Identifying subtypes of young novice drivers: Implications for matching training to the needs of the driver

by

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November, 1998

Report No. 142
Abstract: Although there is a large literature on the young novice driver problem, traditional approaches to driver training have proven to be ineffective. More recently, several techniques for training critical driving skills have shown a great deal of promise. Furthermore, it is argued that young novice drivers are not a homogenous group and that training might be most effective when tailored to the needs of specific driver subtypes. Two separate but related studies are reported. The aim of Study 1 was to obtain empirical support for the presence of driver subtypes in the young novice driver population. One hundred and ninety eight participants (55% male) aged 16 to 19 were recruited from driver licensing offices in metropolitan Melbourne. They completed an extensive self-report questionnaire. Five novice driver subtypes were identified through a cluster analysis of personality and driving-related measures. Two relatively high risk or deviant subtypes emerged (Clusters 1 and 5), characterised by high levels of driving-related aggression, competitive speed, driving to reduce tension, sensation seeking, assaultiveness and hostility. Individuals in one of those subtypes (Cluster 5) also reported low levels of emotional adjustment and high levels of depression, resentfulness and irritability. Significant differences between the subtypes were also found on several demographic, attitude and behavioural measures, including traffic accident record. The aim of Study 2 was to examine whether or not the young novice driver subtypes differed in terms of their simulated driving performance. A subset of participants from Study 1 drove several scenarios in a driving simulator. Differences were observed in the way that the novice driver subtypes responded both to an emergency situation and to several potential traffic hazards in the simulator. Differences were also evident in the proficiency with which they could control their attention among concurrent tasks while driving. Most of the statistically significant differences were related to skill decrements for the two highest risk novice driver subtypes (Clusters 1 and 5). Several training techniques are described that seem to be particularly appropriate for the highest risk young novice driver subtypes (Clusters 1 and 5). Recommendations are also made for further research and development.

Key Words: Novice drivers, driver training

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ACKNOWLEDGMENTS

This project was funded by the NRMA Limited. The authors gratefully acknowledge this support from the NRMA Limited, as well as the assistance of the following people.

- The managers of VicRoads' Registration and Licensing offices at Burwood East, Oakleigh South and Dandenong for allowing data collection to be undertaken at their offices;
- Professor Claes Tingvall, Warren Harrison and Dr Michael Regan for their ideas and input to the project and this report;
- Dr Elizabeth Wells-Parker for providing part of the research questionnaire;
- Naomi Wilson for her assistance with the project;
- Sanjeev Narayan for his advice on statistical analysis;
- Nebojsa Tomasevic for his technical assistance with the simulator;
- The Transport Accident Commission (TAC) for the use of the simulator.
EXECUTIVE SUMMARY

Background

Young novice drivers are overrepresented in road accidents. There is a large literature that has increased our understanding of the factors that contribute to this problem. This understanding has not, however, been translated into the development of effective driver training programs. In fact, there is very little empirical support for the effectiveness of "traditional" forms of driver training, such as behind the wheel instruction, classroom education and skid training. There are probably two main reasons for this lack of success.

First, driver training programs have not focussed on those skills and behaviours that are important in crash causation. For example, failure to detect traffic hazards and the ability to divide and switch attention have been identified as sources of individual differences in road accidents. They have also been identified as a significant problem for young drivers, but they have traditionally received very little attention in driver training. More recently, however, researchers have begun to explore methods for training these skills in novice drivers. Although these methods are yet to be evaluated in the real world, the results of laboratory-based research indicates that they offer a great deal of promise as a means of enhancing the safety of young novice drivers.

Second, at least some groups of young novice drivers are not motivated to drive safely and apply their skills on the road. In other words, young novice drivers are probably not a homogenous group and training and other countermeasures might be most effective when tailored to the needs of specific driver subtypes. Indeed, there is some evidence to support the effectiveness of matching training or interventions to population subtypes in other areas of road safety, such as drink-driving, and in various educational and clinical settings.

The general aim of this research was to examine the factors that contribute to safe driving among subtypes of young novice drivers, with implications for matching training to the needs of the driver. Two separate but related studies are reported.

Summary of Research Findings

The aim of Study 1 was to obtain empirical support for the presence of driver subtypes in the young novice driver population. One hundred and ninety eight participants (55% male) aged 16 to 19 years were recruited from three driver licensing offices in metropolitan Melbourne. They completed an extensive self-report questionnaire. Five novice driver subtypes were identified through a cluster analysis of driving-related attitudes and behaviours, general personality traits, and hostility and aggression. Two relatively high risk or deviant subtypes emerged (Clusters 1 and 5), characterised by high levels of driving-related aggression, competitive speed, driving to reduce tension, sensation seeking, assaultiveness and hostility. Individuals in one of those subtypes (Cluster 5) also reported low levels of emotional adjustment and high levels of depression, resentfulness and irritability. In order to validate the cluster solution, the subtypes were compared on a number of measures not used in the cluster analysis. Significant differences were found between the young novice driver subtypes on several demographic, attitude and behavioural measures, including self-reported driving style and traffic accident record.
The aim of Study 2 was to examine whether or not the young novice driver subtypes identified in Study 1 differed in terms of their performance in a driving simulator. A subset of participants from Study 1 drove several scenarios in a mid-range driving simulator. The scenarios were designed to assess: (a) aspects of general driving skill (e.g. variability in lateral position) and driving style (e.g. speed choice), (b) the ability to control attention between competing tasks in high workload situations, (c) performance around potential traffic hazards, and (d) performance during an emergency situation requiring evasive braking and steering.

The results of Study 2 indicated that the novice driver subtypes, identified on the basis of differential levels of driving-related attitudes and behaviours, general personality traits, and hostility and aggression, also differed in terms of their driving performance. Differences were observed in the way that the novice driver subtypes responded both to an emergency situation and to several potential traffic hazards in the simulator. Differences were also evident in the proficiency with which they could control their attention among competing tasks while driving in high workload situations. Most of the statistically significant differences in driving performance were related to skill decrements for the two most deviant or highest risk novice driver subtypes (Clusters 1 and 5). The individuals in Cluster 1 travelled the fastest around some potential traffic hazards and did not moderate their driving speed around others. Those in Cluster 5 were the least safe responding to an emergency situation and had difficulty controlling their attention between competing tasks while driving. They were also the least cautious around a potential traffic hazard that was particularly notable for the need to anticipate a sequence of gradually unfolding events.

**Implications for Driver Training**

The results of this research suggest that the approach of identifying and matching subtypes of young novice drivers to training or education programs appears promising. For example, the novice drivers in the two highest risk or most deviant subtypes (Clusters 1 and 5) seem to have problems with driving-related aggression and competitive speed, as well as personality and emotional functioning problems, such as irritability and depression. Programs to address these problems might promote a more moderate driving style among those drivers.

The safety of the novice drivers in Clusters 1 and 5 could also be increased by training that enhances their precautionary behaviour around potential traffic hazards. Those in Cluster 5 might also benefit from training designed to improve their ability to control their attention among competing sources of information. Several approaches to training these skill have recently shown a great deal of promise and would seem to be appropriate for novice drivers generally and the highest risk driver subtypes (Clusters 1 and 5) particularly.

In terms of risk perception, personal computer-based instruction on critical risk perception skills, combined with the opportunity to practice and obtain feedback on those skills, have been effective in enhancing the safety of novice drivers around traffic hazards in a driving simulator (Regan, Deery & Triggs, 1998b). Training that includes predicting what might happen in unfolding events, using video of actual traffic hazards, has also enhanced the risk perception skills of novice drivers (McKenna & Crick, 1995) and would appear to be particularly appropriate for the novice drivers in Cluster 5.
The individuals in Cluster 5 would also benefit from training to improve their attentional control. Recent driving simulator research at the Monash University Accident Research Centre (Regan, Deery & Triggs, 1998a) has shown that the attentional control skills of novice drivers can be enhanced using a training technique called Variable Priority Training (VPT). With VPT, participants perform two or more tasks concurrently. They are instructed to systematically vary the relative amount of attention that they give to each task across training trials. The research at MUARC has shown that, in addition to attentional control, the ability to detect, perceive and respond safely to potential traffic hazards can be enhanced with VPT.

Several recommendations are made for further research and development. These include developing and validating a short screening instrument for identifying high risk driver subtypes, developing incentive schemes for young novice drivers to undertake tailored training programs, and empirical evaluations of the effectiveness of matching training to the needs of the driver.
1. GENERAL INTRODUCTION

1.1 BACKGROUND

The problem of young novice driver safety is well documented in terms of the size and nature of the problem. It is well established, for example, that young novice drivers play a disproportionately large role in traffic crashes. In Australia, 16 to 24 year olds comprise about 15% of the driving population, but account for around 35% of fatal and 50% of injury crashes (Macdonald, 1994). The situation in many overseas countries, including the U.S.A. (Department of Education, 1988) and Canada (Transport Canada, 1984), is similar to that in Australia, with young novice drivers more likely to be seriously injured or killed in road accidents than their more experienced counterparts.

1.2 RESEARCH AIMS

The general aim of this research was to examine the factors that contribute to safe driving among subtypes of young novice drivers, with implications for tailoring training to the needs of particular groups of drivers. The specific aims were to:

- obtain empirical support for the presence of driver subtypes in the young novice drivers population;
- examine whether or not membership of young novice drivers subtypes predicts self-reported driving behaviour, accident record and other high risk behaviours, such as drug and alcohol use.
- determine if high risk driver subtypes (defined by specific personality traits, attitudes, driving record, and so on) respond to traffic hazards as quickly and efficiently and deal with high workload situations as well as other novice drivers.

To achieve these aims, several research tasks were undertaken.

1.3 RESEARCH TASKS

It is argued that in order to train novice drivers effectively, it is necessary to understand the critical factors that underlie their driving performance and overrepresentation in crashes. Hence, the first task was to review both the factors that contribute to novice drivers' overrepresentation in crashes and the driver training literature. This review is undertaken in Section 2, where it is argued that skill-based driver training has not, to date, generally worked. There are probably two main reasons for this lack of success. First, drivers have not been trained on those skills and behaviours that are important in crash causation. Second, at least some groups of novice drivers are not motivated to drive safely or apply their skills on the road. Moreover, the design of effective driver training programs is complicated by the fact that young novice drivers are not a homogenous group. In other words, training might be most effective when tailored to the needs of specific groups of novice drivers, including groups defined by different personality traits, motivational characteristics and levels of driving skill.

The second task was to undertake a questionnaire-based study to (a) identify subtypes of young novice drivers, defined by factors such as personality, motivation and attitude, and (b) examine whether or not membership of those subtypes predicts self-reported driving behaviour.
behaviour, accident record and participation in specific high risk behaviours, such as drug and alcohol use. The results of the questionnaire study are reported in Section 3.

The final task was to undertake a driving simulator-based study to determine if the high risk driver subtypes identified in Study 1 respond to traffic hazards as quickly and efficiently and cope with high workload situations as well as other novice drivers. The result of the simulator study are reported in Section 4.

Section 5 contains the general discussion and conclusions to this report, including recommendations for driver training and countermeasure development.
2. A REVIEW OF NOVICE DRIVERS' PERFORMANCE AND TRAINING ISSUES

2.1 NOVICE DRIVER PERFORMANCE ISSUES

2.1.1 Background to the Young Novice Driver Problem

The young novice driver problem is often considered to stem from two main factors: age (or youthfulness) and inexperience (e.g. Gregersen, 1996; Macdonald, 1994). In terms of age-related factors, researchers have argued that young drivers' overrepresentation in road accidents reflects the fact that they are teenagers and willing to take risks. Proponents of this view claim that it is necessary to consider how young drivers' leisure time is spent and what the automobile represents to them. It provides the opportunity to engage in risky behaviours. It also signifies adulthood, autonomy from parents and school and status in regard to the opposite sex (Gusfield, 1991).

Research on skilled performance suggests that compared to more experienced drivers, novice drivers' performance is inferior in several ways (see Mayhew & Simpson 1995; Macdonald, 1994). The skills most critical to the crash problem of novice drivers include: hazard perception (i.e. detecting, recognising and dealing with traffic hazards); attentional control (i.e. attending to the right things, in the right amounts, at the right time); timesharing (i.e. dealing with changing workloads); and calibration (i.e. matching one’s driving performance with task demands). These skills are usually acquired through on-road experience, but they take several years to develop. In other words, on-road experience is a slow and inefficient means of developing the higher order cognitive skills involved in driving. Moreover, many novice drivers are seriously injured or killed while acquiring those skills.

Researchers have attempted to partial-out the relative effects of age and experience on the accident rate of novice drivers. Cooper, Pinili and Chen (1995), for example, examined the crash rates of novice drivers aged 16 to 55 years in the U.S.A. They found that all novice drivers, regardless of age, had a higher accident involvement than their more experienced counterparts, although this was particularly the case for novice drivers aged 16 years. In other words, experience, as well as age-related factors, are important in the novice driver crash problem.

It should be noted that the distinction between age and experience corresponds to what several authors (e.g. Deery & Love, 1996a,b; Elander et al., 1993) have termed driving style (or behaviour) and driving skill (or performance). Driving skill, which is expected to improve with practice or training, is concerned with limitations of performance on aspects of the driving task, such as the use of the steering wheel to track the road and the time taken to respond to traffic hazards. Driving style is concerned with decision making aspects of driving, that is, the manner in which people choose to drive or driving habits that have developed over time. Such choices may include, for instance, driving speed and how close one drives to the car in front.

Driving skill and driving style are also closely related. For example, by adopting a riskier driving style (e.g. a faster driving speed), the need for better driving skill is increased (e.g. faster reaction time to potential hazards). Thus, it may not always be clear whether a certain
aspect of driving or a particular area of research is concerned with driving skill or driving style. Elander et al. (1993) noted, for example, that passing an advanced driving test may involve employing a more cautious style of driving, acquiring greater driving skill, or both. Nonetheless, the distinction between driving skill and driving style has both practical and theoretical utility, and their importance in accident involvement has been largely confirmed (see Elander et al., 1993, for a review). With respect to driving skill, speed at detecting hazards and the ability to divide and switch attention rapidly have been related to crash frequency. Certain driving styles, namely, faster driving (Cowley, 1983; Wasielewski, 1984; West et al., 1993) and the tendency to commit traffic violations (Williams & O'Neill, 1974), have also been associated with increased accident risk. These results have been found even after controlling for age, gender and driving experience.

The role of age- and experience-related factors in the young novice driver crash problem are considered in some detail in the following sections.

2.1.2 Experience-Related Factors: Driving Skill

The complexity of the young novice driver problem is widely acknowledged. One reason for this is that the task of driving is extremely complicated: few activities match the demands required for the safe operation of a motor vehicle. Novice drivers learn the basic vehicle handling skills and traffic laws quickly. In fact, it has been suggested that they learn these skills after only 15 hours of driving (Hall & West, 1996). Young drivers, in comparison to their older counterparts, are also better at some driving tasks, such as accelerator release (Olson & Sivak, 1986), and they acquire simple motor skills at a rapid rate (Brown & Groeger, 1988). This suggests that driver training programs that focus on the basic vehicle handling skills of young novice drivers are unlikely to provide much benefit, at least for drivers who have more than 15 or so hours of driving experience.

Although novice drivers learn the vehicle handling skills quickly, they have limited experience to develop the complex, higher-order cognitive skills required to safely interact with the traffic environment. The extensive literature on the driving skill of novice drivers has been reviewed elsewhere (Mayhew & Simpson, 1995) and will not be discussed here in detail. Rather, this discussion will focus on hazard perception and attentional control as they have been related to crash involvement and are areas in which novice drivers display deficits compared to more experienced drivers. Furthermore, methods for studying these skills have been developed in the driving simulator that is located at the Monash University Accident Research Centre (MUARC) and was used in the second stage of this research to compare the driving performance of young novice driver subtypes.

2.1.2.1 Risk Perception

The OECD (1980) report concluded that most traffic accidents are caused by errors or lapses in the perceptual component of driving, rather than by errors in vehicle-control skills and thus greater emphasis should be given to the driver's perceptual task. Similarly, failure to perceive, comprehend and/or react to potential traffic hazards has been estimated to contribute to over 50% of crashes in which a young driver is killed (Insurance Institute for Highway Safety, 1995). Thus, it is not surprising that in recent times, increasing emphasis has been placed on the need to study the driver's perceptual processes directly, such as the manner in which they identify the most important visual aspects of the road environment (Macdonald, 1987).
Mayhew and Simpson (1995) reviewed the literature on hazard and risk perception while driving. They concluded that, compared to more experienced drivers, novice drivers are less likely to perceive hazards quickly and efficiently because they: display a smaller range of horizontal scanning of the road environment; look closer to the front of the vehicle; check the mirrors and glance at objects less frequently; utilise peripheral vision less efficiently; and fixate on fewer objects. Novice drivers also appear to fixate more on stationary objects, whereas experienced drivers fixate more on moving objects.

The level of risk that drivers perceive in potential traffic hazards has been related to their accident record. Quimby (1988) observed participants during on-the-road driving and found that risk-taking, such as the choice of an inappropriate speed, was related to measures of driving performance. In particular, participants’ ratings of risk were negatively correlated with their accident history, suggesting that drivers with a risky everyday driving style perceive low levels of risk in certain traffic conditions. Drivers taking the most risks also tended to be the youngest, supporting the often cited notion that a risky driving style is most prevalent among young drivers.

Quimby et al. (1986) examined the relationship between crash frequency and the time taken to detect and respond to hazards, termed hazard perception latency. They found that a long hazard perception latency was associated with higher crash rates after controlling for age, driving exposure and simple reaction time. Specifically, the crash rate doubled between the 5th and 95th percentiles of hazard perception scores. These results suggest that a relatively long hazard perception latency may be one source of individual differences in crash involvement, especially for young drivers.

Researchers have illustrated that drivers who display long hazard perception latencies may not necessarily show slow reactions in other contexts or on other tasks. Quimby and Watts (1981) found that drivers under the age of 25 displayed faster simple and choice reaction times than older drivers. Yet, the younger drivers also displayed longer hazard perception latencies. Other researchers have reported similar results, with young drivers more likely to take longer to detect traffic hazards, or miss detecting them altogether, than older drivers (McKenna & Crick, 1991; Summala, 1987).

2.1.2.2 Attentional Control

As Gopher (1996) noted, when performing complex tasks, such as operating a motor vehicle, people would benefit most if they could attend to all aspects of the task, at all times. However, limitations in the human’s ability to process large amounts of information at any one time mean that this is not possible. Consequently, priorities and trade-offs must be established along with attentional control or allocation strategies. Gopher (1996) defines such a strategy as “a vector of differential weights, or attention biases assigned to task elements. It influences the performer’s mode of response to the general requirements of the task” (p. 28).

Driving a motor vehicle requires considerable attentional control. It involves the division of attention between the manual control of the vehicle, scanning the instrument panel, monitoring the road and the behaviour of other drivers, identifying and responding to traffic signs, and orienting oneself in the driving environment (Gopher, 1996). A person’s driving experience influences their direction and level of attention to the traffic environment (Rumar, 1985). Experienced drivers, in comparison to novice drivers, have...
developed cognitive short-cuts to decision-making in high workload situations, they can process information at a more automatic level, and they can switch and control their limited attentional resources more efficiently (Elander et al., 1993; Rumar, 1985).

2.1.3 Age-Related Factors: Driving Style

Compared to the extensive literature on novice drivers’ skilled performance, much less work has been undertaken in the area of age-related factors and their effect on driving style (Macdonald, 1994). Indirect evidence suggest that young drivers are more likely to be motivated to take and accept risks than older drivers. Research has found relationships between youth and speeding (Federal Office of Road Safety, 1994), leaving shorter distances to the car in front (Baxter, Manstead, Stradling, Campbell, Reason & Parker, 1990), accepting narrower gaps when entering traffic (Bottom & Ashworth, 1978) and running yellow lights (Koneci, Ebbesen & Koneci, 1976). Cowley (1983) found that serious speeding offences are typically committed by young male drivers and that those drivers are overrepresented in accidents involving excessive speed.

The subjective experience of risk plays a central role in several theories of driving (Ranney, 1994). In these theories, the perception, acceptance and/or misperception of risk is used to explain the relationship between driving style and accident involvement (Cvetkovich & Earle, 1988; Martens, Ross & Mundt, 1991). According to this view, if young drivers perceive relatively low levels of risk in a traffic hazard, such as pedestrian stepping onto the road, then they are likely not to respond to that hazard or to respond to it less cautiously than other drivers. Indeed, novice drivers perceive lower levels of risk in a variety of traffic situations than more experienced drivers (Deery et al., 1997; Mayhew & Simpson, 1995).

A large body of research has been undertaken to identify the factors that might predict or discriminate drivers on the basis of their accident record. In this research, personality traits, such as sensation seeking and impulsiveness, as well as a risky lifestyle, have been related to risk taking and accident involvement (Elander et al., 1993; Gregersen, 1996; Mayhew & Simpson, 1995). Such factors are also most prevalent among young people, particularly young males, suggesting that they may be more likely to accept or seek risks while driving than older drivers.

Several authors (e.g. Jonah, 1990) have reviewed the literature on the factors associated with high risk driving practices and integrated their findings within the framework provided by problem behaviour theory. The central premise of problem behaviour theory is that risky behaviours are interrelated (Jessor & Jessor, 1977). Indeed, research has revealed that risky driving is one part of a large and complex network of problem behaviours, particularly among young drivers. Jessor (1987) found, for example, that self-reported risky driving was associated with other high risk and problem behaviours among young drivers, including alcohol-related difficulties, illicit drug use and delinquency.

Gregersen and Berg (1994) examined the relationship between lifestyle and accident involvement among a sample of young drivers. They found that accident risk varied according to self-reported lifestyle. For example, the highest accident risk group in the sample tended to comprise males who did not participate in sporting activities, drank large quantities of alcohol regularly, and had a great interest in cars.
2.1.4 Driver Subtypes: The “Young Problem Driver”

The design of effective driver training programs and other countermeasures is complicated by the fact that young drivers are not a homogenous group. In other words, training might be most effective when tailored to the needs of specific subtypes of young drivers, including subtypes defined by different personality and motivational characteristics. Macdonald (1994) noted that the concept of a subgroup of “young problem drivers” is often advocated in the literature. However, there is very little, if any, direct scientific evidence to support the presence of such a subgroup.

In 1993, the National Highway Traffic Safety Administration in the U.S.A. prepared a report to congress on young driver safety. It suggested that, although there is good reason to develop general countermeasures for all young drivers (due to the overall risk of that group), all young drivers are not equivalent and thus some subgroups merit special consideration due to their increased risk (NHTSA, 1993). Part of NHTSA’s research agenda is to determine the effectiveness of educational and other programs for different population subtypes.

From a training perspective, if subtypes of young novice drivers exist, then understanding the characteristics that define those subtypes may be important in ensuring that the skills that are required for safe driving are both learned effectively and applied on the road. The characteristics that define problem driver subtypes are likely to include motivation, attitude, personality, values and demographic characteristics. Researchers in the drink-driving area have shown, for example, that considerable heterogeneity exists within the drink-driving population and have used cluster analysis to derive subtypes of driving while intoxicated (DWI) offenders that differ along a number of dimensions, including personality variables, driving-related attitudes, drinking-related variables, and driving record (e.g. Donovan & Marlatt, 1992; McMillen et al., 1992). Several subtypes have been identified, such as a depressed, non-assertive and poorly adjusted group; a reasonably well adjusted but alcoholic group; a group with lower alcohol consumption patterns combined with lower scores on scales measuring personality functioning; and a young, hostile, assaultive and heavy drinking group (Donovan & Marlatt 1982; Donovan et al., 1985; Salstone & Poudrier, 1989; Steer, Fine & Scoles, 1979; Wells-Parker et al., 1993, 1990; Wieczorek & Miller, 1992). Recommendations from this research are that particular subtypes of DWI offenders be the target for specific prevention and intervention programs (Wells-Parker et al., 1990).

The identification of driver subtypes within the multiple crash-involved population has also been successful (Donovan et al., 1985, 1988; Wells-Parker et al., 1990). Wilson (1991) identified four clusters of multiple crash-involved drivers. The largest cluster, comprising 46.4% of the sample, consisted of a relatively well adjusted and responsible group. The second cluster was also reasonably well adjusted, although it was characterised by an elevated level of hostility. The remaining two clusters were similar to the highest-risk groups identified in the research on DWI offenders, that is, a group characterised by relatively low levels of depression and resentment but high levels of driving to reduce tension, and a group identified by high levels of driving-related aggression, competitive speed, hostility and sensation-seeking.

In a similar manner to the DWI and multiple crash involved driver populations, it is likely that subtypes of young novice drivers exist. Moreover, the characteristics that define those
subtypes may be important for ensuring that the skills that are important for safe driving are learned effectively and applied on the road. As noted above, the characteristics that define young novice driver subtypes are likely to include driving-related attitudes and behaviours, personality traits and demographic characteristics. Therefore, the aim of Study 1 was to obtain empirical support for the presence of driver subtypes in the young novice drivers population.

It should be noted that several authors have raised concerns regarding the consistency of cluster compositions across independent samples, as well as between subgroups when different clustering methods are used (Wells-Parker et al. 1993). Salstone and Fraboni (1990) studied 113 DWI offenders and found that the consistency of cluster group membership established by the four most commonly used clustering methods approached chance level. To address this issue, Blashfield (1990) recommended that the division of a sample based on cluster analysis be externally validated with measures not used in the initial cluster analysis. Such an approach was adopted in Study 1, where the young novice driver subtypes were compared on a variety of measures that were not used in the initial cluster analysis, including self-reported driving style, crash involvement and participation in specific high risk behaviours, such as drug and alcohol use.

2.2 DRIVER TRAINING

2.2.1 The Effectiveness of Driver Training Programs

The findings from the large body of research on the young novice driver problem have not yet been translated into effective driver education and training programs. Many training programs have been evaluated empirically, including high school education classes (Robertson, 1980), behind-the-wheel instruction with professional driving schools and parents (Gregersen, 1994), collision avoidance training (Potvin et al., 1988), skid training (Jones, 1993; also see Gregersen, 1996), driving range instruction (Strang et al., 1982); and driving simulator-based training (Smith, 1994). Mayhew and Simpson (1995) noted that:

*A fundamental and compelling assumption underlying all such initiatives is that students who are exposed to the education/training will be at lower risk of traffic mishap than those who are not. Because of the strength of this assumption it has been difficult for many to accept the results of decades of research in this field that have shown driver education/training is not an effective loss-reduction measure (p. 217).*

Some researchers have found that specific driver education programs actually have a deleterious effect on safety by increasing novice drivers' exposure to accident risk (e.g. Robertson, 1980).

2.2.2 Recent Developments and Opportunities in Driver Training

A possible reason for the lack of success of previous driver training programs is that at least some groups of young novice drivers are not motivated to drive safely and apply their skills on the road. Such drivers might benefit from training designed to change their safety-related attitudes and behaviours. Although changing attitudes and behaviour is difficult, such change has been achieved in other areas of health promotion like cigarette smoking (Viswesvaran & Schmidt, 1992) and AIDS prevention (de Jarlias, 1989). If applied to the
young driver population, the lessons learned from these campaigns (see Barokas, 1995) could enhance the safety of young novice drivers generally and certain high-risk subtypes in particular by promoting a more moderate driving style.

Another likely reason for the lack of success of previous driver training programs is that drivers have not been trained on those skills that are important in crash causation. As noted previously, for example, failure to detect traffic hazards and the ability to divide and switch attention have been identified as sources of individual differences in road accidents. They have also been identified as a significant problem for young novice drivers, but they have traditionally received very little attention in terms of driver training. More recently, however, several approaches to training these skills have shown a great deal of promise.

Recent driving simulator research at the MUARC has indicated that the risk perception skills of young novice drivers can be enhanced through personal computer (PC) based mediated instruction (Regan et al., 1998b; Regan, Deery & Triggs, 1988b). Mediated instruction is an approach whereby an external influence, such as an instructor, moderates the process of individual learning. The method employed at MUARC was based on an incremental transfer model of skill learning (Wallace, 1992), which assumes that the acquisition of a skill is an evolutionary process that extends over several definable stages, such as “knowledgeable”, “prepared”, “trained”, “skilled” and “expert”. The model assumes that skill development involves the transfer of learning between increasingly complex contexts, from situations that are similar (near transfer) to situations that are dissimilar (far transfer) from the learning context.

In the research at MUARC, the aim was to foster far transfer so that novice drivers could apply the risk perception skills learned during the training to a variety of novel driving contexts. A 30 minute PC-based training program was developed which followed a briefing-debrief procedure. During the briefing stage, participants undertook PC-based exercises on risk perception skills. These included information on the importance of scanning the road environment, keeping ahead of the situation, and choosing the safest option. The training materials consisted of digitised still images and video clips of actual driving situations as seen from the driver’s perspective. Participants were given PC-based tasks relating to these materials which provided practice in exercising the critical risk perception skills.

In the simulation stage, participants practiced the skills learned earlier in training in both digitised video segments of potential hazards and a drive in the simulator. With the digitised video, participants were required to identify potential traffic hazards in the driving scene. They then drove a scenario in the driving simulator that included a potential traffic hazard that developed with sufficient preview to enable them to practice their risk perception skills, such as scanning the road environment.

In the debrief stage of the training, participants received guided feedback and self-critiqued their performance from the simulator drive. Finally, performance around a number of potential hazards was assessed in the driving simulator and the training was found to foster both near and far transfer of the critical risk perception skills. In particular, drivers who received the mediated instruction displayed a more gradual and controlled anticipatory avoidance response to the range of potential traffic hazards than did a group of controls.
McKenna and Crick (1997) also designed a risk perception training program that included watching video segments of potential traffic hazards. The video was paused as the traffic hazards were unfolding and participants were instructed to make predictions about what might happen next in the sequence of events. McKenna and Crick (1997) showed that novice drivers' risk perception skills were enhanced by this prediction training. A similar approach to training the risk perception skills of novice drivers has been adopted in the U.S.A., using a CD-ROM based training product (Blank & McCord, 1988).

Recent driving simulator research at MUARC (Regan et al., 1998a; Regan, Deery & Triggs, 1988a) has also shown that the attentional control skill of novice drivers can be enhanced with Variable Priority Training (VPT). VPT was originally developed by Gopher (1996) to improve the attentional control skills of military pilots. It involves performing two or more tasks concurrently during training. In the research at MUARC, a headway maintenance task and a numeric calculation task were performed by young drivers during 20, three minute training trials. The headway task required the driver to follow a sedan and maintain a headway of approximately 50 metres. The speed of the sedan varied sinusoidally from 70 to 85km/h at an acceleration rate of 0.3m/s² with 6 reversals. This task was designed to load the driver continuously and simulate the cognitive demands of driving in heavy traffic.

With the numeric calculation task, a single digit number, ranging from 1 to 9, appeared next to the sedan for one second, every five seconds. Participants calculated the absolute difference between the two previous numbers and decided whether that value was the same as or different from the current number. They responded by pressing one of two switches on the steering wheel (the left switch was the "different" switch and the right was the "same" switch). This task was designed to load the driver continuously and to roughly simulate the cognitive demands of subsidiary driving tasks, such as detecting, assessing and responding to potential traffic hazards.

The important characteristic of VPT is that participants are instructed over training trials to systematically vary the relative amount of attention that they give to each task. Across the 20 training trials in the MUARC research, participants were instructed to either perform equally well on both tasks (.50/.50 attention emphasis), perform the headway task twice as well as the numeric calculation task (.66/.33 emphasis), or vice-versa (.33/.66 emphasis). Participants were also given feedback on their desired and actual performance levels.

The research at MUARC showed that novice drivers who undertook VPT subsequently performed significantly better than a group of controls in a transfer of training drive in the simulator involving three sub-tasks: a numeric calculation sub-task, a driving sub-task and a comprehension sub-task. A follow-up study was also undertaken incorporating risk perception tasks in the training (Regan et al., 1998c). In particular, the numeric calculation task appeared at random position in the driving environment, including the rear-view mirror, approximating the driving requirement to scan for traffic hazards. The results of the experiment showed that, in addition to attentional control, the ability to detect, perceive and respond to potential traffic hazards was enhanced through VPT, suggesting that attentional control is an important component of risk perception. In other words, drivers who are able to allocate their limited attentional resources to several tasks while driving are likely to exercise more efficient risk perception skills than drivers with less well-developed attentional control skills.
2.2.3 Matching Training to the Needs of the Driver

The idea that training or interventions might be most effective when tailored to the needs of specific population subgroups is not new. Such an approach has been advocated to enhance learning in a variety of educational contexts, including schools and universities (Cleverly, 1994; Hayes & Allinson, 1993), adult learning in the home (Worcester, 1990) and training in the public sector (Sims & Sims, 1991). Ayersman and von Minden (1999) reported that student performance was enhanced by matching learning styles to particular modes of teaching, including high technology applications like computer assisted instruction.

In psychology, researchers have recognised that considerable heterogeneity exists within many clinical populations. Related to the realisation has been the recommendation that interventions be tailored to the needs of particular clinical subtypes. In fact, such an approach has been proposed for the management of occupational stress (Johnson, 1993) and the treatment of clinical problems, such as alcohol and drug addictive disorders (Angres & Easton, 1997; Heather, 1996; Margolin & Avants, 1997), obesity and eating disorders (Greben & Kaplan, 1995; Clark & Goldstein, 1995) phobic disorders (Ford et al., 1997; Menzies, 1996), insomnia (Chambers, 1992), and developmental disabilities (Heather, 1996; Scotti et al., 1996).

In road safety, researchers have proposed that interventions to reduce the alcohol and driving problem may be most effective when matched to the needs of specific driver subtypes (Donovan & Marlatt, 1982). Indeed, there is some evidence that drink-driving countermeasures are most effective when tailored to the needs of drivers at various points across the spectrum of drink-driving practices, from non drink-drivers to drivers who have been convicted of DWI (Mann et al., 1988; Wells-Parker et al., 1990). For example, the impaired driving laws in Scandinavia have been most effective in deterring drink-drivers who are "moderate" drinkers (Ross, 1982), whereas intense rehabilitation programs have been most effective with individuals who have severe alcohol problems and have been convicted of DWI (Mann et al., 1988).

As mentioned above, it is likely that subtypes of young novice drivers exist and the characteristics that define those subtypes are important for safe driving. It is likely, for example, that some young novice driver subtypes are not motivated to drive safely. It is also likely that specific subtypes manage high workload situations and deal with potential traffic hazards differently than others. The safety of those subtypes could be enhanced by training designed to address their specific skill deficits and/or motivational characteristics. Indication of such differences are, for instance, that drivers with a poor driving record tend to be high in sensation-seeking and have an external locus of control (Donovan et al., 1983). When confronted with a potential hazard, such as another vehicle failing to give way, such drivers are likely to externalise the responsibility for dealing with the hazard and thus are less likely than other drivers to take preventative action that would help them to deal with the hazard effectively (McMillen et al., 1987). Therefore, the aim of Study 2 was to determine if high risk driver subtypes (identified in Study 1 by their driving-related attitudes and behaviours, personality traits, and so on) respond to traffic hazards as quickly and efficiently and manage high workload situations as well as other novice drivers.
2.3 CONCLUSION

There is a large literature highlighting factors that contribute to the young novice driver crash problem, including aspects of both driving skill and driving style. However, knowledge of these factors has not yet led to the development of effective driver education and training programs. In fact, there is very little empirical evidence to support the effectiveness of such programs. Young novice drivers are probably not a homogenous group and training or interventions might be most effective when tailored to the needs of specific driver subtypes. The general aim of this research was to identify subtypes of young novice drivers and examine whether or not membership of those subtypes predicts self-reported accident involvement, driving style, attitudes and behaviour, and simulated driving performance. Risk perception and attentional control were the main aspects of driving performance studied, as they have been identified as sources of individual differences in road accidents and are known to be a significant problem for young novice drivers.
3. IDENTIFYING SUBTYPES OF YOUNG NOVICE DRIVERS - STUDY 1

In this section, a study is described that was undertaken to identify subtypes of young novice drivers. Initially, the method that was adopted for the study is outlined. The results of the study are then presented. In the final section, the results are discussed in some detail.

3.1 METHOD

3.1.1 Participants

One hundred and ninety eight participants aged 16 to 19 years (mean age = 17.9 years; standard deviation (SD) = 0.76) took part in the study. Participants were recruited in approximately equal numbers from three VicRoads' Registration and Licensing offices in metropolitan Melbourne: East Burwood, South Oakleigh and Dandenong. These offices were chosen on the basis of demographic data collected by VicRoads indicating that those novice drivers undertaking their Learners Permit and Probationary licence tests at these offices are representative of Melbourne's new driver population.

3.1.2 Questionnaire

Participants completed an extensive self-report questionnaire based on an instrument developed by Donovan and Marlatt (1982) and used by other road safety researchers (e.g. McMillen et al., 1992). The questionnaire comprised well-validated measures that have been shown to be associated with high risk driving practices (Donovan & Marlatt, 1982; McMillen et al, 1992; Wilson, 1991). A copy of the questionnaire is presented in Appendix A.

The questionnaire comprised six sections.

1. The first section comprised a number of items measuring demographic and background variables, such as age, sex, and occupation.

2. The second section consisted of 105 true-false items concerned with personality functioning. Five subscales of the Buss-Durkee Hostility Inventory were used: assaultiveness, indirect hostility, verbal hostility, irritability, and resentment (Buss & Durkee, 1957). Other personality measures include assertiveness (Rathus, 1973); depression (Costello & Comrey, 1967); emotional adjustment (abbreviated Eysenck Personality Inventory, see Howarth, 1976); locus of control (internality; externality; Rotter, 1966); and sensation seeking (Sensation Seeking Scale; Zuckerman, 1971).

3. The third section comprised 38 true-false items measuring several driving-related attitudes and behaviours. These included competitive speed, aggression and perceived responsibility for accidents (Goldstein & Mosel, 1958); the extent to which the driving is used to reduce tension or to increase feelings of personal efficacy and power (e.g. Mayer & Treat, 1977; Goldstein & Mosel, 1958); and driving inhibition (Donovan & Marlatt, 1982).
4. The fourth section measured self-reported driving style (Deery & Love, 1996a). It comprised nine items related to decision making aspects of driving, such as speed choice and risk taking.

5. The fifth section assessed attitudes towards the TAC's road safety television advertisements\(^1\), the Victoria Police's "booze bus" and speed camera programs, the safety of young drivers, and the adequacy of driver training programs.

6. The final section assessed involvement in a number of high risk behaviours, such as drug and alcohol use. Alcohol use was measured with a modified version of Cahalan et al.'s (1969) quantity-frequency index.

The questionnaire was pilot tested with a small sample of participants \(n = 5\) to ensure the comprehensibility of the items. This resulted in slight changes to the wording of a few items to reflect Australian language use and terminology (the questionnaire was originally developed for use in North America).

3.1.3 Procedure

Potential participants were approached by the experimenter after they had undertaken their Probationary licence or Learner Permit test at one of the VicRoads Registration and Licensing offices. For those individuals undertaking their Probationary licence test, this occurred after the on-road driving component of their test. Those undertaking their Learner Permit test were approached at the completion of their written test. Those individuals who agreed to complete the questionnaire did so at a desk in a quiet section of the office. They were offered $20 for their time and a taxi home, if required.

3.2 RESULTS

3.2.1 Statistical Analysis

Cluster analysis is a multivariate statistical procedure for detecting natural groupings in data and assigning cases to more or less homogeneous groups. As noted above, it has been used previously to identify subtypes of both DWI offenders and multiple crash involved drivers that differ along a number of dimensions, including personality variables, driving-related attitudes, drinking-related variables, and driving record (Donovan & Marlatt, 1992; Wilson, 1991).

Cluster analysis was used here to derive meaningful subtypes within the novice driver population studied. Cluster analysis begins by using "distance" to establish the similarity of participants' profiles on the measures under study, so that those individuals with similar profiles can be grouped together. In this study, the scores derived for the driving-related attitudes and behaviours, general personality traits, and hostility and aggression were analysed using the squared Euclidean Distance (the sum of the squared difference over all of the variables). Standardised questionnaire scores were used to avoid the problem of comparing Euclidean Distances based on different measurement scales (i.e. variables

\(^1\)The TAC has made a great investment in Victorian road safety, placing "hard-hitting" advertisements on television in Victoria since 1989. The advertisements target particular road safety issues, such as young drivers, drink-driving, speed, and fatigue.
measured in larger numbers would have a greater weight when squared than would those measured in smaller numbers if unstandardised scores were used).

The second step in a cluster analysis is to group cases based on their distance measure. Ward's hierarchical clustering method was used to combine cases into clusters (Kaufman & Rousseuw, 1990). This technique is particularly good at identifying the number of clusters in the data. To help determine the number of clusters present, the Cubic Clustering Criterion (CCC) provided by the SAS package (Sarle, 1983) was used. Of 30 indices for determining the number of clusters in a data set, Milligan and Copper (1985) found the CCC to be among the most valid.

Wieczorek and Miller (1992) noted that because Ward's technique is hierarchical, it cannot separate clusters created at previous steps and thus cannot provide a solution with optimal between-cluster heterogeneity. It is also influenced by outliers and ordering effects. A technique called $k$-means clustering, on the other hand, produces $k$ number of clusters by minimising the sum of the squared distances from the cluster means. Hence, $k$-means clustering was used in the final analysis to classify participants into the number of clusters identified using Wards' clustering technique.

### 3.2.2 Cluster Profiles

Five unique combinations of personality traits and driving-related attitudes and behaviours were identified from the Ward's cluster analysis. This was confirmed by the CCC. Hence, a five cluster solution was forced in the final $k$-means cluster analysis.

Table 3.1 presents the cluster means for the variables used in the $k$-means cluster analysis. A statistical comparison of the clusters on the variables is inappropriate because cluster analysis classifies cases into separate groups. Rather, interpretation of the clusters is made by examining the patterns of means. For example, Cluster 1 was a relatively high risk or deviant group, as indicated by its mean score on particular measures. The individuals in this group reported high levels of driving-related aggression, competitive speed and driving to reduce tension. They also reported high levels of assertiveness, sensation seeking, assaultiveness and hostility.

The individuals in Cluster 2 scored moderately on the driving-related measures. However, they were also the most depressed and emotionally maladjusted. They also reported relatively high levels of hostility, resentment and irritability. The individuals in Cluster 3 tended to score moderately on all of the measures. Cluster 4 was the least deviant group. The individuals in that cluster reported the lowest levels of driving-related aggression, competitive speed and driving to reduce tension. They also reported the highest level of emotional and behavioural adjustment.

Cluster 5 was the highest risk or most deviant group. It was similar, although not identical, to Cluster 1. For example, the individuals in this group reported high levels of driving-related aggression, competitive speed, driving to reduce tension, sensation seeking and hostility. However, the individuals in Cluster 5 reported being more depressed, aggressive, resentful and irritable than those in Cluster 1.
Table 3.1  Mean score on the measures defining the young novice driver clusters*  

<table>
<thead>
<tr>
<th>Variable</th>
<th>1 (n = 27)</th>
<th>2 (n = 19)</th>
<th>3 (n = 50)</th>
<th>4 (n = 59)</th>
<th>5 (n = 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving-related</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>3.8</td>
<td>2.7</td>
<td>2.0</td>
<td>1.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Competitive speed</td>
<td>3.4</td>
<td>1.5</td>
<td>1.4</td>
<td>0.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Externality</td>
<td>0.8</td>
<td>1.0</td>
<td>0.4</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Internality</td>
<td>2.7</td>
<td>2.6</td>
<td>2.6</td>
<td>2.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Inhibition</td>
<td>1.9</td>
<td>2.7</td>
<td>2.5</td>
<td>2.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Tension reduction</td>
<td>1.6</td>
<td>1.2</td>
<td>1.3</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>General Personality Traits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assertiveness</td>
<td>6.4</td>
<td>4.2</td>
<td>4.1</td>
<td>5.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Depression</td>
<td>0.4</td>
<td>4.3</td>
<td>1.6</td>
<td>0.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Emotional adjustment</td>
<td>0.8</td>
<td>3.6</td>
<td>1.8</td>
<td>1.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Internality</td>
<td>2.0</td>
<td>2.4</td>
<td>2.5</td>
<td>1.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Externality</td>
<td>1.8</td>
<td>1.8</td>
<td>2.2</td>
<td>1.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Sensation seeking</td>
<td>5.6</td>
<td>4.1</td>
<td>4.6</td>
<td>3.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Hostility &amp; Aggression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assertiveness</td>
<td>6.0</td>
<td>4.6</td>
<td>3.5</td>
<td>1.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Indirect hostility</td>
<td>5.4</td>
<td>6.1</td>
<td>4.5</td>
<td>4.3</td>
<td>6.6</td>
</tr>
<tr>
<td>Verbal hostility</td>
<td>10.1</td>
<td>8.7</td>
<td>6.9</td>
<td>6.1</td>
<td>9.8</td>
</tr>
<tr>
<td>Irritability</td>
<td>5.2</td>
<td>7.1</td>
<td>4.3</td>
<td>3.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Resentment</td>
<td>2.9</td>
<td>5.2</td>
<td>3.0</td>
<td>1.8</td>
<td>5.3</td>
</tr>
</tbody>
</table>

* For each measure, higher scores reflect greater levels of the trait or behaviour, except for emotional adjustment, where high scores reflect low levels of adjustment.

Note: shaded areas are for illustrative purposes only to show those clusters with a relatively high mean score on a particular measure.

3.2.3  External Cluster Validation

As noted earlier (Section 2.1.4), researchers have recommended that cluster solutions based on personality measures be externally validated with variables not used in the initial cluster analysis. The five clusters of young novice drivers were compared on a variety of demographic, attitude and behavioural measures external to the cluster analysis. Descriptive statistics for these measures are presented in Table 3.2.

Multivariate analysis of variance (MANOVA) is a statistical procedure for testing whether or not mean differences among groups on a combination of variables are statistically significant (likely to have occurred by chance). When the results of MANOVA are significant, Analysis of Variance (ANOVA) is used to test whether or not the difference among the groups for each variable is statistically significant (Tabachnick & Fidell, 1989).
Table 3.2 Descriptive statistics (means with standard deviations in brackets, or proportion of participants) and ANOVA results (interval measures only) for the driving style, driving record, attitudes and demographic measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>1 (n = 27)</th>
<th>2 (n = 19)</th>
<th>3 (n = 50)</th>
<th>4 (n = 59)</th>
<th>5 (n = 21)</th>
<th>ANOVA (F, 4/171 df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving Style*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43.1**</td>
</tr>
<tr>
<td>Driving Record</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic violations</td>
<td>2.5 (0.6)</td>
<td>1.8 (0.3)</td>
<td>1.9 (0.4)</td>
<td>1.6 (0.4)</td>
<td>3.0 (0.7)</td>
<td></td>
</tr>
<tr>
<td>% involved in an accident</td>
<td>3.7 (10.5)</td>
<td>2.0 (15.8)</td>
<td>2.0 (15.8)</td>
<td>3.4 (19.0)</td>
<td>19.0 (n/a)</td>
<td></td>
</tr>
<tr>
<td>% responsible for an accident</td>
<td>3.7 (20.5)</td>
<td>3.4 (19.0)</td>
<td>3.4 (19.0)</td>
<td>19.0 (n/a)</td>
<td>19.0 (n/a)</td>
<td></td>
</tr>
<tr>
<td>Attitudesb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Booze buses</td>
<td>4.4 (0.7)</td>
<td>4.2 (1.4)</td>
<td>4.6 (0.9)</td>
<td>4.8 (0.4)</td>
<td>4.8 (0.4)</td>
<td>3.3*</td>
</tr>
<tr>
<td>Drunk driving</td>
<td>4.3 (0.8)</td>
<td>4.1 (1.2)</td>
<td>4.5 (0.8)</td>
<td>4.7 (0.6)</td>
<td>4.4 (0.9)</td>
<td>2.4*</td>
</tr>
<tr>
<td>Speed cameras</td>
<td>3.7 (1.4)</td>
<td>4.1 (1.4)</td>
<td>4.4 (0.9)</td>
<td>4.6 (0.6)</td>
<td>4.4 (1.0)</td>
<td>4.4**</td>
</tr>
<tr>
<td>TAC advertisements</td>
<td>4.4 (0.7)</td>
<td>4.1 (1.4)</td>
<td>4.6 (0.9)</td>
<td>4.7 (0.7)</td>
<td>4.9 (0.3)</td>
<td>3.1*</td>
</tr>
<tr>
<td>Driver training</td>
<td>4.0 (1.0)</td>
<td>3.7 (1.2)</td>
<td>4.0 (1.1)</td>
<td>3.8 (0.8)</td>
<td>3.8 (1.1)</td>
<td>0.5</td>
</tr>
<tr>
<td>Young driver safety</td>
<td>4.2 (0.9)</td>
<td>4.2 (1.2)</td>
<td>4.3 (0.9)</td>
<td>4.4 (0.9)</td>
<td>4.1 (1.0)</td>
<td>0.5</td>
</tr>
<tr>
<td>Alcohol Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking occasions per month</td>
<td>5.6 (6.4)</td>
<td>3.1 (5.1)</td>
<td>3.6 (4.4)</td>
<td>2.2 (3.2)</td>
<td>5.5 (5.4)</td>
<td>3.6**</td>
</tr>
<tr>
<td>Drinks per occasion</td>
<td>6.6 (2.9)</td>
<td>2.8 (3.2)</td>
<td>3.9 (3.1)</td>
<td>2.0 (2.3)</td>
<td>5.3 (3.6)</td>
<td>13.5**</td>
</tr>
<tr>
<td>Total quantity per month</td>
<td>43.6 (62.7)</td>
<td>19.4 (36.4)</td>
<td>17.9 (22.8)</td>
<td>8.1 (13.3)</td>
<td>42.8 (49.8)</td>
<td>6.9**</td>
</tr>
<tr>
<td>Other Drug Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% use prohibited drugs</td>
<td>37</td>
<td>21</td>
<td>22</td>
<td>7</td>
<td>33</td>
<td>n/a</td>
</tr>
<tr>
<td>% ever smoked tobacco</td>
<td>52</td>
<td>37</td>
<td>40</td>
<td>20</td>
<td>52</td>
<td>n/a</td>
</tr>
<tr>
<td>% smoke tobacco now</td>
<td>41</td>
<td>32</td>
<td>20</td>
<td>14</td>
<td>43</td>
<td>n/a</td>
</tr>
<tr>
<td>Demographic variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>17.7 (0.9)</td>
<td>17.9 (0.8)</td>
<td>18.1 (0.7)</td>
<td>17.9 (0.7)</td>
<td>18.1 (0.4)</td>
<td>1.0</td>
</tr>
<tr>
<td>Sex (%male)</td>
<td>82</td>
<td>47</td>
<td>50</td>
<td>40</td>
<td>76</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*Higher scores indicate a more risky driving style; * Scores range from 1 (strongly disagree) to 5 (strongly agree)
*p < .05, **p < .01
Table 3.3  Post-hoc Tukey tests with the critical statistical significance level (alpha) set at .05

<table>
<thead>
<tr>
<th>Variable</th>
<th>1 and 2</th>
<th>1 and 3</th>
<th>1 and 4</th>
<th>1 and 5</th>
<th>2 and 3</th>
<th>2 and 4</th>
<th>2 and 5</th>
<th>3 and 4</th>
<th>3 and 5</th>
<th>4 and 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving Style</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
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<tr>
<td>Driving Record</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violations</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>Attitudes Booze buses</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drunk driving</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Speed cameras</td>
<td>ns</td>
<td>.05</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>TAC advertisements</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Alcohol Use</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking occasions per month</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
</tr>
<tr>
<td>Drinks per occasion</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>ns</td>
<td>.05</td>
</tr>
<tr>
<td>Total quantity per month</td>
<td>ns</td>
<td>.05</td>
<td>.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.05</td>
<td>ns</td>
<td>.05</td>
</tr>
</tbody>
</table>

Note: ns = not significant.
Separate MANOVA were undertaken to test whether or not the combination of alcohol use and attitude measures varied as a function of membership of the young novice driver subtypes. With the use of Wilks' criterion, a statistically significant effect of cluster membership was found for the combination of attitude ($F = 1.6$, $24/580$ df, $p < .05$) and alcohol use ($F = 4.8$, $12/447$ df, $p < .001$) measures. ANOVA was used to test whether or not the young novice driver clusters differed significantly on each of the alcohol use and attitude variables. Driving style, the number of self-reported moving violations, and age were also compared with separate ANOVA, the results of which are summarised in Table 3.2. A significant difference between the clusters was observed for: driving style; the number of moving violations; attitudes to Victoria's booze bus and speed camera program and the TAC's road safety advertising campaign; and each of the alcohol use measures (frequency, quantity and total consumption per month).

Where ANOVA revealed a significant difference between the clusters on a measure, comparisons of the subtypes were undertaken using Tukey tests with the critical statistical significance level (alpha) set at .05. These tests indicate which of the clusters are statistically different from each other on the measure under consideration (see Table 3.3).

The two most deviant young novice driver subtypes (Clusters 1 and 5) differed from the least deviant subtype (Cluster 4) on several measures. For example, the individuals in Clusters 1 and 5 reported a more risky driving style and greater alcohol use (frequency, quantity and total consumption per month) than those in the least deviant subtype (Cluster 4). Some differences also emerged between the pattern of results for the two most deviant subtypes (Clusters 1 and 5). The individuals in Cluster 5 reported a greater number of citations for moving violations than those in the least deviant subtype (Cluster 4). In contrast, the individuals in Cluster 1 reported less favourable attitudes towards Victoria's speed camera program than those in the least deviant subtype (Cluster 4).

Compared to the individuals in the least deviant subtype (Cluster 4), those in Cluster 2 (depressed, irritable and resentful) reported less favourable attitudes to Victoria's booze bus and speed camera program and the TAC's road safety advertising campaign.

Compared to the three least deviant subtypes (Clusters 2, 3 and 4), a higher proportion of participants in the two most deviant subtypes (Clusters 1 and 5) reported having smoked tobacco regularly ($\chi^2 = 12.0$, 4 df, $p < .05$), currently smoking tobacco regularly ($\chi^2 = 12.4$, 4 df, $p < .05$) and using prohibited drugs ($\chi^2 = 13.6$, 4 df, $p < .01$). A higher proportion of participants in the two most deviant groups were also male ($\chi^2 = 18.4$, 4 df, $p < .01$).

3.2.3.1 Traffic Accident Record

Logit analyses were undertaken to examine whether or not traffic accident record (involvement and responsibility) varied as a function of cluster membership. A significant association was found between cluster membership and accident involvement ($\chi^2 = 11.5$, 4 df, $p < .05$), but not accident responsibility ($\chi^2 = 5.2$, 4 df, ns). Orthogonal (independent) contrasts were undertaken to establish which groups were different from each other (see Table 3.4). They revealed that the proportion of individuals who reported being involved in at least one accident was significantly higher among Clusters 2 and 5 compared with the other three clusters, which did not differ from each other (there was also no significant difference between Clusters 2 and 5).
The logit analyses were repeated with several measures used as covariates in an effort to statistically control for possible differences in driving exposure. However, these analyses yielded almost identical results to those reported in Table 3.4. In these analyses, age and license type (Probationary or Learner Permit) were entered as covariates. In terms of license type, 20% of participants had obtained their Learner Permit on the day they were recruited into the study and thus had zero driving exposure. On the other hand, 80% of participants had obtained their Probationary license on the day they were recruited into the study and thus had accrued some exposure (on average, Victorian novice drivers obtain 30 to 50 hours of experience before undertaking their Probationary license test).

### Table 3.4 Logit analysis comparing the clusters on traffic accident involvement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>95% confidence limits</th>
<th>Z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clusters 2 and 5 vs Clusters 1, 3 and 4</td>
<td>-0.19</td>
<td>-0.33</td>
<td>-0.06</td>
</tr>
<tr>
<td>Cluster 2 vs Cluster 5</td>
<td>-0.06</td>
<td>-0.47</td>
<td>0.35</td>
</tr>
<tr>
<td>Cluster 1 vs Clusters 3 and 4</td>
<td>-0.06</td>
<td>-0.45</td>
<td>0.32</td>
</tr>
<tr>
<td>Cluster 3 vs Cluster 4</td>
<td>0.14</td>
<td>-0.47</td>
<td>0.74</td>
</tr>
</tbody>
</table>

*p < .01

### 3.2.3.2 Effect of License Type

As noted above, 80% of the sample for the analyses reported above obtained their Probationary license on the day of testing; the remaining 20% obtained their Learner Permit. Analyses were undertaken to compare the two groups of license holders on the variables used to validate the cluster solution. These analyses failed to reveal any significant differences, supporting the interpretation of the study results based on the combined data for the different license holders.

### 3.3 DISCUSSION

The aim of this study was to identify subtypes of young novice drivers. Cluster analysis revealed five distinct subtypes of young novice drivers based on differential levels of driving-related attitudes and behaviours, general personality traits, and hostility and aggression. Two of these subtypes (Cluster 1 and 5) were the most deviant, reporting relatively high levels of driving-related aggression, competitive speed and driving to reduce tension. The individuals in those subtypes also reported high levels of assertiveness, sensation seeking, assaultiveness and hostility. Those subtypes could be distinguished from each other on some measures. In other words, they were similar, but not identical, groups. The individuals in Cluster 5 were more depressed, resentful and irritable, and were emotionally less well adjusted, than those in Cluster 1.

Two of the remaining three subtypes (Clusters 2 and 3) scored moderately on the driving-related measures, although one of those subtypes (Cluster 2) comprised individuals characterised by high levels of inhibition while driving, depression, irritability and
resentfulness. The final subtype, Cluster 4, was the least deviant. The individuals in this cluster reported the lowest levels of driving-related aggression, competitive speed and driving to reduce tension. They also reported the highest levels of emotional and behavioural adjustment.

Several demographic, attitude and behavioural measures were used to validate the cluster solution. Statistically reliable differences were found on several variables, particularly between the two highest risk or most deviant subtype (Clusters 1 and 5) and the least deviant subtype (Cluster 4). For example, the individuals in the two most deviant subtypes reported a more risky driving style and greater tobacco, drug and alcohol use (frequency, quantity and total consumption per month) than those in the least deviant subtype. The individuals in Cluster 1 reported less favourable attitudes towards the Victoria Police’s speed camera program than the individuals in the least deviant subtypes. On the other hand, the individuals in Cluster 5 reported a greater number of citations for moving violations than the individuals in the least deviant subtype. Those in Cluster 5 were also more likely to have been involved in a traffic accident than those in Clusters 1, 3 and 4.

It may be useful to review the pattern of results found for the most deviant young novice driver subtype (Cluster 5). This subtype comprised a large proportion of males. The individuals in this subtype were characterised by high levels of driving-related aggression, competitive speed and driving to reduce tension. They also reported low levels of emotional and behavioural adjustment: they were characterised by high levels of sensation seeking, assaultiveness, hostility, depression, resentfulness and irritability. Furthermore, they reported the riskiest driving style and the worst driving record (number of citations for moving violations and involvement in traffic accidents). They were also likely to take part in other high risk behaviours, such as drinking large quantities of alcohol regularly, smoking tobacco and using illicit drugs. These results are consistent with previous research indicating that high risk driving practices among young drivers are usually one component of a risky lifestyle or network of problem behaviours (Jessor, 1987; Wilson & Jonah, 1988). They are also consistent with research on DWI offender subtypes, in which young, hostile and heavy drinking groups with a particularly poor driving record have been identified (Donovan & Marlatt, 1982; Wiczoreck & Miller, 1992).

Several potential limitations of the research questionnaire used in this study should be noted. For example, only select items from particular personality scales were used to minimise the overall length of the questionnaire. As a result, the reliability and internal consistency of those scales may have been affected (Donovan & Marlatt, 1982). Self-reported traffic accident record was one measure used to validate the cluster solution. To avoid possible inaccuracies with these type of data, longitudinal research could be undertaken in which participants’ official driving records are followed-up several years later.

From both an empirical and practical view-point, several issues need to be addressed before particular training or interventions can be matched to novice driver subtypes. For example, to the author’s knowledge, this is the first study to examine young novice driver subtypes. Hence, further tests of the reliability and validity of the clusters should be undertaken.
3.3.1 Conclusion

The aim of this study was to identify subtypes of young novice drivers that might be at a higher accident risk than others. Five distinct subtypes of drivers were identified from a cluster analysis of general personality and specific driving-related attitude and behaviour measures. Two particularly high risk or deviant subtypes (Clusters 1 and 5) were identified. The individuals in those clusters reported high levels of driving-related aggression, competitive speed and driving to reduce tension. They also reported high levels of assertiveness, sensation seeking, assaultiveness and hostility. The individuals in one of those subtypes (Cluster 1) also reported high levels of depression, resentfulness and irritability. Statistically significant differences were also found between the clusters on a number of demographic, attitude and behavioural variables, including self-reported driving style and traffic accident record.
4. SIMULATED DRIVING PERFORMANCE OF YOUNG NOVICE DRIVER SUBTYPES - STUDY 2

The results of Study 1 indicate that young novice drivers are not a homogenous group. The aim of the study reported in this section was to determine if the high risk driver subtypes identified in Study 1 (defined by driving-related attitudes and behaviours, personality traits, driving record, and so on) respond to traffic hazards as quickly and efficiently and deal with high workload situations as well as other novice drivers.

4.1 PARTICIPANTS

A subset of participants from Study 1 were randomly recruited to participate in this study. Participants were telephoned and asked to take part in a driving simulator study with the aim of attaining an equal number of participants from each of the young novice drivers subtypes. A total of 54 subjects participated in the study, comprising 12, 12, 12, 7 and 11 from Cluster 1, 2, 3, 4 and 5, respectively (the rate of subject participation by cluster membership is summarised in Appendix B). They were offered $20 for their time.

4.2 APPARATUS

A mid-range driving simulator was used as the main research tool for the study. The simulator comprises a full size passenger car body (Ford Falcon) with cabin controls that operate in the same manner as a normal vehicle. The body of the vehicle is mounted on a partial motion platform which provides road feel but no lateral acceleration forces. It is surrounded by screens on which images are projected, providing 180° forward and 60° rear views. Sounds like engine noises are provided through a surround sound stereo system. Other “automated” vehicles can be included in the simulation and programmed to behave in specific ways.

The simulator provides an extremely data-rich environment. The computer system, powered by two Silicon Graphics machines - an Onyx and an Indy - is able to record, at a rate of 30 hertz, the driver’s behaviour across a number of performance measures. In this experiment, the measures that were sampled included speed, headway and lane deviation.

Two small switches were secured to the steering wheel of the simulator vehicle at the 10 o’clock and 2 o’clock positions. Participants were required to use these buttons to respond to specific tasks during some of the drives (these tasks are described below). Participants’ responses (which one of the two buttons they pressed and the time at which they pressed it) were recorded by the simulator and written directly into their data file.

4.2.1 Simulated Environments and Tasks

Five simulated driving scenarios were used in the study.

1. The first scenario consisted of a familiarisation drive in a rural road environment. This scenario involved approximately 3 km of simulated rural road with other ambient traffic that behaved in a safe and predictable manner. The aim of this drive was to provide participants with practice and the opportunity to familiarise themselves with the simulator.
2. The second scenario comprised a drive in an arterial road environment. This drive was approximately 6 km, had a posted speed limit of 70 km/h, and included other ambient traffic that behaved in a safe and predictable manner. The aim of this drive was to obtain measures of general driving skill (e.g. variability in lateral position) and style (e.g. speed choice).

3. The third scenario was similar to that developed by Regan et al. (1998a) to examine the skill of attentional control during high workload situations. It was developed within an arterial road environment along a 3 km length of road with no oncoming vehicles in the right lane. It embodied two sub-tasks that were performed concurrently: (1) a driving sub-task, and (2) a numeric calculation sub-task.

The driving sub-task required participants to change and maintain their driving speed according to speed limit signs, which varied from 60 to 80 km/h. The posted speed limits were unusual and thus different from those typically used on Australian roads (e.g. 63 km/h, 71 km/h). A different sign appeared every 500 metres or so, requiring the driver to alter their driving speed by between 8 and 14 km/h.

The numeric calculation sub-task required participants to remember the values shown on successive speed signs. They were required to calculate the absolute difference between the value of the current speed sign and the previous one. They had to respond by pressing one of the two buttons on the steering wheel to indicate whether the current value was the same as or different to that of the previous task (see Table 4.1 for an example). As there were six speed signs, four responses were required during a drive. The values on the speed signs were such that an equal number of “same” and “different” responses were required during a drive.

<table>
<thead>
<tr>
<th>Speed Limit Sign</th>
<th>Absolute Difference</th>
<th>Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>73</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>68</td>
<td>5</td>
<td>Different</td>
</tr>
<tr>
<td>63</td>
<td>5</td>
<td>Same</td>
</tr>
<tr>
<td>67</td>
<td>4</td>
<td>Different</td>
</tr>
<tr>
<td>71</td>
<td>4</td>
<td>Same</td>
</tr>
</tbody>
</table>

Previous experience with the driving simulator has shown that novice drivers display a relatively steep learning curve when performing these attentional control tasks (Regan et al., 1998a). Hence, three versions of the attentional control drive were developed (with different speed signs) and participants undertook each of the three drives so that both overall performance on the tasks and the rate of performance improvement could be examined.
4. The fourth scenario was designed to examine precautionary behaviour around potential traffic hazards. It comprised two drives, each approximately 6km, in a simulated arterial road environment. Each of these risk perception drives contained 3 potentially hazardous situations corresponding to three VicRoads' definitions for classifying accidents (DCA). Every effort was made to ensure that participants had sufficient time to perceive the potential hazards and take some action to minimise the possibility of a crash. For these types of traffic hazards, novice drivers are more likely to display a delayed avoidance response, whereas more experienced drivers are more likely to display an anticipatory avoidance response (Fuller, 1984). For example, previous research with the driving simulator (Regan et al., 1998b) has shown that drivers with well-developed risk perception skills detect the cues indicating potential danger earlier and thus display a more gradual and controlled anticipatory response (e.g. earlier and more gradual deceleration) than do drivers with less well-developed risk perception skills.

The first risk perception drive contained three potentially hazardous situations corresponding to DCA 110, DCA 111, and DCA 130 (these DCAs are illustrated in Appendix C). They were chosen because young drivers are overrepresented in crashes of these kinds, probably due to a cognitive skill deficit (Catchpole, 1997). For DCA 110, a car approached a cross intersection from the left, braked late without an indicator and stopped. There was some degree of ambiguity both as to whether or not the car would actually stop and its intended direction at the intersection. Parked cars forced participants to be travelling in the left lane as they approached DCA 110. DCA 111 was similar to DCA 110, except that the car approached from the right side of the cross intersection and parked cars forced participants to be travelling in the right lane. For DCA 130, a car in front of the subject’s vehicle slowed almost to a stop without an indicator or a brake light activated, as though its engine had stalled, and then turned right.

The second risk perception drive contained three potentially hazardous situations corresponding to DCA 102, DCA 121, and DCA 134. For DCA 102, an adult pedestrian was standing on the left curb near an intersection and a child pedestrian was standing on the centre median. This situation was intended to raise the possibility that one of the pedestrians might cross the road in front of the participant’s vehicle. For DCA 121, a vehicle in the right lane approached a T-intersection from the opposite direction and slowed rapidly without an indicator activated, thereby raising the possibility of it turning right across the participant’s path. For DCA 134, a car was parked in the left lane (other parked cars forced participants to be travelling in the right lane). When the participant was 50m or so from the parked car, that car began to accelerate slowly. However, a truck was also parked in the left lane approximately 100m ahead, raising the possibility that the other car would merge into the participant’s lane to manoeuvre around the truck.

Participants were asked to press one of the buttons on the steering wheel as quickly as possible to indicate that they had detected any situation that they considered to be a potential hazard during the second risk perception drive. This task was included because the time taken to detect hazards has been identified as one source of individual differences in road accidents (see Section 2.1.2.1) and is an area in which novice drivers perform poorly compared with their more experienced counterparts. Participants were not asked to perform this button pressing task during the first risk perception...
drive to avoid alerting them to the fact that it contained potential hazards. This issue was considered less relevant for the second risk perception drive, by which time participants would be expecting the possibility of potential hazards after experiencing them in the first risk perception drive.

5. The final scenario comprised a drive along a 6km arterial road. It included ambient traffic throughout, as well as one emergency situation in which a vehicle reversed from a driveway partly into the lane in which the participant was travelling. The other vehicle reversed in such a manner that the participant had to perform evasive steering and braking to avoid a collision. The driveway was partly obscured by a parked car in the left lane. This situation corresponded to DCA 147.

It should be noted that the performance of the other “automated” vehicles in the DCAs during the risk perception and emergency drives was triggered by the position of the participant’s vehicle. This was achieved by programming invisible “trigger lines” into the scenario. The moment that the participant’s vehicle crossed the trigger line, the other vehicle behaved according to pre-programmed parameters, such as rate of acceleration, speed and lane position. This ensured that the DCAs were presented in a consistent manner across participants, assuming all participants were travelling at the same speed.

4.3 Procedure

4.3.1 Session Schedule

The following procedure was used for the experimental sessions.

1. Introduction to experiment (written instructions).
2. Familiarisation drive (rural road environment).
3. Drive on an arterial road to assess aspects of driving skill and driving style.
4. Three attentional control drives in arterial road environment.
5. Two risk perception drives on an arterial road, each with three potential hazards (DCAs).
6. Drive on an arterial road, with one emergency situation (car reversing from driveway).
7. Post drive questionnaire (Simulator Sickness Questionnaire).

4.4 RESULTS

4.4.1 Performance Measures

The aim of the first drive was to assess participants’ overall driving skill and style. Measures of driving style included average and standard deviation of speed, which were calculated for the entire drive (excluding the first and last 500m when participants were likely to be accelerating and decelerating, respectively). Average and standard deviation of lateral position served as the measures of driving skill. As lateral position in the simulator is calculated from the centre of the road at the beginning of the drive, it is influenced by the horizontal road alignment. Hence, measures of lateral position were calculated for a 1 km stretch of straight road only during the drive.
For each of the three attentional control drives, four data collection areas were available, corresponding to the last four speed signs (see Table 4.1). For each data collection area, several performance measures were taken and a number of summary scores derived. These scores, which represent the mean across the four data collection areas, included standard deviation of speed, time to reach desired speed, maximum acceleration, and the time taken to initiate a speed change. Where a subject lacked data for a performance measure in a data collection area (due to technical problems with the simulator), that point was dropped when computing his or her average summary score.

For the two risk perception drives and the emergency drive, speed and lateral position were recorded. Performance profiles were plotted for each novice driver subtype (see Appendices H and I) to examine the overall patterns in the data. These profiles depict the group averages on lateral position or speed calculated every 10 metres for the entire drive. Inferential statistics were used to assess whether or not there were statistically significant differences between the groups around the critical situations or DCAs. For each DCA, data collection points were examined for approximately 50m before the trigger point for that situation (around 100m before the DCA) to 50m after the potential point of collision (see Figures 4.1 to 4.6). For the first risk perception drive, this corresponded to 31, 26, and 27 data collection points for DCAs 130, 111, 110, respectively. For the second risk perception drive, 35, 21 and 37 data collection points were analysed for DCAs 134, 102 and 121, respectively. For the emergency drive, 21 data collection points were analysed around the car reversing from the driveway.

### 4.4.2 Driving Skill and Driving Style

The mean scores for each of the young novice driver subtypes on the performance measures collected during the first drive are presented in Table D.1 (Appendix D). Analysis of Variance (ANOVA) was used to determine whether or not the mean scores of the young novice driver clusters were significantly different. The results of the ANOVA are also summarised in Table D.1.

The ANOVA revealed that there were no statistically significant differences between the young novice driver clusters or subtypes for the measures of driving style. However, the subtypes differed significantly in terms of standard deviation of lateral position (a measure of variability in driving performance across the drive). Post-hoc Tukey tests were undertaken to determine which of the five novice driver clusters were different from each other in terms of standard deviation of lateral position. Those tests revealed greater variation in driving performance for those in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) compared to those in Cluster 5 (similar to Cluster 1, but also depressed, irritable and resentful).

### 4.4.3 Attentional Control

It will be recalled that three versions of the attentional control drive were developed so that both overall performance on the tasks and the rate of performance improvement could be examined. These aspects of performance were examined by undertaking a separate $5 \times 3$, cluster $\times$ drive ANOVA on each performance measure, with the novice driver clusters serving as a between-subjects factor and drive (attentional control drives 1, 2 and 3) as a repeated-measure or within-subject factor.
The mean scores for the performance measures collected during the attentional control drives and the results of the ANOVA are summarised in Appendix E (Table E.1 and E.2, respectively). The results of the ANOVA are interpreted in the following sections (a more detailed discussion of the statistical output from the ANOVA is given in Appendix E).

### 4.4.3.1 Driving Performance

For driving performance around the speed signs, no evidence was found of a difference between the young novice driver subtypes. In other words, the subtypes did not differ significantly in terms of maximum acceleration, time to reach desired speed, time to initiate a speed change and standard deviation of speed.

A statistically significant effect of drive was found for maximum acceleration, time to reach desired speed and standard deviation of speed (see Table E.2, Appendix E). Regardless of cluster membership, participants improved with practice, displaying a smoother and more efficient performance. In particular, both the time it took them to reach the desired speed and the variability in their driving speed decreased significantly across the drives. Furthermore, their maximum acceleration decreased significantly across the drives, indicating a smoother performance with practice.

### 4.4.3.2 Numeric Calculation Task

A statistically significant difference was found between the clusters in terms of the number of correct answers to the numeric calculation task. Participants in Cluster 5 were less likely to be correct than those in Cluster 1, 2 and 3, regardless of which of the three attentional control drives they were undertaking (see Table E.1, Appendix E).

There was also some evidence of a difference between the clusters for time to respond to the numeric calculation task \((F = 2.3, 4/40 \text{ df, } p = 0.79)\). The trend was towards participants in Cluster 5 taking longer to respond than those in the other clusters (see Table E.1, Appendix E).

### 4.4.4 Risk Perception

Participants' speed and lateral position around each DCA in the risk perception drives were analysed with separate cluster × time ANOVA, with the novice driver clusters serving as a between-subjects factor and time a within-subjects factor. The data collection points around the DCAs served as the levels of the within-subjects effect. The results of the ANOVA are summarised in Appendix F and are interpreted below (a more detailed discussion of the statistical output from the ANOVA is given in Appendix F).

For both risk perception drives, the main effect of time was significant for all DCAs when both speed and lateral position were considered. These results suggest that, regardless of cluster membership, participants altered their lateral position and speed throughout the potential hazards. For some DCAs, however, a significant time × cluster interaction was found, indicating that the clusters differentially responded to the potential hazards over time. The significant interactions are considered in the next section.
4.4.4.1 Differential Performance Across Clusters: Significant Time × Cluster Interactions

**DCA 130 (a vehicle in front slowed without brake lights or turn signal activated).** Participants in Cluster 3 (moderate personality functioning and driving-related attitudes) were, on average, positioned significantly further to the right than those in Cluster 1 (high levels of driving-related aggression, competitive speed, assertiveness, etc) 100m before the DCA (see Figure 4.1).

**DCA 111 (a vehicle approached an intersection from the right, as though it may not stop).** At the potential point of collision, those in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) were, on average, travelling significantly faster than those in Cluster 5 (similar to Cluster 1, but also relatively depressed, resentful and irritable). This pattern of results is illustrated in Figure 4.2.

**DCA 110 (a vehicle approached an intersection from the left, as though it may not stop).** Cluster 1 was travelling significantly faster than Cluster 2 30m after the trigger point (see Figure 4.3). Furthermore, the change in speed across time was examined for each cluster separately and was statistically significant for Clusters 2, 3 and 5, but not for Clusters 1 and 4. In other words, participants in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) and 4 (least deviant group) did not significantly alter their speed throughout the DCA.

**DCA 102 (an adult pedestrian was standing on the left curb; a child pedestrian on the centre median).** The change in lateral position across time was examined for each cluster separately and was statistically significant for all clusters, except Cluster 1. In other words, Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) was the only group not to significantly alter their lateral position throughout the DCA (see Figure 4.4).

**DCA 134 (a vehicle initially parked in the left lane accelerated towards a parked truck also in the left lane, raising the possibility that the other car would merge into the participant’s lane).** Those in Cluster 5 (high levels of driving-related aggression, competitive speed, sensation seeking, depression, irritability) were, on average, travelling significantly further to the left than those Cluster 3 (moderate on all personality and driving-related measures) 220m after the trigger point (see Figure 4.5). The change in lateral position across time for each cluster was also examined for statistical significance. The only significant effect was for Cluster 2. In other words, only those in Cluster 2 (moderate on the driving-related measures, but most inhibited while driving and relatively depressed, irritable and resentful) altered their speed significantly throughout the DCA.

4.4.4.2 Button Pressing Task

It will be recalled that participants were instructed to press one of the buttons on the steering wheel as quickly as possible when they detected a potential hazard in the second risk perception drive. No statistically reliable differences were found between the clusters in terms of the time taken to detect the potential hazards (see Table F.1, Appendix F).
Figure 4.1  Lateral position profile around DCA 130
(smaller values indicate driving further to the right)

Figure 4.2  Speed profile around DCA 110
Figure 4.3  Speed profile around DCA 111

Figure 4.4  Lateral position profile around DCA 102
(smaller values indicate driving further to the right)
Figure 4.5  Lateral position profile around DCA 134
(smaller values indicate driving further to the right)

Figure 4.6  Speed profile around the emergency situation
4.4.5 Emergency Situation

Speed and lateral position around the emergency situation were analysed with separate ANOVA, the results of which are summarised in Table G.1 (Appendix G). The interaction was significant for speed. The participants in Cluster 5 (high levels of driving-related aggression, competitive speed, sensation seeking, depression, resentment and irritability) were, on average, travelling significantly faster than those in Cluster 4 (the least deviant group) as they passed the potential point of collision (see Figure 4.6).

4.5 DISCUSSION

4.5.1 Summary and Interpretation of Results

The results of this study suggest that the novice subtypes, identified in Study 1 on the basis of differential levels of driving-related attitudes and behaviours, general personality traits, and hostility and aggression, also differ in terms of their level of driving skill. Differences were observed in the way that the novice driver subtypes responded to an emergency situation and several potential traffic hazards. Differences were also evident in the proficiency with which they could control their attention among concurrent tasks while driving in high workload situations in the simulator.

No evidence was found of a difference between the young novice driver clusters in terms of general driving style, as measured by average driving speed. However, those in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) tended to display greater variability in lateral position than those in Cluster 5 (similar to Cluster 1, but also depressed and irritable), suggesting a less proficient level of general vehicle control skill.

Participants undertook two risk perception drives, each containing three potential hazards or DCAs. The DCAs corresponded to crash situations in which novice drivers are known to be overrepresented, probably due to a cognitive skills deficit (Catchpole, 1997). They were also designed to assess precautionary behaviour around potential hazards, rather than responses to emergency situations. As expected, irrespective of cluster membership, participants altered their lateral position and speed throughout the potential DCAs. For some DCAs, however, the novice driver subtypes performed differently as the potential hazards unfolded.

For DCA 111 (a vehicle approached an intersection from the right, as though it may not stop) participants in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) were travelling slower before the DCA than those in Cluster 5 (similar to Cluster 1, but also depressed, resentful and irritable). However, by the potential point of collision, participants in Cluster 1 were travelling significantly faster than those in Cluster 5.

For DCA 110 (a vehicle approached an intersection from the left, as though it may not stop), Cluster 1 and 4 were the only groups not to moderate their speed throughout the DCA. Some evidence was also found that those in Cluster 1 were travelling faster than those in Cluster 2 as they approached the DCA. Cluster 1 was also the only group not to alter its lateral position around DCA 102 (an adult pedestrian was standing on the left curb, a child pedestrian was standing on the centre median).
For DCA 134 (participants were in the right lane, with another vehicle ahead in the left lane approaching a parked truck), Cluster 5 (the most deviant group) was travelling further to the left than Cluster 3 (moderate on all personality and driving-related measures) as they approached the truck. In other words, those in Cluster 5 did not give themselves as much “crash avoidance space” in the event that the other car travelling in the left lane merged into their lane.

Performance of the novice driver subtypes was also examined around one emergency situation that required evasive braking and steering. The situation, corresponding to DCA 147, involved a car reversing from a driveway slightly into the path of the participant’s vehicle. Participants, regardless of cluster membership, took some evasive action to avoid a collision with the vehicle reversing from the driveway. However, those in Cluster 5 (the most deviant group) were travelling significantly faster than those in Cluster 4 (the least deviant group) as they passed the driveway. This less cautious response by the novice drivers in Cluster 5 may contribute, at least in part, to their high accident involvement rate, as reported in Study 1 (Section 3.2.3.1).

It will be recalled that, in each of three attentional control drives, participants performed two sub-tasks: a driving sub-task and a numeric calculation sub-task. The driving sub-task required participants to change their speed according to speed limit signs, which varied from 60 to 80 km/h. The numeric calculation sub-task required them to remember the values shown on successive speed signs, perform an arithmetic calculation on those values, and respond by pressing one of two buttons on the steering wheel. There was no difference between the clusters in terms of performance on the driving sub-task. However, individuals in Cluster 5 performed the worst on the numeric calculation sub-task in terms of both accuracy and response time, suggesting that they have difficulty controlling their attention between multiple tasks in high workload situations while driving.

It may be useful to summarise the results for the two most deviant or highest risk novice driver subtypes (Clusters 1 and 5), as most of the significant differences that emerged from the study were related to performance decrements for those groups. The individuals in cluster 1 seem to have problems with particular areas of driving skill. They displayed the greatest variability in lateral position during the first drive, suggesting the least proficient level of overall vehicle control skill. They also were travelling the fastest throughout DCA 111 and did not alter their driving speed throughout DCA 110. This lack of precautionary behaviour around some potential hazards may enhance this group’s risk in similar real world driving situations.

Those in Cluster 5 also appear to have difficulties with particular areas of driving skill. Unlike those in Cluster 1, the individuals in Cluster 5 showed precautionary behaviour around all of the potential hazards or DCAs in terms of a reduced driving speed. However, they did not allow themselves as much lateral space throughout DCA 134. This DCA was particularly notable for the need to anticipate or predict a sequence of gradually unfolding events, suggesting that the individuals in Cluster 5 have some difficulties with this area of driving skill.

The individuals in Cluster 5 were also the least safe around the emergency situation that required evasive braking and steering. In particular, they did not moderate their speed as much as those in Cluster 4 (the least deviant cluster) when the car reversed from the driveway partly into their path. Furthermore, those in Cluster 5 performed the worst on the
numeric calculation sub-task (both accuracy and response time) during the three attentional control drives, indicating that they have difficulty controlling their attention between competing tasks in a driving situation. This is likely to cause them problems in high workload situations in the real world, such as driving in heavy traffic. In such situations a driver needs to control his or her attention between competing tasks, such as maintaining a safe headway and scanning for and responding to potential traffic hazards.

4.5.2 Implications for Driver Training

The results of this study suggest that the novice drivers in Clusters 1 and 5 are most likely to benefit from training to enhance particular aspects of their driving skill. They may, for example, benefit from training to enhance precautionary behaviour around potential traffic hazards. As noted previously (see Section 2.2.2), recent research at MUARC has shown that these skills can be enhanced through PC-based mediated instruction (Regan et al., 1998b). This mediated instruction followed the brief-simulation-debrief methodology. During the briefing stage of the training, participants were given information about risk perception skills, such as scanning the road environment, keeping ahead of the situation, and choosing the safest option. In the simulation stage, they practiced the skills in both digitised video segments of potential hazards and a drive in the simulator. Finally, during the debrief stage of the training they received guided feedback and assessed their own performance from the simulation stage of the training.

McKenna and Crick (1997) designed a prediction training program that included watching video segments of potential hazards. The video was paused as the traffic hazards were unfolding and participants were instructed to make predictions about what might happen next in the sequence of events. McKenna and Crick (1997) showed that novice drivers' risk perception skills were enhanced by this training. The novice drivers in Cluster 5 might benefit from such training, given that they did not allow themselves as much lateral space as other drivers throughout the potential hazard that was particularly notable for the need to anticipate or predict a sequence of unfolding events (DCA 134).

The individuals in Cluster 5 might also benefit from training to enhance their attentional control skills. As noted previously (Section 2.2.2), recent simulator research at MUARC has shown that the attentional control skill of novice drivers can be enhanced using a training technique called Variable Priority Training (VPT). The important characteristic of VPT is that participants are instructed over training trials to systematically vary the relative amount of attention that they give to multiple tasks that are performed concurrently. The MUARC research indicated that novice drivers who undertook VPT subsequently performed significantly better than a group of controls in a transfer of training drive in the simulator involving three sub-tasks. The results of a follow-up experiment showed that, in addition to attentional control, the ability to detect, perceive and respond to potential traffic hazards can be enhanced through VPT.

It should be emphasised that the training techniques described above, such as mediated instruction and VPT, have, to date, only been examined in laboratory settings with novice drivers. Hence, although they seem to offer a great deal of promise as a means of modifying behaviour and/or enhancing the cognitive skills of young novice drivers, the long term effects of such techniques in terms of real world safety need to be established. It should be noted, nevertheless, that empirical evaluations of the effectiveness of VPT have revealed training benefits for pilots in the real world (Gopher, 1996).
4.5.3 Methodological and Other Issues

It was difficult to recruit participants from some clusters to take part in the simulator study. As a result, there was a relatively low number of participants in some groups. Only seven participants from Cluster 4 agreed to participate in the study, compared to 11 or 12 from the other Clusters. The extent to which this influenced the results of the study is unclear. However, there would seem to be considerable benefit in extending this research to include more participants to ensure that the results reported here are robust.

Sophisticated driving simulators, such as the one used in this study, are capable of approximating actual road conditions safely. They also offer great flexibility and experimental control in terms of the scenarios that can be presented. There is, however, some loss of generalizability of simulator-based research findings to real world driving. In this regard, recent validation research conducted at MUARC suggests that performance in the driving simulator is a valid predictor of actual on-road driving performance (Fildes et al., in press). However, not all of the aspects of performance studied here were examined in the validation study. Hence, the findings of the present research should, ideally, be validated in the real-world.

It was mentioned above that no evidence was found of a difference in general driving style among the young novice driver subtypes. This result is inconsistent with that reported in Study 1, where the individuals in the two most deviant clusters (Clusters 1 and 5) reported a more risky driving style than those in least deviant cluster (Cluster 4). The reason for these inconsistent results is unclear, although several explanations are possible. First, participants may have altered their driving style in the simulator in an attempt to present themselves in a positive light to the experimenter. Second, driving speed, the measure of overall driving style used in this study, represented only one of nine items used to measure self-reported driving style in Study 1 (e.g. overtaking, lane keeping, risk taking). Given the design of appropriate simulator scenarios, these other aspects of driving style could be examined in future research.

4.5.4 Conclusion

The results of this study indicate that the young novice driver subtypes, identified on the basis of differential levels of driving-related attitudes and behaviours, general personality traits, and hostility and aggression, also differ in terms of particular aspects of driving performance. Most of the significant differences that emerged from the study were related to the performance of the two most deviant or highest risk subtypes (Clusters 1 and 5). The novice drivers in Cluster 1 displayed lack of precautionary behaviour around some potential traffic hazards, particularly in terms of failing to moderate their driving speed. The individuals in Cluster 5 displayed a lack of caution around a potential hazard that was particularly notable for the need to anticipate a sequence of unfolding events. They were also the least cautious in responding to an emergency situation and had difficulty controlling their attention between competing tasks while driving in high workload situations. Specific training techniques being developed or refined at MUARC and elsewhere to enhance both risk perception (e.g. PC-based mediated instruction, including prediction training) and attentional control (e.g. Variable Priority Training) skill would seem to be particularly appropriate for those individuals in the highest risk or most deviant young novice driver subtypes.
SECTION 5: GENERAL DISCUSSION

5.1 SUMMARY OF RESEARCH FINDINGS

Young novice drivers are overrepresented in road accidents. There is a large literature highlighting factors that contribute to this problem, including aspects of both driving skill and driving style. There is, however, very little empirical evidence to support the effectiveness of various forms of driver training. The general aim of this research was to examine the factors that contribute to safe driving among subtypes of young novice drivers, with implications for tailoring training to the needs of specific groups of drivers. Particular attention was given to (a) the role of personality, motivation and attitude in safe driving, and (b) performance of high risk subtypes in high workload situations requiring the control of attention among multiple tasks and around potential traffic hazards in a driving simulator. Two separate but related studies were undertaken.

The aim of Study 1 was to obtain empirical support for the presence of driver subtypes in the young novice driver population. One hundred and ninety eight participants aged 16 to 19 were recruited from three driver licensing offices in metropolitan Melbourne. They completed an extensive self-report questionnaire. Five novice driver subtypes were identified through cluster analysis of driving-related attitudes and behaviours, general personality traits, and hostility and aggression. Two relatively high risk or deviant subtypes emerged (Clusters 1 and 5), characterised by high levels of driving-related aggression, competitive speed, driving to reduce tension, sensation seeking, assaultiveness and hostility. The individuals in one of those subtypes (Clusters 5) also reported low levels of emotional adjustment and high levels of depression, resentfulness and irritability.

The validity of the cluster solution was confirmed by significant differences on several demographic, attitude and behavioural measures external to the cluster analyses, including self-reported driving style and traffic accident record. For example, the individuals in the two most deviant subtypes (Clusters 1 and 5) reported a more risky driving style and greater tobacco, drug and alcohol use (frequency, quantity and total consumption per month) than those in the least deviant subtype (Cluster 4). The individuals in Cluster 5 also reported the greatest number of citations for moving violations and were the most likely to have been involved in a traffic accident.

The aim of Study 2 was to examine whether or not the novice driver subtypes differed in terms of their simulated driving performance. Risk perception and attentional control were the main aspects of driving performance studied, as they have been identified as sources of individual differences in road accidents and are known to be a significant problem for young novice drivers. Other aspects of driving that were studied included driving style and performance during an emergency situation requiring evasive braking and steering.

The results of Study 2 indicated that the novice driver subtypes differed in terms of their level of driving skill. Differences were observed in the way that the young novice driver subtypes responded to an emergency situation and to several potential traffic hazards in the simulator. Differences were also evident between the subtypes in terms of their ability to control their attention among concurrent tasks while driving in high workload situations.
Most of the significant differences that were found in Study 2 were related to performance decrements of the two most deviant or highest risk young novice driver subtypes (Clusters 1 and 5). For example, the novice drivers in Cluster 1 displayed a lack of precautionary behaviour around some potential traffic hazards, particularly in terms of failing to moderate their driving speed as the hazards were unfolding. In contrast, the individuals in Cluster 5 did not give themselves as much lateral space around a potential traffic hazard that was particularly notable for the need to anticipate a sequence of unfolding events. The individuals in Cluster 5 were also the least safe around the emergency situation that required evasive braking and steering. Furthermore, they performed the worst during the three attentional control drives, suggesting that they have difficulty controlling their attention between competing tasks while driving in high workload situations. These performance decrements may place these individuals at particular risk in high workload situations where several tasks must be performed concurrently, such as maintaining a safe headway and scanning for and responding to traffic hazards. They may also explain, at least in part, the high accident involvement reported by the individuals in Cluster 5 in Study 1.

This research supports the possibility of identifying and matching groups of young novice driver to training or education programs. For example, the individuals in Clusters 1 and 5 seem to have problems in the areas of driving-related aggression and competitive speed, as well as personality and emotional functioning problems, such as depression, hostility and irritability. Interventions such as anger management training may promote a more moderate driving style among those individuals.

The safety of the young novice drivers in Clusters 1 and 5 might be enhanced by particular training techniques. For example, PC-based mediated instruction in risk perception has been effective in enhancing the precautionary behaviour of novice drivers around potential traffic hazards (Regan et al., 1998b). Training that includes predicting unfolding events, using video of actual traffic hazards, has also improved the risk perception skills of novice drivers (McKenna & Crick, 1997) and might be particularly appropriate for the young novice drivers in Cluster 5.

The safety of the novice drivers in Cluster 5 might also be enhanced by training designed to improve the skill of attentional control. Recent research at MUARC has revealed that the attentional control skills of novice drivers can be enhanced using VPT, which involves participants performing two or more tasks concurrently. Across training trials, participants are instructed to systematically vary the relative amount of attention that they give to each task. The research at MUARC has shown that VPT can enhance novice drivers’ attentional control skill and their ability to detect, perceive and respond safely to potential traffic hazards.

5.2 RECOMMENDATIONS

5.2.1 Develop Options To Maximise the Effectiveness of An Integrated Training Product

As noted earlier, the training approaches proposed here, such as PC-based mediated instruction and VPT, have been used successfully with novice drivers in previous simulator research at MUARC and also with pilots in the real world (Gopher, 1996). The TAC, in conjunction with MUARC, is now translating the results of the research into specifications for a CD-ROM based training product that integrates these training approaches.
training product will be produced shortly and evaluated in 1999. A similar product has recently been developed in the U.S.A. (Blank & McCord, 1988).

It is recommended that options be developed in consultation with the key agencies in road safety in Australia for maximising the effectiveness of an integrated training product. It might be possible, for example, to offer all novice drivers an integrated training product, such as a CD-ROM, at a small cost as part of the licensing process. In addition, particular novice driver subtypes could be offered additional training in certain areas, such as VPT, prediction training, or anger management classes (procedures for identifying and tailoring training to the needs of these individuals are discussed below). Such an approach might enhance the benefit provided by a general driver training strategy that uses an integrated training product for all novice drivers.

5.2.2 Develop and Validate a Short Screening Instrument

The identification of novice driver subtypes for training purposes could be based on an assessment of their psychosocial characteristics and/or skill performance. It is recommended that a short instrument for identifying novice driver subtypes be developed and its psychometric properties, such as validity and reliability, be assessed. This instrument might include a questionnaire, laboratory-based tests of risk perception or attentional control, or both. The possibility of utilising existing instruments or technology, such as VicRoads’ hazard perception test, should be explored with the relevant road safety agencies.

5.2.3 Develop Incentive Schemes For Undertaking Tailored Training

Requiring all novice drivers to undertake an assessment for the purpose of receiving tailored training would probably not be practical or morally justifiable (you cannot “punish” people for their particular characteristics or for something that they have not yet done, such as cause harm on the roads). In other words, undertaking such an assessment and tailored training would need to occur on a voluntary basis. Programs that offer incentives to undertake the assessment and training could be developed in consultation with key stakeholders in road safety in Australia. These incentives might be consistent with approaches that have been used previously, such as reduced insurance premiums for those novice drivers who undertake the training. It might also be possible to develop other incentives or programs, such as a reduction in the cost of obtaining a probationary licence for those novice drivers who undertake the assessment and training.

It is recommended that the feasibility of particular incentive programs be examined. Malfetti (1993), for example, suggested that automobile insurance companies represent a powerful source for improving the safety of young novice drivers. He proposed a pilot program be undertaken and evaluated consisting of four main components:

1. Those young drivers participating in the program would be required to pass a rigorous driver education course.

2. The insurance company and the young diver would sign a contract. The contract would stipulate what the young driver would do in terms of safety, such as not willfully commit any moving violations or be in any at-fault accidents, never drive after drinking, always wear a seatbelt, and so on.
3. The company would charge the young driver the regular beginner’s insurance premium. However, after a specified period, the company would refund the difference between the beginner’s premium and that charged to an older driver, assuming that the young driver had met the terms of the contract.

4. If the young driver violated the contract, he or she would forfeit the refund and return to the company’s regular insurance rates for beginner drivers.

This type of program would seem to offer several potential benefits to young drivers and thus could act as a motivator for safety. For example, it clearly illustrates the rewards for safe driving and the penalties for unsafe driving. It also makes insurance policies and premiums more personal for young drivers. This is likely to foster greater commitment in terms of safety. Indeed, the psychological literature (e.g. Rotter, 1966) suggests that when people perceive that they have control over events in their lives, they are likely to behave favourably towards them.

5.2.4 Target High Risk Driver Subtypes Identified By Their Poor Driving Record

The results of this research suggest that certain novice driver subtypes are particularly at risk to harm themselves and other road users. Although mandatory assessment and tailored training for all novice drivers is probably not possible, it may be feasible to develop such a program for “high risk” drivers. The possibility should be explored, for example, that young novice drivers with a poor driving record (e.g., license suspension for speeding, drink-driving, or other traffic violations) be required to undertake particular training programs based on an assessment of their particular training needs. Furthermore, in line with the recommendation made above, insurance companies might be able to offer incentives for drivers with a poor driving record (e.g. multiple claims for vehicle repairs) who undertake an assessment and tailored training program.

5.2.5 Apply the Lessons Learned in Other Public Health Campaigns

Barokas (1995) reviewed the factors that have been successful in promoting changes in societal norms and behaviours in areas such as cigarette smoking and AIDS prevention. The seven most important factors she identified were:

1. Strengthening and clarifying norms through effective communication strategies, such as media campaigns;
2. Utilising the reach of the media by using a variety of mediums, and include celebrities to disseminate key messages;
3. Sustaining norm development by varying and reiterating the messages for the target group(s);
4. Targeting campaigns to specific behaviours;
5. Developing commitment to the solution by suggesting everyone is responsible for its achievement;
6. Correcting any misperceptions and highlighting particular risky behaviours; and
7. Advocating for restrictive legislation, increased taxation and rigorous enforcement of laws.
If applied to the young novice driver problem, the lessons learned from these campaigns might promote safer driving practices among young novice drivers generally and high risk subtypes particularly. Hence, it is recommended that further research be undertaken to establish the feasibility of including at least some of these factors (e.g. correcting misperceptions about risky behaviours) in an integrated training product for novice drivers, such as a the CD-ROM training products described above. Alternatively, new resources could be developed (e.g. videos, booklets) with the aim of developing safer norms and behaviours among novice drivers. These resources could be disseminated through driver training schools or instructors, or as part of the licensing process. They could also be included in any tailored training product for high risk novice driver subtypes, such as anger management classes.

5.2.6 Evaluate the Effectiveness of Matching Training to the Needs of the Driver

The potential unreliable measurement of personality and attitude variables means that any effort to identify high risk subtypes for training purposes could lead to a number of “non-problem” drivers being incorrectly identified (i.e. a high false alarm rate). From a safety point-of-view, this may not be a problem, as training designed for high risk driver subtypes might have only beneficial effects for other novice drivers. It may, however, reduce any cost-benefit that might stem from matching training to the needs of the driver. Clearly, evaluations are needed of the effectiveness of matching drivers to particular training programs, including the derivation of their benefit-to-cost ratios.

5.2.7 Determine the Training Needs of Novice Drivers - Driving Skill Versus Driving Style

It was noted earlier that the young novice driver problem is often considered to stem from two main factors: age and in experience. In other words, both a risky driving style (e.g. speeding, tailgating) and particular skill decrements (e.g. risk perception and attentional control) play an important role in young novice drivers’ overrepresentation in crashes. Several authors have argued that driving should not be conceptualised as simply involving a forced-paced task where the driver responds to the traffic environment (e.g. Näätänen & Summala, 1976; Fuller, 1984). Rather, as driving is essentially a self-paced activity, for most of the time it is the driver’s own decisions and actions that determine the difficulty of his or her task. In this view, people’s driving styles are at least as important, if not more so, than are limitations of their driving skill in contributing to their safety. Researchers have not, however, established the relative effects of these aspects of driving on novice driver safety. Moreover, the nature of the relationship between these variables (e.g. moderating, mediating or direct effects) and the pathways by which they influence safety has not been well-established.

This issue has important implications for the training of novice drivers. In particular, it is unclear the extent to which training should focus on driving skill, driving style, or both. The individuals in Clusters 5, for example, have problems in areas like driving-related aggression and competitive speed and thus would probably be safer drivers after undertaking a training program that promotes a more moderate driving style. They might also be safer drivers after undertaking training that enhances their attentional control and risk perception skills. However, the extent to which training should address these motivation and skill issues is unclear and requires investigation for all novice drivers as well as for specific novice driver subtypes.
5.3 CONCLUDING COMMENTS

The general aim of this research was to examine the factors that contribute to safe driving among subtypes of young novice drivers, with implications for matching training programs to the needs of specific driver subtypes. Five distinct subtypes of young novice drivers were identified, based on differential levels of general personality and specific driving-related attitude and behaviour measures. Differences were also observed between the subtypes in terms of several demographic, attitude and behavioural variables, including self-reported driving style and traffic accident involvement. The subtypes also differed in terms of their level of risk perception and attentional control skill. These results are consistent with the concept of matching training to specific driver subtypes, with several training techniques seeming particularly appropriate for the highest risk or most deviant young novice driver subtypes.
REFERENCES


enhancing attentional control in Learner and Probationary drivers. Prepared for the TAC, MUARC.


DRIVER SURVEY

Introduction: We need to start by asking you some questions about your personal details. Please answer all questions honestly. Remember that any information you provide will remain strictly confidential and will only be used for this study. If you feel that a question is inappropriate or too personal, please go to the next question. We are grateful that you have taken the time to complete this survey.

1. Age: ............... 

1. Sex (place a tick (✓) in the appropriate box):
   - Male
   - Female

2. Occupation: ............................................................

3. Marital status
   - Single (never married)
   - Married
   - Widowed
   - Defacto
   - Separated or divorced
   - Other: .........................

4. What type of licence test did you undertake today?
   - Learner Permit (L-Plate)
   - Probationary (P-Plate)

5. What is the highest level of education that you have completed
   - Some secondary or high school
   - Some University
   - Year 12 (VCE)
   - University degree
   - Other: .........................

Please turn to the next page
**INSTRUCTIONS:** Read each item below carefully. Circle the True (T) next to the item if its is generally characteristic or true of your beliefs or behaviour; circle the False (F) next to the item if the statement is not characteristic or true of your beliefs or behaviour.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I am always willing to admit when I make a mistake</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>2.</td>
<td>If somebody hits me first, I let them have it</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>3.</td>
<td>I am always patient with others</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>4.</td>
<td>Without the right luck, one cannot be an effective leader</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>5.</td>
<td>If someone doesn’t treat me right, I don’t let it annoy me</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>6.</td>
<td>I would call myself a tense or “highly-strung” person</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>7.</td>
<td>There have been occasions when I felt like smashing things</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>8.</td>
<td>I sometimes pout when I don’t get my own way</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>9.</td>
<td>Since the age of ten, I have never had a temper tantrum</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>10.</td>
<td>I sometimes gossip about people I don’t like</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>11.</td>
<td>Sometimes I feel that I don’t have enough control over the direction that my life is taking</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>12.</td>
<td>There is really no such a thing as “luck”</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>13.</td>
<td>When I am angry, I sometimes sulk</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>14.</td>
<td>I lose my temper easily but get over it quickly</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>15.</td>
<td>At times, I feel I get a raw deal out of life</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>16.</td>
<td>Even when my anger is aroused, I don’t use “strong language” or swear</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>17.</td>
<td>I would say that I am fairly self-confident</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>18.</td>
<td>I never play practical jokes</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>19.</td>
<td>I tend to bottle-up my emotions rather than make a scene</td>
<td>T</td>
<td>F</td>
</tr>
</tbody>
</table>

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<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20. I feel best after a couple of drinks</td>
<td>T  F</td>
</tr>
<tr>
<td>21. Living is a wonderful adventure for me</td>
<td>T  F</td>
</tr>
<tr>
<td>22. When I get mad, I say nasty things</td>
<td>T  F</td>
</tr>
<tr>
<td>23. I am often troubled with feelings of inferiority</td>
<td>T  F</td>
</tr>
<tr>
<td>24. I don’t seem to get what’s coming to me</td>
<td>T  F</td>
</tr>
<tr>
<td>25. I avoid arguing over prices with clerks and sales-people</td>
<td>T  F</td>
</tr>
<tr>
<td>26. I feel blue and depressed</td>
<td>T  F</td>
</tr>
<tr>
<td>27. I have known people who have pushed me so far that we have come to blows</td>
<td>T  F</td>
</tr>
<tr>
<td>28. I often have a hard time saying “No”</td>
<td>T  F</td>
</tr>
<tr>
<td>29. Other people always seem to get the breaks</td>
<td>T  F</td>
</tr>
<tr>
<td>30. I often make threats I don’t really mean to carry out</td>
<td>T  F</td>
</tr>
<tr>
<td>31. I will hesitate to make phone calls to business establishments and institutions</td>
<td>T  F</td>
</tr>
<tr>
<td>32. I get into fights about as often as other people</td>
<td>T  F</td>
</tr>
<tr>
<td>33. I am quick to express my opinion</td>
<td>T  F</td>
</tr>
<tr>
<td>34. I could not put someone in their place even if they needed it</td>
<td>T  F</td>
</tr>
<tr>
<td>35. The future looks so gloomy that I wonder if I should go on</td>
<td>T  F</td>
</tr>
<tr>
<td>36. If I have to resort to physical violence to defend my rights, I will</td>
<td>T  F</td>
</tr>
<tr>
<td>37. Most misfortunes result from lack of ability, ignorance, laziness, or all three</td>
<td>T  F</td>
</tr>
<tr>
<td>38. I never get mad enough to throw things</td>
<td>T  F</td>
</tr>
<tr>
<td>39. I don’t know any people that I downright hate</td>
<td>T  F</td>
</tr>
<tr>
<td>40. Once in awhile I cannot control my urge to harm others</td>
<td>T  F</td>
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<tr>
<td></td>
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<td>---</td>
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</tr>
<tr>
<td>41. Whoever insults me or my family is asking for a fight</td>
<td>T F</td>
</tr>
<tr>
<td>42. Although I don't show it, I am sometimes filled with jealousy</td>
<td>T F</td>
</tr>
<tr>
<td>43. I'll try anything once</td>
<td>T F</td>
</tr>
<tr>
<td>44. Almost every week I see someone I dislike</td>
<td>T F</td>
</tr>
<tr>
<td>45. During an argument, I am sometimes afraid that I will get so upset that I begin to shake all over</td>
<td>T F</td>
</tr>
<tr>
<td>46. My future looks hopeful and promising</td>
<td>T F</td>
</tr>
<tr>
<td>47. Who gets to be boss often depends on who was lucky enough to be in the right place first</td>
<td>T F</td>
</tr>
<tr>
<td>48. There are times when I just can't say anything</td>
<td>T F</td>
</tr>
<tr>
<td>49. I can remember being so angry that I picked up the nearest thing and broke it</td>
<td>T F</td>
</tr>
<tr>
<td>50. I often wish that I were never born</td>
<td>T F</td>
</tr>
<tr>
<td>51. When I really lose my temper, I am capable of slapping someone</td>
<td>T F</td>
</tr>
<tr>
<td>52. I can't help being a little rude to people I don't like</td>
<td>T F</td>
</tr>
<tr>
<td>53. I never resent being asked to return a favour</td>
<td>T F</td>
</tr>
<tr>
<td>54. I would rather concede a point than get into an argument</td>
<td>T F</td>
</tr>
<tr>
<td>55. When I get up in the morning, I expect to have an interesting day</td>
<td>T F</td>
</tr>
<tr>
<td>56. When people yell at me, I yell back</td>
<td>T F</td>
</tr>
<tr>
<td>57. Many times we might just as well decide what to do by flipping a coin</td>
<td>T F</td>
</tr>
<tr>
<td>58. I sometimes carry a chip on my shoulder</td>
<td>T F</td>
</tr>
<tr>
<td>59. I feel that there is more disappointment in life than satisfaction</td>
<td>T F</td>
</tr>
<tr>
<td>60. I can think of no good reason for ever hitting anyone</td>
<td>T F</td>
</tr>
<tr>
<td>61. I have never deliberately said something that hurt someone's feelings</td>
<td>T F</td>
</tr>
</tbody>
</table>
62. Routine jobs really bug me
   T  F

63. It is impossible for me to believe that chance or luck plays an important role in my life
   T  F

64. It makes my blood boil to have somebody make fun of me
   T  F

65. When arguing, I tend to raise my voice
   T  F

66. I am careful to avoid hurting other people's feelings even when I feel I have been injured or hurt
   T  F

67. I like to gossip at times
   T  F

68. I sometimes like to do things that are a little frightening
   T  F

69. When I am mad, I sometimes slam doors
   T  F

70. I generally cover up my poor opinions of others
   T  F

71. People's misfortunes result from mistakes they make
   T  F

72. I sometimes try to get even rather than forgive and forget
   T  F

73. I generally seek new and exciting experiences and sensations
   T  F

74. Lately, I have been kind of grouchy
   T  F

75. I feel that life is drudgery and boredom
   T  F

76. When I disapprove of my friend's behaviour, I let them know it
   T  F

77. I often don't know what to say to attractive persons of the opposite sex
   T  F

78. I can't help getting into arguments when people disagree with me
   T  F

79. My feelings are rather easily hurt
   T  F

80. People who continually pester you are asking for a punch in the nose
   T  F

81. I have hesitated to make or accept dates because of "shyness"
   T  F

82. There have been occasions when I took advantage of someone
   T  F
83. I am irritated a great deal more than people are aware  
84. I sometimes do “crazy” things just to be different  
85. I am generally a happy person  
86. I always practice what I preach  
87. It is not always wise to plan too far ahead, because many things turn out to be a matter of good or bad fortune anyway  
88. At times I have really insisted on having things my own way  
89. If I let people see the way I feel, I’d be considered a hard person to get along with  
90. I would call myself a nervous person  
91. I sometimes show my anger by banging on the table  
92. I often feel like a “powder keg” ready to explode  
93. I have never been irked or upset when people expressed ideas very different from my own  
94. I sometimes feel “just miserable” for no good reason  
95. I often like to get “high” (drink liquor or smoke marijuana)  
96. If somebody annoys me, I am apt to tell them what I think of them  
97. When I look back on what’s happened to me, I can’t help feeling mildly resentful  
98. I don’t let a lot of unimportant things irritate me  
99. I like wild “uninhibited” parties  
100. I often find myself disagreeing with people  
101. I seldom strike back, even if someone hits me first
102. Things have worked out well for me                      T       F
103. Sometimes people bother me just by being around       T       F
104. Becoming a success is a matter of hard work; luck has little or nothing to do with it T       F
105. I demand that people respect my rights                T       F
INSTRUCTIONS: Circle the True (T) next to the item if its is generally characteristic or true of your opinion about driving or of your behaviour as a driver; circle the False (F) next to the item if the statement is not characteristic or true of your opinion about driving or your behaviour as a driver.

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Skill in handling a car is less important to safety than an attitude of carefulness</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>2. I often make rude signs at other motorists who annoy me</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>3. I find driving a form of relaxation which I use when I feel tense</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>4. It's fun to manoeuvre and weave through traffic</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>5. I lose my temper when another driver does something stupid</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>6. During the past few months I have gone driving to “blow off steam”</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>7. I am not easily provoked or angered when driving</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>8. It's fun to outwit other drivers</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>9. I have given chase to a driver who has annoyed me</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>10. I find it difficult to control my temper when driving</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>11. Taking chances while driving is just asking for trouble</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>12. I have been known to flash my car lights at others in anger</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>13. When driving on a highway I normally get passed by more cars than I pass myself</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>14. Driving helps me forget about pressures</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>15. Most drivers who have accidents are just unlucky</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>16. I like to pass other cars on the highway even if I’m not in a hurry</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>17. I swear out aloud at other drivers</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>18. The driver who breaks the law should be held responsible for an accident in which they are involved</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>19. I use my horn a great deal</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>20. When I am feeling annoyed or angry I tend to drive more carefully because I am afraid of losing control of the car</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>21. It’s not reasonable to blame “conditions” for accidents since it’s up to the driver to allow for them</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>22. If a driver follows too closely, I might hit the brakes to teach him or her a lesson</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>23. Modern highways are so good you don’t have to worry about the conditions of the road when you drive</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>24. It’s fun to beat other drivers when taking off from traffic lights</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>25. I get annoyed if the traffic lights change to red as I approach them</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>26. When I am angry or stressed I make a conscious effort to make sure I drive safely</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>27. Driving at high speeds is exciting</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>28. I swear under my breath at other drivers</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>29. I generally become more cautious while driving when I am upset</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>30. If the driver behind me has his lights shining in my mirror, I pay him back in some way</td>
<td>T  F</td>
<td></td>
</tr>
<tr>
<td>31. When I am upset, driving helps soothe my nerves</td>
<td>T  F</td>
<td></td>
</tr>
</tbody>
</table>
INSTRUCTIONS: For the questions below, circle the number in the column that best describes how you typically drive. If you have limited driving experience on which to base your answers, then circle the number in the column that best describes how you THINK you will drive with more experience.

<table>
<thead>
<tr>
<th></th>
<th>Not at all some of most of all the time</th>
<th>the time</th>
<th>the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I take risks</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. I race other cars</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. I cut in and out of the traffic</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. I pass other cars</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. I get angry with slow drivers</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. I like to drive fast</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. I obey the road rules</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. I swear at other drivers</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. I exceed the speed limit</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

INSTRUCTIONS: For the questions below, circle the number that best describes your attitude towards the statement.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The TAC advertisements on television should continue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. The level of drink-driving enforcement (e.g. &quot;booze buses&quot;) should continue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. The Police speed camera program in Victoria should continue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. People who are arrested for drink-driving and loose their licence are &quot;getting what they deserve&quot;</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. The safety of young drivers on our roads is a concern for society</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. The training that drivers undergo to obtain their &quot;P-Plates&quot; is adequate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
1. In how many traffic accidents have you been involved while driving .......... 

2. Have you been responsible, to any degree, for a traffic accident while you were driving?

☐ YES ☐ NO

If yes, how many: ..................

3. How many fines have you received as a driver (excluding parking fines) ........

4. Do you drink alcohol

☐ YES ☐ NO (if No, go to Question 7)

5. How often do you have a drink containing alcohol?

Please answer by placing a tick (√) in the box that most applies to you.

☐ Less than once a year or never ☐ Three or four times a week
☐ Less than once a month but at least once a year ☐ Nearly every day
☐ About once a month ☐ Once a day
☐ Two or three times a month ☐ Three or more times a day
☐ Once or twice a week ☐ Three or more times a day
6. On a typical occasion when you drink alcohol, how many standard drinks of alcohol do you have? (a standard drink is a “pot” of beer, a nip (30 ml) of spirits or two-thirds (120 ml) of a glass of wine)

☐ I never drink alcohol
☐ 1 or 2 drinks
☐ 3 or 4 drinks
☐ 5 or 6 drinks
☐ 7 to 9 drinks
☐ 10 or more drinks

7. Have you, at any time in your life, smoked tobacco regularly (cigarettes, cigars or pipes)?

☐ YES
☐ NO (if No, go to Question 9)

8. Do you currently smoke tobacco regularly?

☐ YES
☐ NO (if No, go to Question 9)

9. Do you use prohibited drugs (e.g. marijuana)?

☐ YES
☐ NO (if No, go to Question 11)

10. How often do you use prohibited drugs (e.g. marijuana)?

☐ Less than once a year or never
☐ Less than once a month but at least once a year
☐ About once a month
☐ Two or three times a month
☐ Once or twice a week
☐ Three or four times a week
☐ Nearly every day
☐ Once a day
☐ Three or more times a day
☐ Three or more times a day
APPENDIX B: RATE OF PARTICIPATION IN STUDY 2
#### Table C.1  Summary of participation rates in Study 2

<table>
<thead>
<tr>
<th>Cluster</th>
<th>No. available</th>
<th>Completed session</th>
<th>Started but did not complete session</th>
<th>Declined to take part</th>
<th>Booked in but did not arrive*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>22</td>
<td>12</td>
<td>nil</td>
<td>7</td>
<td>nil</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>45</td>
<td>12</td>
<td>1</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>44</td>
<td>12</td>
<td>nil</td>
<td>5</td>
<td>nil</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>18</td>
<td>7</td>
<td>nil</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>16</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

*These people were given at least 2 follow calls. They then either decided not to take part in the study or rescheduled and failed to arrive again.
APPENDIX C: ILLUSTRATIONS OF POTENTIAL HAZARDS (DCAs) IN THE RISK PERCEPTION DRIVES IN STUDY 2
APPENDIX D: SUMMARY OF PERFORMANCE MEASURES AND ANOVA RESULTS FROM DRIVE 1
Table D.1  Summary of performance measures (mean score) and ANOVA results for Drive 1

<table>
<thead>
<tr>
<th></th>
<th>Young Novice Driver Cluster</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Driving Style</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average speed</td>
<td>68.2</td>
<td>63.6</td>
</tr>
<tr>
<td>SD speed</td>
<td>5.8</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>Driving Skill</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average lateral position</td>
<td>13.2</td>
<td>13.2</td>
</tr>
<tr>
<td>SD lateral position</td>
<td>0.97</td>
<td>0.35</td>
</tr>
</tbody>
</table>

* statistically significant at p < .05

Summary of ANOVA results

The ANOVA revealed that there were no statistically significant differences between the young novice driver clusters for the measures of driving style. However, the clusters differed significantly in terms of standard deviation of lateral position (a measure of variability in driving performance across the drive). Post-hoc Tukey tests were undertaken to determine which of the five novice driver clusters were different from each other in terms of standard deviation of lateral position. Those tests revealed a greater variation in driving performance for those in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) compared to those in Cluster 5 (similar to Cluster 1, but also depressed and irritable).
APPENDIX E: SUMMARY OF PERFORMANCE MEASURES AND ANOVA RESULTS FROM THE ATTENTIONAL CONTROL DRIVES
### Table E.1  Mean performance measures during the attentional control drives

<table>
<thead>
<tr>
<th>Drive</th>
<th>Young Novice Driver Cluster</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Drive 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driving performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum acceleration</td>
<td>1.18</td>
<td>1.03</td>
<td>0.96</td>
<td>1.10</td>
<td>1.05</td>
</tr>
<tr>
<td>Time to desired speed</td>
<td>8.74</td>
<td>9.66</td>
<td>9.76</td>
<td>9.76</td>
<td>8.84</td>
</tr>
<tr>
<td>Time to initiate speed change</td>
<td>3.98</td>
<td>3.87</td>
<td>4.88</td>
<td>3.26</td>
<td>3.21</td>
</tr>
<tr>
<td>Standard deviation of speed</td>
<td>4.60</td>
<td>4.87</td>
<td>5.00</td>
<td>5.98</td>
<td>5.28</td>
</tr>
<tr>
<td><strong>Numeric Calculation task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% correct responses</td>
<td>88.6%</td>
<td>83.3%</td>
<td>89.6%</td>
<td>75.0%</td>
<td>74.0%</td>
</tr>
<tr>
<td>Response time</td>
<td>4.70</td>
<td>4.12</td>
<td>3.76</td>
<td>4.87</td>
<td>6.01</td>
</tr>
<tr>
<td>Drive 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driving performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum acceleration</td>
<td>1.06</td>
<td>0.87</td>
<td>1.02</td>
<td>1.19</td>
<td>1.05</td>
</tr>
<tr>
<td>Time to desired speed</td>
<td>8.01</td>
<td>7.23</td>
<td>8.06</td>
<td>6.89</td>
<td>7.90</td>
</tr>
<tr>
<td>Time to initiate speed change</td>
<td>3.74</td>
<td>3.96</td>
<td>3.89</td>
<td>3.29</td>
<td>3.62</td>
</tr>
<tr>
<td>Standard deviation of speed</td>
<td>4.41</td>
<td>4.30</td>
<td>4.26</td>
<td>4.72</td>
<td>5.11</td>
</tr>
<tr>
<td><strong>Numeric Calculation task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% correct responses</td>
<td>93.1%</td>
<td>95.5%</td>
<td>77.1%</td>
<td>91.7%</td>
<td>66.6%</td>
</tr>
<tr>
<td>Response time</td>
<td>4.00</td>
<td>4.19</td>
<td>3.36</td>
<td>4.01</td>
<td>4.88</td>
</tr>
<tr>
<td>Drive 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driving performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum acceleration</td>
<td>1.03</td>
<td>0.99</td>
<td>0.91</td>
<td>0.99</td>
<td>0.79</td>
</tr>
<tr>
<td>Time to desired speed</td>
<td>7.08</td>
<td>6.98</td>
<td>6.82</td>
<td>6.55</td>
<td>6.54</td>
</tr>
<tr>
<td>Time to initiate speed change</td>
<td>4.29</td>
<td>3.52</td>
<td>3.79</td>
<td>3.04</td>
<td>3.65</td>
</tr>
<tr>
<td>Standard deviation of speed</td>
<td>4.73</td>
<td>5.20</td>
<td>4.41</td>
<td>4.91</td>
<td>4.44</td>
</tr>
<tr>
<td><strong>Numeric Calculation task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% correct responses</td>
<td>81.8%</td>
<td>88.6%</td>
<td>93.8%</td>
<td>70.8%</td>
<td>74.1%</td>
</tr>
<tr>
<td>Response time</td>
<td>5.34</td>
<td>5.57</td>
<td>4.24</td>
<td>5.26</td>
<td>7.22</td>
</tr>
</tbody>
</table>

### Table E.2  Summary of ANOVA results for the attentional control drives

<table>
<thead>
<tr>
<th></th>
<th>Main effect of cluster</th>
<th>Main effect of drive</th>
<th>Cluster × Drive interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>p</td>
<td>F</td>
</tr>
<tr>
<td><strong>Driving Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. acceleration</td>
<td>0.8</td>
<td>.537</td>
<td>4.2</td>
</tr>
<tr>
<td>Time to desired speed</td>
<td>0.1</td>
<td>.971</td>
<td>16.1</td>
</tr>
<tr>
<td>RT to speed change</td>
<td>0.8</td>
<td>.526</td>
<td>0.2</td>
</tr>
<tr>
<td>SD speed</td>
<td>1.0</td>
<td>.394</td>
<td>3.9</td>
</tr>
<tr>
<td><strong>Numeric task</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% correct responses</td>
<td>3.3</td>
<td>.019</td>
<td>0.4</td>
</tr>
<tr>
<td>Response time</td>
<td>2.3</td>
<td>.079</td>
<td>20.6</td>
</tr>
</tbody>
</table>
Summary of ANOVA Results

In terms of driving performance in response to the speed signs, the main effect of cluster was not significant for each of the measures (see Table E.2). In other words, no evidence was found of a difference in driving performance between the clusters. A significant main effect of cluster was found, however, for the proportion of correct answers to the numeric calculation task. Scheffe tests revealed that participants in Cluster 5 displayed a lower proportion of correct responses than those in Cluster 1, 2 and 3, regardless of which of the three attentional control drives they were undertaking. There was also a trend towards a main effect of cluster for time to respond to the numeric calculation task (p = 0.079). The trend was towards participants in Cluster 5 taking longer to respond than those in the other clusters.

The main effect of drive was significant for maximum acceleration, time to reach desired speed and standard deviation of speed (see Table E.1). Regardless of cluster membership, participants improved with practice. In particular, both the time it took them to reach the desired speed and the variability in their driving speed decreased across the drives (see Table E.1). Their maximum acceleration decreased across the drives, indicating a smoother driving performance with practice.
APPENDIX F: ANOVA RESULTS FROM THE RISK PERCEPTION DRIVES
Table F.1  Summary of ANOVA results for speed and lateral position around the DCAs in the two risk perception drives.

<table>
<thead>
<tr>
<th>Drive/Measure</th>
<th>Main effect of cluster</th>
<th>Main effect of time</th>
<th>Cluster × Time interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCA 130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>0.6  .675</td>
<td>32.1  .000</td>
<td>1.6  .000</td>
</tr>
<tr>
<td>Speed</td>
<td>1.9  .127</td>
<td>71.8  .000</td>
<td>1.0  .374</td>
</tr>
<tr>
<td>DCA 111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>1.4  .245</td>
<td>31.6  .000</td>
<td>0.6  1.00</td>
</tr>
<tr>
<td>Speed</td>
<td>2.2  .080</td>
<td>9.2   .000</td>
<td>2.0  .000</td>
</tr>
<tr>
<td>DCA 110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>1.1  .386</td>
<td>127.4 .000</td>
<td>1.2  .157</td>
</tr>
<tr>
<td>Speed</td>
<td>2.4  .062</td>
<td>14.7  .000</td>
<td>1.9  .000</td>
</tr>
<tr>
<td>Drive 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCA 121</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>2.1  .094</td>
<td>172.3 .000</td>
<td>1.0  .473</td>
</tr>
<tr>
<td>Speed</td>
<td>1.5  .229</td>
<td>1.53  .023</td>
<td>0.7  .999</td>
</tr>
<tr>
<td>DCA 102</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>1.7  .172</td>
<td>12.0  .000</td>
<td>2.1  .000</td>
</tr>
<tr>
<td>Speed</td>
<td>0.8  .527</td>
<td>2.2   .002</td>
<td>0.8  .855</td>
</tr>
<tr>
<td>DCA 134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral position</td>
<td>2.4  .065</td>
<td>151.2 .000</td>
<td>1.8  .000</td>
</tr>
<tr>
<td>Speed</td>
<td>2.5  .053</td>
<td>4.54  .000</td>
<td>1.9  .000</td>
</tr>
<tr>
<td>Button Press Task</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>1.6  .209</td>
<td>2.3   .090</td>
<td>0.5  .738</td>
</tr>
</tbody>
</table>

Summary of ANOVA Results

For both risk perception drives, the main effect of time was significant for all DCAs when both speed and lateral position were considered (see Table F.1). These results suggest that, regardless of cluster membership, participants altered their lateral position and speed throughout the potential DCA (see Figures 4.1 to 4.5, pages 30-32, and Appendix G and H). For some DCAs, however, a significant time × cluster interaction was found, indicating that the clusters differentially responded to the potential hazards over time. In such cases, the interaction should be interpreted, rather than the main effects. The significant interactions are considered in the next section.
**Differential Performance Across Clusters: Significant Time × Cluster Interactions**

**DCA 130 (vehicle in front slows without brake lights activated).** Simple effects tests were undertaken to compare the cluster on lateral position 100m before and 200m after the car in front began to slow (see Figure 4.1, page 30). The effect was not significant 200m after the DCA \((p = .646)\) and approached significance 100m before the DCA \((p = .077)\). The trend was towards participants in Cluster 3 (moderate personality functioning and driving-related attitudes) being positioned further to the right than those in Cluster 1 (high levels of driving-related aggression, competitive speed, assertiveness, etc) 100m before the DCA.

**DCA 110 (other vehicle approaches intersection from the left, as though it may not stop).** Simple effect tests were undertaken to compare the cluster on speed 50m before and 30m after the trigger point, as well as 50m after the potential point of collision (see Figure 4.2, page, 30) The only significant effect was at 30m after the trigger \((p = .047)\). Scheffe’ tests failed to reveal any statistically significant differences between the Clusters, although there was a trend towards Cluster 1 travelling faster than Cluster 2. Simple effects examining the pattern of speed across time for each cluster separately were also undertaken and were significant for Clusters 2, 3 and 5, but not for Clusters 1 and 4. In other words, participants in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) and 4 (least deviant group) did not significantly alter their speed throughout the DCA.

**DCA 111 (other vehicle approaches intersection from the right, as though it may not stop).** Simple effects were undertaken to compare the cluster on speed 50m before and after the trigger point and at the potential point of collision (see Figure 4.3, page 31). The effect was not significant 50m after the trigger point \((p = .247)\), approached significance 50m before the trigger point \((p = .067)\) and was significant at the potential point of collision \((p = .031)\). Scheffé tests revealed that at the potential point of collision, participants in Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) were travelling significantly faster than those in Cluster 5 (similar to Cluster 1, but also depressed, resentful and irritable).

**DCA 102 (adult pedestrian on left curb, child pedestrian on centre median).** Simple effects tests were undertaken to compare the cluster on lateral position 100m before and after the pedestrians and at the point equal with the pedestrians (see Figure 4.4, page 31). None of the effects were statistically significant \((p > .097)\). Simple effect tests were also undertaken to examining the pattern of lateral position across time for each cluster separately. These tests were significant for all clusters, except Cluster 1. In other words, Cluster 1 (high levels of driving-related aggression, competitive speed, sensation seeking, etc) was the only group not to significantly alter their lateral position throughout the DCA.

**DCA 134 (other vehicle in left lane approaching a parked truck, raising possibility it might merge into subject’s lane).** Simple effect tests were undertaken to compare the clusters on lateral position 50m before and 90m and 220m after the trigger, as well as 50m after the parked truck (see Figure 4.5, page 32). The only significant effect was at 220m after the trigger point \((p = .004)\). Scheffé contrasts comparing each of the clusters revealed that Cluster 5 (high levels of driving-related aggression, competitive speed, sensation seeking, depression, irritability) was travelling further to the left than Cluster 3 (moderate on all personality and driving-related measures). Simple effects to examine the pattern of results across time for each cluster separately were also undertaken for speed. The only significant
effect was for Cluster 2 (p < .001). In other words, only participants in Cluster 2 (moderate on the driving-related measures, but most inhibited while driving and depressed, irritable and resentful) altered their speed significantly throughout the DCA (see Figure 4.5, page 32).
APPENDIX G: ANOVA RESULTS FROM THE EMERGENCY DRIVE
Summary of ANOVA Results

For lateral position around the emergency situation, the main effect of time was significant. Participants, regardless of cluster membership, altered their lateral position throughout the DCA (see Figure 1.1, Appendix J).

In terms of speed, a significant Cluster x Time interaction was found. A simple effects test was undertaken to compare the young novice driver clusters at the point of potential collision (i.e. the driveway) and was statistically significant \( (p = .046) \). Scheffé tests revealed that participants in Cluster 5 (high levels of driving-related aggression, competitive speed, sensation seeking, depression, resentment and irritability) were travelling faster than those in Cluster 4 (the least deviant group) as they passed the potential point of collision (see Figure 4.6, page 32).
APPENDIX H: SPEED AND LATERAL POSITION PROFILES DURING THE FIRST RISK PERCEPTION DRIVE
Figure H.1  Lateral position profile for the entire first risk perception drive (smaller values indicate driving further to the right).
Figure H.2  Speed profile for the entire first risk perception drive
Figure H.4  Lateral position profile around DCA 111 (smaller values indicate driving further to the right)
Figure H.5  Lateral position profile around DCA 110 (smaller values indicate driving further to the right)
APPENDIX I: SPEED AND LATERAL POSITION PROFILES DURING THE SECOND *RISK PERCEPTION* DRIVE
Figure 1.1 Lateral position profile for the entire second risk perception drive (smaller values indicate driving further to the right)
Figure L.2

Average Speed (km/h)

Distance From Start of Drive (metres)

Cluster 1
Cluster 2
Cluster 3
Cluster 4
Cluster 5

DCA 121

DCA 122

DCA 134

DCA 135
Figure 1.4  Speed profile for DCA 102
Figure 1.5

Lateral position profile for DCA 121 (smaller values indicate driving further to the right)

Point around DCA (metres)

Average Lateral Position (metres)

- Trigger-50
- Trigger-40
- Trigger-30
- Trigger-20
- Trigger-10
- Trigger
- Trigger+10
- Trigger+20
- Trigger+30
- Trigger+40
- Trigger+50
- Trigger+60
- Trigger+70
- Trigger+80
- Trigger+90
- Trigger+100
- Trigger+110
- Trigger+120
- Trigger+130
- Trigger+140
- Trigger+150
- Trigger+160
- Trigger+170
- Trigger+180
- Trigger+190
- Trigger+200
- Trigger+210
- Trigger+220
- Trigger+230
- Trigger+240
- Trigger+250
- Collision
- Collision+10
- Collision+20
- Collision+30
- Collision+40
- Collision+50
APPENDIX J: LATERAL POSITION PROFILES AROUND THE EMERGENCY SITUATION
Figure J.1 Lateral position profile around the emergency situation (smaller values indicate driving further to the right)