making a decision to change their driving behaviour. Any such interventions should be tailored to address driving-related aggression by discussing effective strategies to manage hostile feelings and anger arising from the driving context, and encouraging participants to find means other than driving to express aggression, or release tension. Furthermore, a program correcting misconceptions about social norms and promoting a general motivation towards road safety issues would be consistent with the personality and attitudinal profiles of the young traffic offenders.

8.4 Young Driver Subtypes

The studies reported in Chapters 6 and 7 were designed to identify subtypes of young drivers among different populations, based on cluster analyses of personality characteristics and driving-related attitudes. More specifically, these studies were designed to define and validate young driver subtypes at a higher risk of crashing and to determine whether the characteristics of these high-risk young driver subtypes were similar to characteristics of other high-risk subtypes reported in the literature. Subtypes were interpreted as “low”, “medium” or “high” risk according to the levels of personality characteristics and driving-related attitudes associated with crashes and risky driving. Following this, other variables (e.g., driver records) were used to validate the high-risk subtypes, that is, determine whether there were any statistically meaningful differences between subtypes.

The following sections summarise the characteristics associated with the single high-risk subtype identified among young drivers (i.e., students, see section 8.4.1), and the two high-risk subtypes found among young traffic offenders (see section 8.4.2). The characteristics of the high-risk subtypes from these two young driver populations are compared and contrasts are made with other young driver subtypes

found in previous research (see section 8.4.3). In addition, interventions matching the characteristics and needs of these high-risk young driver subtypes are suggested.

Note that in this section and the following sections, the term “student subtypes” refers to the subtypes of drivers obtained from the student sample and “young traffic offender subtypes” refers to the subtypes of drivers recruited from the DIP.

8.4.1 High-Risk Student Subtype

The main purpose of the study in Chapter 6 was to ascertain which personality characteristics defined high-risk young drivers in South Australia and to validate young driver subtypes previously identified in the literature. A sample of 270 drivers (i.e., university students) aged 17 to 21 years completed an extensive self-report questionnaire. Young driver subtypes were identified through a cluster analysis based on the same personality traits and driving-related attitudes used in a previous study on a similar young driver population (Deery et al., 1998). External validation of the clusters was undertaken by comparing the young driver subtypes on a variety of demographic, attitudinal and behavioural measures not included in the cluster derivation, in addition to crash and traffic offence history.

Cluster analysis derived four meaningful subtypes of young drivers, one of which was more likely to represent a road safety risk than the others. This finding provides empirical support for the existence of a subgroup of high-risk young drivers, based on personality measures and attitudes. The high-risk subtype (Cluster 3), labelled “hostile, aggressive”, was characterised by high levels of driving-related aggression, overt hostility (i.e., assaultiveness and verbal hostility), and indirect hostility. This subtype was assertive, used driving to reduce tension and frustration, and reported the lowest tendency to drive cautiously when upset. This subtype also reported high levels of competitive speed, positive scores on sensation seeking and excitement seeking, a risky driving style, a positive attitude towards speeding, and high alcohol consumption. Events were perceived to be attributable to their own

behaviour (internal locus of control) and they reported the highest level of confidence in their driving skill despite a poor driving record. Although this subtype reported the most traffic offences, the difference between subtypes was not statistically significant after controlling for driving exposure. There were no differences between clusters for crash involvement.

Driver records for the 12 months following questionnaire completion indicated that there was a trend for the high-risk subtype to record more traffic offences than other subtypes although very few young drivers were detected committing traffic offences. Again, there were no differences in crash involvement.

8.4.2 High-Risk Young Traffic Offender Subtypes

The main purpose of the study described in Chapter 7 was to determine whether distinct driver subtypes could be identified among young traffic offenders (16-24 years, *N*=336), and to ascertain any personality characteristics and driving-related attitudes defining these subtypes. Young traffic offenders (i.e., young drivers caught engaging in risky driving) were examined in preference to crash involved young drivers, because, as discussed in Chapter 2, research suggests that driving behaviour leading to detection for a traffic offence is more intentional and connected to the motivations of the driver than are crashes (Burg, 1970; Harrington, 1972). In addition, research in this chapter investigated the extent to which the attributes of young offender subtypes were comparable to the attributes of the student subtypes identified in Chapter 6 and to other young driver subtypes identified in the literature. To the best of my knowledge, this study was the first to attempt to define subtypes within a population of young traffic offenders.

A cluster analysis was performed on a similar set of personality and attitudinal variables to that used for the students in Chapter 6. Consistent with the findings for the students, four subtypes of young traffic offenders were identified. However, the composition of the characteristics defining the four subtypes differed between the two

groups of young drivers. Two high-risk subtypes ("thrill seeking, hostile" and "emotionally distressed, hostile") were identified among the young traffic offenders while only one high-risk subtype ("hostile, aggressive") was found among the students.

Of the two high-risk young traffic offender subtypes, Cluster 1 was conceptualised as a "thrill seeking, hostile" subtype; individuals appeared to use driving as a means of satisfying a need for thrills or excitement and were somewhat hostile. Cluster 3 individuals were also hostile and thrill seeking but they used driving to cope with personal stress, and so this subtype was labelled "emotionally distressed, hostile".

The "thrill seeking, hostile" young offender subtype (Cluster 1) had similar attributes to the single high-risk subtype identified among the students (Cluster 3) and other high-risk subtypes identified among young novice drivers (Cluster 1; Deery et al., 1998) (Cluster 2; Ulleberg, 2001). Characteristics shared by these subtypes included high levels of driving-related aggression, competitive speed, sensation seeking, overt expression of hostility (assaultiveness, verbal hostility), low levels of driving inhibition, and the use of driving to reduce tension. Furthermore, all of these high-risk young driver subtypes exhibited a risky driving style, participated in another risky behaviour (i.e., high alcohol use), and, for the students and traffic offenders, viewed speeding behaviour as acceptable.

Cluster 3, the other high-risk young offender subtype, reported some similar attributes to Cluster 1 (i.e., high levels of driving-related aggression, sensation seeking, competitive speed, overt expression of hostility, a positive attitude towards speeding). Despite the similarities, the high-risk subtypes differed considerably in terms of personal adjustment. Cluster 1 was emotionally stable while Cluster 3 was characterised by poor emotional adjustment and had the highest depression score. Furthermore, this emotionally distressed subtype not only expressed hostility overtly

but also with little provocation (irritability) and was resentful. Cluster 3 drivers reported the most driving to reduce tension, indicating that driving was a way of coping with personal problems. However, they were the least likely to drive cautiously when upset.

An emotional subtype was found in the student sample but it was not deemed a high-risk group because it did not have high levels of other characteristics associated with crash involvement and risky driving. Nevertheless, like the other young offender high-risk subtype, the emotional, hostile high-risk offender subtype was consistent with other high-risk young driver subtypes found in Australia (Cluster 5; Deery et al., 1998) and in Norway (Cluster 5; Ulleberg, 2001). It was also similar to other subtypes identified among adult drink drivers in the United States (Cluster 3; Donovan et al., 1988) and multiple crash/traffic offenders in Canada (Cluster 2; Wilson, 1991). Thus, there is cross-cultural evidence of high-risk young driver subtypes with similar profiles.

In general, the young traffic offender subtypes were actually more similar to the young driver subtypes (Deery et al., 1998; Ulleberg, 2001), drink driver subtypes (Donovan & Marlatt, 1982), and multiple offender subtypes (Wilson, 1991) previously identified in the literature than to the student subtypes identified in Chapter 6. A plausible reason for the similarities between the young offender subtypes and the young driver subtypes found in other studies may be the proportion of males in the sample (i.e., 81%). Previous studies examining offender populations have been comprised of mainly males (e.g., Donovan & Marlatt, 1982), while other studies of general young driver populations (Deery et al., 1998; Ulleberg, 2001) have consisted of approximately equal proportions of males and females. In contrast, the student sample consisted of a greater proportion of females (71%). Cluster analysis could not be performed for males and females separately to investigate this possibility and to see if the profiles of the clusters replicated. The low number of females in the

offender sample and males in the student sample prevented meaningful statistical analyses.

Interestingly, the young offender subtypes appeared to be more clearly differentiated than the student subtypes, suggesting that there was greater variability among the traffic offenders. External validation of the young offender subtypes (i.e., driving behaviours, attitudes, and driver records) demonstrated that there were distinct, significant differences between the low and the high-risk offender subtypes. For example, the two high-risk young offender subtypes had the riskiest driving style, the highest levels of mild social deviance, consumed more alcohol, and had the least road safety oriented attitudes compared to low-risk groups. Note that this combination of characteristics in the high-risk young offender subtypes lends support to “Problem Behaviour Theory” (Jessor & Jessor, 1977). According to this theory, risky driving is a component of an emerging deviant lifestyle among young adults and correlates highly with other problem or risky behaviours (Beirness & Simpson, 1988; Wilson & Jonah, 1988). While there were significant differences between student subtypes for the validation measures, most of these differences were between the lowest risk subtype and the other three subtypes.

A history of crashes and traffic offences was more prevalent among the high-risk young offender subtypes than in the low risk offender subtypes, even when considering the greater estimated driving exposure of the high-risk subtypes. This finding replicated previous studies that found a poor driving record was associated with high-risk young driver subtypes (Deery et al., 1998; Ulleberg, 2001), although only one of these studies (Ulleberg, 2001) adequately controlled for driving exposure. In contrast, the high-risk student subtype was not associated with a poor driving record when controlling for driving exposure.

When interpreting these findings, it must be remembered that the driving exposure of drivers is an individual choice that may be associated with certain

characteristics of the high-risk drivers. Controlling for driving exposure may remove some of the variation associated with these drivers. For example, the greater driving exposure of the high-risk young offender subtypes may be related to driving for social purposes or pleasure and driving for these reasons has been associated with increased young driver crash involvement (e.g., Clarke *et al.*, 2006).

It is interesting that although the young traffic offenders were detected for risky driving behaviour, as defined by the law, two low-risk groups were identified (representing 53% of the sample when combined). This finding was consistent with other research investigating driver subtypes (e.g., Beirness, 1995); at least one well-adjusted cluster has been identified, usually it is the largest group, among drivers already defined as high-risk (e.g., drink drivers, multiple offenders) (Donovan et al., 1988; Wilson, 1991). These findings suggest that even though these young drivers have been caught engaging in risky driving behaviour, they are not necessarily all high-risk drivers. Alternatively, the risky driving behaviour of this subtype was relatively independent of their personality functioning.

8.4.3 *Discussion of High-Risk Young Driver Subtypes and Interventions*

In this section, a number of interventions are suggested for the high-risk student and young traffic offender subtypes defined in Chapters 6 and 7. Note that this study did not intend for these personality measures to be used as a diagnostic tool in determining which young drivers should be licensed. It is difficult to justify the refusal of an individual a driver's licence based on their particular personality characteristics and not their actual driving behaviour. Rather, as stated above, personality measures can be used to tailor interventions to the needs of high-risk subgroups, or even as a means for young drivers to acquire greater self-awareness.

Before discussing any interventions, it should be acknowledged that there is a widespread view that any form of driver education, improvement program, or training will not greatly improve driver behaviour and crash rates. Masten and Peck (2004)

reviewed 35 studies examining different types of driver interventions and reported that overall, on average there was a six per cent decrease in crash rates for treated drivers. Perhaps somewhat overstated, Ker and colleagues (2003) reviewed remedial driver education and reported that the evidence suggested no type of driver education for licensed drivers lead to a reduction in traffic crashes or injuries. Thus, driver interventions have had only a small effect, if any at all, on driver behaviour and crash rates. However, there may be other interventions, not yet rigorously evaluated, that will be found to be effective in the future.

As mentioned in the previous section, well adjusted subtypes determined to be at a low-risk of crashing were identified in both samples of young drivers and have commonly been reported in other research examining young and high-risk driver subtypes. Short-term education interventions might be appropriate for these low-risk offender subtypes. Reviews of educational and drink driving rehabilitation programs have indicated that low-risk groups are more responsive to these types of interventions than high-risk groups (DeJong & Hingson, 1998; Foon, 1988; Shope *et al.*, 2001a). For example, Shope and colleagues (2001a) evaluated the effects of a short-term alcohol misuse prevention program in high schools. Students were randomly assigned to the program that consisted of five 45-minute sessions. The program aimed to increase student awareness of the short-term effects of alcohol, risks associated with drink driving, and social pressures. Students who reported drinking the least alcohol (the largest subgroup) experienced the most positive effects from this program, a reduction in serious traffic offences but not crashes. Interestingly, these effects were only evident in the first year of licensure.

Alternatively, individuals in these subtypes may not even need any intervention. The characteristics of the low-risk subtypes (i.e., emotionally well-adjusted, low sensation seeking, low driving aggression and hostility) suggested that they were less likely to crash or commit traffic offences in the future, a finding

confirmed by trends in subsequent driver records. Moreover, the attitudes of these low-risk subtypes indicated that they were motivated to change their driving behaviour if necessary; they had the highest scores on road safety motivation.

The high-risk young offender subtype most consistent with high-risk subtypes in previous research was chiefly characterised by poor emotional adjustment, hostility, and driving-related aggression. Individuals in this subtype are likely to be inattentive because poor personal adjustment and a state of depression (usually associated with personal problems) are thought to have a negative effect on a driver's attention level and distract drivers from the driving task (Beirness *et al.*, 1992). Furthermore, drivers in this subtype reported using driving as a means of coping with their emotional problems and reducing tension and hostile feelings but they were unlikely to drive cautiously when upset. The acquisition and development of coping skills to deal with personal problems and reduce personal stress might be a useful intervention for this subtype of young drivers. For example, the development of coping skills was a topic discussed in a cognitive behavioural intervention found to reduce aggressive driving behaviour (Galovski & Blanchard, 2002).

The other high-risk offender subtype was characterised by a need to seek thrills or sensations, the overt expression of hostility, and high levels of aggression when driving. With regard to sensation seeking, an intervention that focuses on presenting alternative ways to seek thrills or stimulation, other than driving, might be beneficial for this high-risk subtype. Jonah (1997) suggested high sensation seekers should attend an educational program highlighting the adverse consequences of risky driving and encouraging participation in less destructive activities such as mountain biking or rock climbing. It is anticipated that through greater self-awareness, some sensation seeking young drivers, certainly not all, might modify their risky driving behaviour, or at least have greater risk awareness.

This thrill seeking subtype also reported low safety motivation but, unlike the other emotional, hostile high-risk subtype, was personally well adjusted. Thus, this subtype may be a good candidate for motivational interviewing, a therapeutic psychological technique based on self-reflection. Motivational interviewing is used to motivate and increase readiness for change in undesirable behaviours that are perceived by the individual to have positive qualities (Miller *et al.*, 1992). Examples of such behaviours include alcohol use, drug use, and aggressive driving (as opposed to conditions considered to be negative such as depression).

It is important to note that personality traits (i.e., hostility) are resistant to change but behavioural manifestations of these traits in the driving context (i.e., driving aggression, using driving to reduce tension) have been learned and are, therefore, more amenable to change. It is plausible that psychological interventions might be appropriate for changing such driving-related behaviours among high-risk young driver subtypes. In recent years, positive results have been reported for psychological interventions to reduce driving anger and subsequently driving aggression such as relaxation and cognitive restructuring interventions (Deffenbacher *et al.*, 2002; Deffenbacher *et al.*, 2000; Galovski & Blanchard, 2002). Deffenbacher and colleagues (2000) investigated the effects of two interventions in reducing driving anger among high anger college students: a self-managed relaxation coping skills intervention (RCS) and an intervention combining cognitive and relaxation coping skills (CRCS). Both interventions involved attending a one hour weekly session over a period of eight weeks. The RCS intervention involved the application of progressive relaxation, relaxation imagery, and breathing-cued relaxation. The CRCS program consisted of similar relaxation techniques and cognitive restructuring to counter cognitive biases and misrepresentations when driving. Results indicated that both of the interventions demonstrated decreases in aggressive driving behavior, as measured by driving logs and the Driving Anger Scale (DAS). Another study by Deffenbacher

and colleagues (2002) evaluated similar interventions and reported reductions in levels of driving anger, trait anger, and aggressive forms of anger expression.

Galovski and Blanchard (2002) showed that a cognitive-behavioral anger management treatment program (CBT) could be effective among a more severely impaired aggressive-driving population (court and self-referred drivers). Positive effects were found in as few as four sessions of 90 minutes. The intervention addressed progressive muscle relaxation strategies, coping skills, education about the impact of aggressive driving, and cognitive strategies. Similar to the results of Deffenbacher et al. (2000), findings were encouraging with significant reduction in aggressive driving for the CBT treatment group in comparison to controls. A generalisation effect to other measures of psychological distress was also reported with significant decreases in state anxiety, anger, and a non-significant decrease in depression. Note that CBT interventions are therapeutic in that they assist in improving interpersonal and social adjustment but they do not deal directly with a driver's personal problems.

Given the high levels of driving aggression found in the high-risk subtypes, relaxation and CBT based psychological interventions hold some promise for reducing young driver crash risk. In particular, the positive effects generalised to other aspects of psychological well being so these interventions might be beneficial for the "emotional, hostile" high-risk subtype characterised by low levels of personal adjustment. However, none of these studies examined whether these interventions were associated with crash reductions.

Consistent with problem behaviour theory, both high-risk young offender subtypes reported a risky driving style and high levels of other risky behaviours (i.e., alcohol consumption and social deviance). Therefore, interventions targeting only risky driving are likely to be ineffective in addressing other problem behaviours or risk taking. Comprehensive interventions that cover lifestyle issues may be needed for

these high-risk young offender subtypes. For example, the “Under the Limit” educational intervention, developed in Queensland, was specifically designed to examine the lifestyle of drink drivers and assist them in separating drinking from driving. An evaluation of the 11-week program suggested that the primary message of the program was responded to via a change in self-reported driving behaviours, rather than through a change in drinking habits (Ferguson *et al.*, 2001). Detailed information concerning the extent of alcohol consumption (i.e., frequency, not just quantity) was not gathered in this study so it is not known whether these high-risk young offender subtypes need treatment to stop drinking or the skills to control drinking as provided by the “Under the Limit” program.

A program that incorporates a broad range of lifestyle issues beyond simply drink driving is the Prosocial Driver Training Program. This program is a multifaceted educational program designed to teach cognitive and social skills so as to develop “prosocial driving competence”, that is, to combat antisocial driving (Ross & Antonowicz, 2004). The program aims to change driving behaviour but it also seeks to provide drivers with social skills and values to cope with conflict or stress in other parts of their life that may impact on driving. The program is conducted over 12 two-hour sessions and covers seven modules: problem solving, social skills, negotiation skills, alternate thinking, emotional management, values enhancement, and critical reasoning. A holistic approach that encompasses aspects of lifestyle in addition to driving behaviour may be beneficial for high-risk subtypes. However, this program has not been evaluated among drivers.

Most of the interventions for high-risk young drivers discussed in this section have concentrated on measures aimed to influence the driver directly. An alternative is to adopt non-direct strategies that focus on the social environment surrounding the young driver (Ulleberg, 2001). Such strategies might be particularly effective for the thrill seeking, hostile high-risk subtypes whose risky driving style and desire to seek

thrills may be reinforced by their peers. For example, a program conducted in the United States that aimed to motivate young drivers to intervene in the drink driving of their peers reported improvements in self-reported peer intervention behaviour (McKnight & McPherson, 1985). Another peer intervention, conducted in Norway, encouraged young passengers to reduce the risk taking of drivers by telling the driver when they felt their driving was unsafe (Amundsen *et al.*, 1999). An evaluation of this intervention reported reductions of approximately 15 per cent in serious and fatal young driver crashes (Amundsen et al., 1999). Furthermore, a benefit cost analysis of this intervention indicated that benefits greatly exceeded costs. The success of this campaign was attributed to a clearly defined target group, a simple message, a long-term effort, accompanying police enforcement, and high profile media attention.

Note that this evaluation of the Norwegian campaign was one of the few evaluations of an intervention that examined young driver crashes as an outcome. Therefore, it is difficult to establish whether many of the interventions discussed in this section actually translate to reductions in young driver crashes.

Several other measures have shown positive results by exerting control over young drivers' social environment, that is, reducing the exposure of young drivers to risky situations. Such "risk management" measures include passenger restrictions and night-time driving restrictions. These restrictions feature in graduated licensing programs currently operating across a number of different countries (e.g., Australia, New Zealand, Canada and United States) but have primarily been applied to all novice drivers, rather than subtypes of high-risk young drivers.

To summarise, the type of interventions required to reduce the crash involvement of high-risk subtypes identified in this thesis may need to address lifestyle issues (i.e., high alcohol use, social deviance) and equip young drivers with better coping and social skills to counter driving induced aggression or stress and emotional problems. In addition, psychological interventions such as CBT and

motivational interviewing may be needed to motivate and attempt to change driving behaviour, although evaluations of these interventions need to examine young driver crashes to substantiate intervention effectiveness. Peer interventions also hold some promise for changing the social environment of young drivers.

8.4.4 Identifying High-Risk Drivers: Potential Applications for South Australia

The previous sections have discussed various types of interventions that match the needs of the high-risk young driver subtypes identified in this thesis. From a practical perspective, one should consider the process by which the subtypes of young South Australian drivers in the current licensing system can be identified and matched to these interventions. A number of suggestions are discussed in this section.

The identification of young driver subtypes, particularly those at a higher risk of crashing, could be based on the assessment of psychological characteristics through a short screening instrument. This screening instrument, in the form of a questionnaire, could be developed to assess the characteristics and needs of the young driver. The driver could then be matched to an appropriate intervention. However, the validity and reliability of any such instrument would require rigorous testing.

The next point to consider is on determining which young drivers should be screened. The various proposed paths for determining which young drivers are directed to an intervention program in South Australia, are presented in Figure 8.1. One option is that all young drivers could be required to go through the screening process when first obtaining a provisional licence. Even if non-problematic young drivers are identified, such interventions may still be beneficial to all young drivers. However, it may be a costly process to screen all drivers. Another alternative is to provide a voluntary system, whereby young drivers who choose to be screened and complete an intervention are rewarded. Incentive schemes may also need to be developed to encourage young drivers to undertake tailored interventions (i.e., insurance premium reductions).

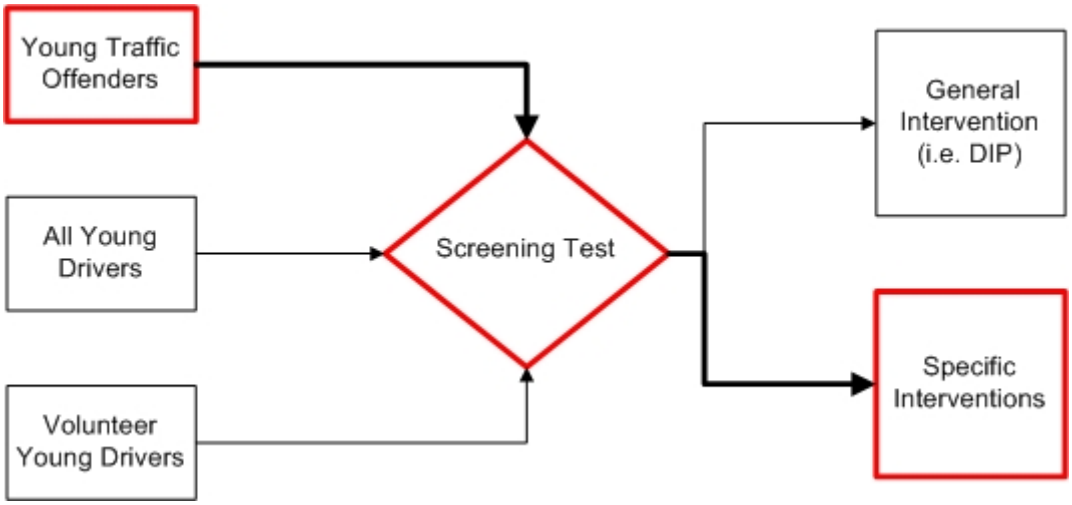

Figure 8.1. Proposed model of paths by which young drivers are directed to an intervention program in South Australia

At present, in South Australia young drivers aged 25 years and under with a disqualified learners permit or provisional licence are required to attend the Driver Intervention Program (DIP). If drivers choose not to attend the program, they must pay an expiation fee. DIP is a 90-minute interactive small-group program that covers a broad range of road safety issues relevant to young drivers (see Wundersitz & Hutchinson, 2006). The young traffic offender profiles described in Chapter 5 suggested that the young offenders as a group had relatively normal personality functioning and did not differ greatly from other young drivers. However, findings in Chapter 7 suggested that there were certain subtypes within the young offender group that were at a higher risk of crashing. Given these findings, screening these young traffic offenders, defined by license disqualification, appears to be a reasonable starting point in targeting high-risk young drivers. Thus, using the process already in place, the screening instrument could be administered to young drivers with a disqualified driver's licence. Based on their responses, they could then be directed to an intervention appropriate to their needs, rather than to a general intervention. This

proposed model, based on findings from this thesis, is depicted in bold within Figure 8.1.

Alternatively, the program currently in place could be tailored more towards the needs of the young traffic offenders attending the program, as discussed earlier in this chapter (see section 8.3.2). Clearly, future research needs to evaluate the effectiveness of matching interventions to young driver needs by determining the costs and benefits associated with these models.

8.5 Overall Conclusions of Thesis: Identifying High-Risk Young Drivers

This thesis was concerned with examining characteristics that identify young drivers with an elevated risk of crash involvement. This investigation began by examining the likelihood that previous driving behaviour, reflected in driving records, may be useful in identifying drivers culpable for a multiple vehicle fatal crash. Next, individual personality characteristics, driving-related attitudes, and behaviours were examined to ascertain whether they could differentiate young traffic offenders from other young drivers. Finally, this thesis also examined whether personality characteristics and driving-related attitudes could identify different subtypes of young drivers, specifically subtypes of young drivers thought to have an elevated risk of crashing. One of the strengths of the study was that it related current attitudes and personality factors to past driver history *and* to levels of subsequent traffic offence detections and crash involvement. To the best of my knowledge, this was the first study to attempt to identify driver subtypes among young traffic offenders.

The analysis of driver records indicated that drink driving offences were, to a limited degree, useful in identifying high-risk drivers (i.e., drivers culpable for a multiple vehicle fatal crash). However, driver records were not found to be useful in identifying a subset of high-risk young drivers although there was a non-significant relationship for drink driving offences. It was argued that the lack of statistically significant relationships was partially attributable to the smaller sample size and

limited driving exposure of young drivers. Few crashes or traffic offences were reported in young driver's records; consequently, the statistical power of analyses was low. Given the trend for drink driving offences, further research could examine the driver records of a larger sample of crash involved young drivers, over a substantial length of time. Furthermore, the fatal crash involvement of non-culpable young drivers may have resulted from less proficiency at avoiding a crash, most likely the result of inexperience.

The remainder of this thesis was designed to examine whether personality characteristics, motivations, and driving-related attitudes could identify young drivers at a higher risk of crashing. A profile of young traffic offenders, considered high-risk young drivers, indicated that they were not a psychologically dysfunctional group but were personally well-adjusted and generally did not differ to a large extent from the comparison group of young drivers (i.e., students). However, there were notable differences on some measures related to aggression, consistent with findings of other young driver studies (e.g., Begg & Langley, 2004; Miles & Johnson, 2003). Young offenders reported higher levels of driving-related aggression than did students, and young male offenders reported higher levels of driving to reduce tension than did young male students. It may be beneficial for these drivers to discuss ways of expressing anger and aggression other than on the road and to develop effective strategies to manage hostile feelings and anger arising from situations when driving.

The greatest contrasts between the groups were found for some road-safety-related attitudinal measure; offenders were more likely to have attitudes promoting engagement in risky driving behaviour. This pattern of attitudes was broadly consistent with previous research on high-risk young driver attitudes (Beirness & Simpson, 1988; Ulleberg & Rundmo, 2002). These findings indicate that promoting "safer" social norms and a more safety-oriented attitude towards road safety should be

encouraged among young traffic offenders. However changing attitudes is not an easy task.

The combination of young traffic offender's characteristics suggests that they feel they are in personal control of their lives and have the ability to alter their behaviour but their attitudes suggest that they are not motivated to change their behaviour. Therefore, young traffic offenders might benefit from group discussion based interventions that give them personal control over the process of making a decision and provide motivation to change their driving behaviour.

Females were characterised by less risky attributes and more safety-oriented attitudes than males. Nevertheless, females at a higher risk of crashing could be identified by high alcohol consumption. Interventions highlighting lifestyle issues such as excessive alcohol intake may be beneficial for females.

Many of the personality measures were not associated with the young offenders as a group. However, previous studies (e.g., Donovan et al., 1985) that did find relationships examined populations of more serious traffic offenders (i.e., convicted drink drivers, multiple offenders). Consequently, it was argued that the findings from this study provide support for a continuum of psychological well-being among traffic offenders, with the degree of personality dysfunction related to the severity and types of traffic offences detected. Nonetheless, these personality and attitudinal measures were useful in defining high-risk young driver subtypes within the young offender group.

Findings from the last two studies in this thesis confirmed that it was possible to identify young driver subtypes based on personality characteristics and driving-related attitudes. Moreover, the existence of high-risk young driver subtypes was confirmed in two different young driver populations (i.e., students and young traffic offenders) and these subtypes were characterised by similar attributes to other high-

risk young driver subtypes identified in the literature (Deery et al., 1998; Ulleberg, 2001).

Characteristics shared by the “thrill seeking, hostile” subtypes identified in both young driver populations included high levels of driving-related aggression, competitive speed, sensation seeking, overt expression of hostility, low levels of driving inhibition, and the use of driving to reduce tension. Furthermore, these thrill seeking and hostile high-risk subtypes exhibited a risky driving style, participated in other risky behaviour (i.e., high alcohol use), and, for the students and traffic offenders, viewed speeding behaviour as acceptable. Another high-risk subtype identified among young offenders reported some similar attributes to the other high-risk subtype but differed considerably in terms of personal adjustment. Similar “emotional, hostile” subtypes have been identified among young drivers (Deery et al., 1998; Ulleberg, 2001) and other high-risk drivers (Donovan et al., 1988; Wilson, 1991).

Of note, well-adjusted subtypes determined to be low-risk in traffic were identified in both samples of young drivers and have commonly been reported in other research examining young and adult driver subtypes. The fact that the high-risk subtypes identified in this thesis were similar to high-risk subtypes identified in the literature suggests that high-risk groups have similar profiles in different cultures.

Interestingly, external validation of the subtypes indicated that the high-risk subtypes were more clearly differentiated from lower risk subtypes among the young offenders than among the students. Moreover, of these two young driver populations examined in this thesis, the young offender subtypes were more similar to novice driver subtypes identified in the literature (Deery et al., 1998). It was suspected that these findings were at least partly attributable to the gender composition in each young driver sample (i.e., a greater number of males in the offender group and females in the student group).

Having established the existence of high-risk young driver subtypes and validating the subtypes in different young driver populations, it may be useful to consider the development and implementation of a short screening instrument to identify subtypes of young drivers some time after they obtain their provisional licence. Based on subtype membership, young drivers can then be matched to an appropriate intervention. Further research should explore the costs and benefits associated with the development and implementation of such a screening instrument.

With respect to matching interventions to the needs of the high-risk subtypes, findings from the present study suggest interventions need to change lifestyle issues (i.e., reduce alcohol consumption) or equip young drivers with better coping and social skills to counter driving induced aggression and emotional problems. Relaxation and CBT based psychological interventions hold some promise for reducing driving aggression, and show some generalizing positive effects to other aspects of psychological well-being that would be particularly beneficial for the "emotional, hostile" subtype. However, it is unknown whether these interventions are associated with young driver crash reductions. Peer interventions may be useful for changing the social environment of young drivers who seek peer reinforcement (i.e., thrill seeking subtypes). In addition, motivational interviewing may be useful in motivating the high-risk subtypes to change their driving behaviour. Short-term education interventions might be appropriate for the low-risk offender subtypes.

As noted earlier, one of the strengths of this study was that it related current attitudes and personality factors to levels of subsequent traffic offence detections and crash involvement, in addition to past driving history. These personality and attitudinal based measures identified young driver subtypes that continued to be detected for traffic offences but the measures were not as successful in identifying young driver subtypes who were crash involved. However, this latter finding may be attributable to the low number of crashes recorded during the short follow up period.

8.6 Limitations

Previous chapters have made reference to a number of limitations associated with the studies conducted in this thesis: self selection bias, the self-reported nature of some measures, the choice of measures, under-estimation of official driver records, and the arbitrary nature of cluster analysis. These limitations are summarised before discussing future research opportunities.

Firstly, young drivers who volunteered to participate in this study may have possessed characteristics that predisposed them towards more socially acceptable behaviour or attitudes. Consequently, selection bias may have excluded the riskier drivers from the study sample. If such selection bias were evident, it would result in an underestimation of the magnitude of study findings related to risk taking and increased traffic offences and crashes. The degree to which selection bias occurred is unknown, although response rates were high among traffic offenders.

Two limitations are associated with the questionnaire measures used in Chapters 5, 6 and 7. The self-reported nature of measures employed in this study means that the information derived from these measures may not be accurate. Specifically, there might be inaccuracies in the driving exposure measure (i.e., estimate of the amount of driving in past week) and driver's recall of crash and traffic offence history. Erroneous estimates of weekly driving are most likely random. However, the question concerning weekly driving was asked slightly differently among traffic offenders and students. It is suspected that the offenders over-estimated their driving exposure because they were not required to give a detailed estimate. Errors in self-reported crash and traffic history could be accidental (i.e., forgetfulness) or deliberate. The self-report measures of personality and attitudinal factors provide an opportunity for drivers to give a "good" or socially desirable account of themselves. Thus, social desirability bias may have affected the analyses of relationships. The degree to which social desirability bias occurred is unknown.

It is acknowledged that some of the measures used in this thesis might be considered dated because they were developed in the 1960s. However, these measures were selected so that a previous study identifying young driver subtypes (Deery et al., 1998) could be replicated. Moreover, a review of the personality characteristics and attitudinal literature in Chapter 4 demonstrated various associations between these measures and high-risk drivers. Future research might consider whether similar young driver subtypes can be found based on more recent, well-validated measures of similar personality and driving-related attitudinal characteristics.

Another limitation is the under-reporting of incidents in official driver records. When self-reported and official driving histories were compared, it appeared that official driver records underestimated the number of crashes. This was most likely the result of crash reporting policies: only crashes reported to police are listed in official records. Young drivers are typically involved in many minor crashes that result in insufficient damage or injury for the police to be notified. Therefore, the underestimation of crashes in official records would result in bias toward crashes that are more serious. Nonetheless, the combination of both self-reported and official driver records provided a more comprehensive picture of young driver crashes and traffic offences.

The final limitations concern cluster analysis, the method used to identify the subtypes of young drivers. Cluster analysis has been criticised for its subjectivity and its sensitivity to the choice of variables and different clustering methods. Ulleberg (2001) noted that cluster analysis “is largely judged on the usefulness of results, interpretability, replicability, and stability” (p. 295). By selecting similar variables and replicating a clustering methodology previously used among a young driving population, the results from this study allowed validation of the young driver subtypes identified in previous research. Moreover, in the present study, cluster analyses identified four separate meaningful and interpretable clusters in two different young

driver populations. Thus, many of the criticisms associated with cluster analysis did not apply in this research.

One last limitation associated with cluster analysis, was the different gender compositions of the two samples analysed. It is possible that the slight differences between the student subtypes and other young driver subtypes, including the young traffic offender subtypes reflected different gender compositions (i.e., the student group consisted of a greater percentage of females than other studies using cluster analysis). Any effect of different gender compositions could not be confirmed in this study because the number of male students and female traffic offenders was too low for meaningful analysis.

8.7 Future Directions for Research

Findings from these studies suggest a number of avenues for future research. Research is needed to confirm the validity of high-risk young offender subtypes. Such research should also examine subtypes among more severe high-risk young driver populations that have accumulated multiple traffic offences or have been involved in multiple crashes. It would also be interesting to see if these subtypes replicate in a representative sample of young drivers from the general driving population and a representative sample of drivers who are older and have greater driver experience (i.e., drivers aged 25-35 years). Few studies have attempted to determine if the same subtypes can be found in drivers among different age groups.

As mentioned previously, more research is also needed to investigate sex differences. To determine whether similar subtypes can be derived across both genders, cluster analyses should be performed with males and females separately, based on similar measures. If different subtypes emerge, road safety professionals should consider developing strategies and interventions that treat young males and females differently.

Critics suggest cluster analysis says nothing about the causal relationships between variables and does not test any specific hypothesis. Cluster analysis does tend to generate rather than test hypotheses (Everitt, 1993). Therefore, it is important that future research should examine the nature of the relationships between the variables in the high-risk subtypes and how they influence young driver crash risk.

A final suggestion for future research is to investigate the profile of young traffic offenders by offence type. Drivers detected committing more serious traffic offences may have different characteristics than drivers detected committing more administrative traffic offences such as “failure to display P-plates”. This analysis would only be possible if official driver records definitively state which traffic offence(s) resulted in licence disqualification.

8.8 Final Conclusion

Road trauma has persistently been, and continues to be, a leading cause of death in young people both in Australia and worldwide. However, not all young drivers are crash involved. Interventions designed for young drivers need to recognise the heterogeneity of young drivers. Rather than treating all young drivers in the same way, interventions should be matched to the needs of these specific subtypes of young drivers identified as being at high-risk of crash involvement. Consequently, this thesis aimed to examine characteristics that identify young drivers at a higher risk of crashing and to validate driver subtypes among different young driver populations.

The first study in this thesis demonstrated that past driving behaviour, reflected in driver records, was not useful in identifying high-risk young drivers, at least not young drivers culpable for a multiple vehicle fatal crash. Other studies in this thesis confirmed that subtypes of young drivers at a higher risk of crashing can be identified by personality characteristics and driving-related attitudes. Moreover, high-risk young driver subtypes were more clearly differentiated among young drivers already identified by their driver record as high-risk (i.e., young traffic offenders). Of

significance, the high-risk young driver subtypes reported a similar profile to those found in previous research. It was argued that these findings provide increasing cross-cultural evidence of high-risk young driver subtypes with specific characteristics.

As noted earlier, one of the strengths of this thesis was that it not only related current personality factors and attitudes to past driving history but also to subsequent traffic offence detections and crash involvement. High-risk subtypes continued to be detected for more traffic offences than other subtypes and there was a trend for greater crash involvement.

This thesis also showed that young traffic offenders as a group had normal personality profiles and did not differ greatly from other young drivers. However, distinct high-risk subtypes were found within the young traffic offender group, based on personality characteristics and attitudes, suggesting that young traffic offenders may provide a starting point for identifying high-risk young driver subtypes. A short screening instrument could be developed to determine the subtype membership of young traffic offenders. Based on subtype membership, young traffic offenders could then be directed to an intervention tailored to their needs. Further research should determine the costs and benefits associated with the matching interventions to young driver requirements.

It is acknowledged that efforts to develop effective strategies specifically to reduce young driver crashes have achieved little success in the past and this task will continue to be difficult. To achieve a reduction in young driver crashes, a comprehensive strategy that integrates a number of elements (e.g., driver interventions, graduated licensing programs) is required. Findings from this thesis build on current knowledge about the personality characteristics and attitudes of young drivers at a higher risk of crashing. Moreover, this thesis identified subtypes of high-risk young drivers and suggested interventions that might be beneficial for these drivers. To continue to shape transport policies relating to young driver safety,

continuing research is needed that acknowledges the heterogeneity among young drivers and follows any changing trends in their behaviour, attitudes and crash experiences over time.