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YOUNG DRIVERS

The Road to Safety

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In Europe, the ECMT helps to create an integrated transport system that is economically efficient and meets environmental and safety standards.

At their meeting in Dublin, Ireland, in May 2006, the Council of Ministers agreed on the creation of an **International Transport Forum**, which would be open to a much wider group of countries. The founding members of the Forum consist of the 50 ECMT Members and Associate Members. Other economies are also expected to participate in future. The yearly Forum will provide Ministers of Transport with an opportunity to discuss topics of global, strategic importance, relating to all modes of transport, and will include the participation of leading non-government actors. The aim of the Forum is to bring high-profile, international attention to the essential role played by transport in the economy and society, while facilitating the integration of transport and logistics into key policy-making processes.

In January 2004, the ECMT and the Organisation for Economic Co-operation and Development (OECD) brought together their transport research capabilities in setting up the **Joint Transport Research Centre**. The Centre conducts co-operative research programmes addressing all modes of inland transport and their intermodal linkages, in support of policy-making processes in member countries.

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FOREWORD

The high levels of crash risk experienced by young drivers – especially young men – are a crucial element of the social and economic costs imposed on societies by road transport. Dealing with this problem should be a fundamental aspect of any initiative to improve traffic safety and reduce crashes and resulting deaths and injuries.

This report puts forward policy-oriented, research-based recommendations for implementing countermeasures to address young driver risk. It also provides a general overview of the problem, and the factors behind it.

Young Drivers: The Road to Safety is the result of two years of work by a group of expert researchers in the field of traffic safety from many Organisation for Economic Co-operation and Development (OECD) and European Conference of Ministers of Transport (ECMT) countries. Working group members came from Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Korea, the Netherlands, Norway, Sweden, the United Kingdom and the United States. An earlier draft of this report was reviewed by international experts in the field of young driver risk. A complete list of participants and reviewers is provided in Annex B.

The Joint OECD/ECMT Transport Research Centre was established in January 2004. It has 50 full member countries and reports directly to Ministers, as well as to the OECD Council. The Mandate of the Centre is as follows:

> *"The Centre shall promote economic development and contribute to structural improvements of OECD and ECMT economies, through co-operative transport research programmes addressing all modes of inland transport and their intermodal linkages in a wider economic, social, environmental and institutional context.*"

This is one of three road safety reports developed concurrently by the Joint OECD/ECMT Transport Research Centre, along with *Achieving Ambitious Road Safety Targets* and *Speed Management.*

Young driver risk is a serious public health issue in all countries, and it is hoped that this report will assist policy-makers, road safety professionals and researchers in addressing this problem, thereby reducing the overall impact of traffic crashes on individuals, families, communities and societies.

ABSTRACT

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Internationally, young drivers are vastly over-represented in road crash fatality and injury statistics. This problem exacts great social and economic costs. Indeed, dealing with the high levels of young driver risk is an essential element of any campaign to reduce the impact of road traffic on human health. However, while the causes of this problem are well known – and are related principally to inexperience, age and gender – a major challenge remains in identifying and implementing appropriate countermeasures.

This research report is the result of two years of effort by a group of experts in the field of road safety. The report focuses on the following issues:

Chapter 1: Analysis of the extent of the problem, and the main factors behind it; as well as consideration of economic impacts.

Chapter 2: An overview of knowledge about why young people experience higher levels of traffic crashes and injuries.

Chapter 3: Assessment of the main countermeasures.

Chapter 4: Potential new countermeasures, including technology applications.

Chapter 5: A policy-oriented, strategic approach to addressing young driver risk.

Chapter 6: Managing the implementation of effective countermeasures, including addressing expected barriers to change.

Chapter 7: The young driver problem in countries at different stages of development and levels of motorisation.

Chapter 8: Conclusions and recommendations of the report.

Annex A: An overview of different countries' driver licensing systems.

Annex B: A listing of participants in the project.

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EXECUTIVE SUMMARY

Globally, 16-24 year-old drivers are greatly over-represented in crash and traffic fatality statistics. They pose a greater risk than other drivers to themselves, their passengers and other road users. This problem imposes great social and economic costs on individuals, families and societies.

This report is the result of two years of collective effort by experts in the field of young driver risk from throughout the countries of the Organisation for Economic Co-operation and Development (OECD) and the European Conference of Ministers of Transport (ECMT). The project focused on the high levels of risk associated with young, novice drivers of passenger vehicles[1], including fundamental causes and concrete options for action. *Young* drivers are defined as those below the age of 25, keeping in mind that the minimum licensing age varies from country to country. However, it should be noted that many of the proposed countermeasures would be relevant for all novice drivers.

The ECMT Ministers have established the target of a 50% reduction in traffic-related deaths in the period 2000-2012. Similar commitments have been made within the European Union and by many national governments. A 2003 United Nations General Assembly Resolution recognised the high cost of traffic crashes on global human health, and resulted in the UN Road Safety Collaboration led by the World Health Organisation (WHO). Addressing the issue of young driver risk – particularly that of young men – will be essential to achieving the goals of these initiatives.

What is the scope and nature of the problem?

Traffic crashes are the single greatest killer of 15-24 year-olds in OECD countries. It is estimated that over 8 500 young drivers of passenger vehicles were killed in OECD countries in 2004.[2] This included almost 4 000 in the US, over 750 in Germany, 645 in France, and over 300 in both Japan and Spain. Within the OECD, young drivers typically represent between 18% and 30% of all killed drivers, although people in the same age group only represent between 9% and 13% of the total populations in their countries. Furthermore, for each young driver killed, more than 1.3 passengers or other road users likely also die in the same crashes, based on findings from the US and the Netherlands. National data from various countries indicate that crashes involving a young driver account for between 20% and 30% of total road traffic fatalities. Clearly, young drivers play a disproportionate role in the overall public health problem of road traffic safety risk.

While data are not generally available for countries that are not part of the OECD, it must be assumed that their young driver situations are similar. This would include some ECMT countries where overall road safety levels are lower than those of most OECD members. Worldwide, WHO data show that, in 2002, traffic crashes were the second greatest cause of death for persons aged 15-29, and the greatest for men in the same age group.

Death rates for young, novice drivers have decreased in many countries in recent decades. However, these reductions have mirrored overall improvements in road safety, and death rates for 18-24 year-old drivers typically remain more than double those of older drivers. In other words, despite overall improvements in road safety, the specific problem of young driver risk is not being

resolved. However, in general, the situation for young, novice drivers is better in countries with higher overall standards of driver safety.

Death rates for young men are consistently much higher than those of their female counterparts, often by a factor of three or more. Large differences remain after taking into consideration the fact that men drive more than women. Data from the Netherlands, Sweden and the UK have shown that young male drivers' relative risk, compared to that of older drivers, has increased considerably over the last decade. Whether adjusted for exposure or not, the high crash fatality and injury rates of young, male novice drivers represent a major public health issue.

Young drivers have high numbers of crashes when driving at night and/or on weekends, when carrying similarly aged passengers, and as a result of speeding. Alcohol and driving without seat belts remain key factors in young driver crashes and resulting deaths and injuries. Drug-driving, especially involving cannabis, is increasing, particularly among young men, and becomes especially dangerous when mixed with alcohol, and for habitual users. Young people are over-represented in single-car and loss-of-control crashes, and crashes where the driver is turning across oncoming traffic.

Apart from the enormous social costs, young driver crashes impose a huge economic cost burden on societies. In the US alone, government estimates state that crashes involving 15-20 year-old drivers cost $40.8 billion in 2002.

What are the key factors behind the problem?

Why do young drivers have such high crash rates? The response can be summarised under three general headings: experience, age and gender. The universal problem of young, novice drivers is inexperience. As most people learn to drive while they are young, inexperience explains much of the high levels of young driver risk. Furthermore, a minority of young drivers fails to manage a complex range of additional risk factors – many of which are related to age and gender – and is thus involved in a further disproportionate number of fatal crashes.

Experience

Where experience-related factors are concerned, learning to drive takes time and needs extensive practice in order to reach a sufficient competence level – this is true for everyone, not just the young. With time, the actions of driving – changing gears, looking in the rear-view mirror, steering, correctly assessing situations, reacting appropriately, etc. – become automated. However, for the novice driver, these actions require consideration, increasing overall mental workload and possibly distracting attention from the road. Thus, novice drivers' attention is easily overloaded, and their ability to combine simultaneous actions is relatively poor. At the same time, because serious crashes are relatively rare events, new drivers are not provided with the sort of negative feedback that might induce them to drive more carefully, while they might also be motivated to arrive at a destination as quickly as possible, as well as by other factors, such as peer pressure or a desire to "show off".

Age

Data show that novice driver crash involvement decreases as the licensing age for solo driving increases, indicating that age factors play a role in causing crashes. Indeed, physical and emotional immaturity, as well as the lifestyles associated with youth, can increase crash risk and severity. Young people are typically in a period of rapid maturation, whereby they test boundaries and assert independence. They are at a stage in life that is often intensely social, including being active at night and on weekends, in groups, and sometimes involving alcohol and/or drugs.

Gender

Young men drive more than young women, and have more fatal crashes per kilometre driven. Furthermore, research has revealed that they are generally more inclined toward risk-taking, sensation-seeking, speeding and anti-social behaviour than their female counterparts. They are also more likely to over-estimate their driving abilities and more susceptible to the influence of their friends.

It is precisely the interaction of experience and age-related factors, exacerbated by gender differences, that makes young drivers' risk situation unique, although experience has a greater overall impact on risk reduction than age. While men have more crashes than women at any age, the impact of gender is particularly strong among the young and exacerbates the negative effects of both age and inexperience.

The reasons why age, gender and experience combine so destructively in some young people on the road, and why some young people are more risk prone than others, are highly complex. They involve a myriad of interacting factors, including physiological and emotional development, personality, social norms, the role of youth in society, individuals' socio-economic circumstances, impairments to capabilities, the driving task itself, and the type of driving that young, novice drivers often engage in. Certain personality types are particularly subject to high crash risk. Social norms, including peer pressure and the emphasis placed on rebellion in youth culture, can affect driving style, as do the examples provided by role models. Alcohol, drugs, fatigue, emotions and in-vehicle distractions, such as mobile telephones, all impair a driver's abilities. Based on economic considerations, young people may also drive older vehicles with fewer safety features. Recent research indicates that the parts of the brain responsible for inhibiting impulses and weighing the consequences of decisions may be under development until well after the teenage years, possibly impacting on driving behaviour. Furthermore, different testosterone levels partially explain the divergence in behaviour between young men and women. In short, young drivers' high risk levels are a product of both who they are and the environment in which they exist.

However, it is important to note that, while young drivers are a high risk group in themselves, most young drivers are not deliberately unsafe. The same may be said of young male drivers. While profiles exist for high-risk young drivers, current knowledge does not allow particular individuals to be singled out with countermeasures before they engage in dangerous driving.

This leaves policy-makers with a complex problem. While young, novice drivers must gain experience to be safer, the process of gaining that experience exposes them, and others, to risk. Also, the mobility associated with driving provides people with access to many social, economic and education opportunities. Individual young drivers are much more likely than older drivers to have crashes, and many do, but only a small share of these results in death or serious injury. With this in mind, how do we tackle the problem of young driver risk without limiting young people's access to experience and mobility, and without appearing to unfairly penalise youth or a sub-group of youth, such as young men?

What are our options for action?

Given the severity of the problem, it is imperative that governments take action to reduce young driver risk, especially as measures to improve the safety of young and newly qualified drivers can be readily identified.

Reducing the number of young, novice driver crashes and fatalities will require a focussed and co-ordinated approach, involving education, training, licensing, enforcement, communication and the

selective use of technology, in combination with other road safety measures. The success of this approach will require public and political acceptance of the gravity of the problem and need to act, and the proactive participation of regulators and lawmakers; transport, health, safety and education administrations; the police; parents; and young drivers themselves. The goal of these efforts should be to create a situation in which overall road safety continually improves while the differences in risk levels between young and older drivers are greatly reduced, especially with regard to young male drivers.

A key first step in reducing young, novice driver risk is to work to ensure the highest possible overall standards of road safety. Given that young people suffer more crashes and fatalities, they can be expected to benefit to a great extent from general road safety measures, especially in countries where the road safety performance is relatively low. This should include focus on safety issues that have been seen to impact particularly on young drivers, such as speed, alcohol, seat belts, and drugs. Effective enforcement will play a key role, and is also a basic prerequisite to implementing some of the more targeted measures noted below. High levels of safety in vehicle and road design will also have an important impact. However, the wide gap between young and older drivers' traffic fatality risks underscores the fact that general road safety measures are not enough – it is also essential to directly address the specific problem of young, novice driver risk.

It is important to implement countermeasures that will reduce the wide gap between young drivers' risk levels and those of older, more experienced drivers. Given the nature of the problem, actions need to be concentrated on breaking the historically developed dangerous link between, on the one hand, immaturity and inexperience and, on the other, unlimited access to unsupervised solo driving in the challenging environment that is traffic. Breaking this link inevitably involves measures that either limit the available choices, or alter the attractiveness of these choices.

Countermeasures for addressing the young driver problem should be put forward based on a careful balancing of the interests and responsibilities of young drivers, as well as of governments' broader social responsibility to provide a safe road transport system.

The licensing process itself presents important opportunities. While countries employ different licensing systems, common objectives for risk reduction are seen throughout the world and there are increasing similarities between different systems.

Licensing age

As noted above, the younger a person starts unrestricted solo driving, the more likely it is that he or she will have a fatal accident, particularly below 18 years-old. Thus, as a first step, it is extremely important to set an appropriate age for first unrestricted solo driving. Administrations should resist, on safety grounds, any pressure to lower current licensing ages; conversely, increasing the licensing age for solo driving would reduce fatalities. Conditions for driving motorised two-wheeled vehicles should be similarly stringent to prevent migration to less safe forms of transport.

Training

To date, formal training itself has not proven to be highly effective in reducing accident risk. Training should focus on creating drivers who are safe, and not just technically competent, meaning that there should be increased focus on self-assessment and understanding of the factors that increase risk, including the context in which driving is undertaken. Training, stated training objectives and the test should reinforce one another, and a structured approach should be undertaken to ensure that novice drivers get wide experience in all the necessary competencies.

Increased pre-licence practice

Safe drivers are made and not born – extended practice should be recognised as a precondition for reaching higher cognitive skill levels. Thus, it is particularly important that substantial experience be attained in lower-risk conditions before unrestricted solo driving. High levels of accompanied practice before licensing for solo driving, conducted in a methodical manner that involves a variety of driving circumstances, will result in lower levels of fatalities. While at least 50 hours of pre-licensing practice are recommendable in any system, experience in one country showed that increasing this to approximately 120 hours reduced crashes in the two years following licensing by about 40%.[3]

Post-licence protective measures

The greatest risk is experienced immediately following licensing for solo driving, especially during the first year. Passing the driving test should not expose novice drivers to risk that they are not able to manage. Risk can be greatly reduced in the period following licensing by way of protective restrictions that are progressively lifted over time, as seen in graduated licensing (GDL) systems:

- Young drivers have been shown to be more susceptible to the effects of alcohol, even at lower levels, than older drivers. Thus, maximum BAC levels of zero or 0.2 g/l for young, novice drivers would be highly desirable.

- Also, important risk reductions have been shown to result from temporarily restricting driving with young passengers and/or at night. Implementation of such measures should be considered on the basis of a solid, evidenced understanding of the nature of the problem in each jurisdiction, taking into account such factors as the severity of the young driver problem, and the age at which people typically learn to drive.

These countermeasures could do much to address the circumstances that contribute to the seriousness of many young, novice driver crashes, such as driving at night, with passengers and/or under the influence of alcohol.

Enforcement

Clearly, many of the countermeasures inherent to the licensing process will not be relevant without effective enforcement, coupled with serious repercussions that act as disincentives for infringements and unsafe behaviour in general. Novices should thus be subject to a probationary period, during which they could lose their licence and/or have to undergo additional training if they do not comply with the rules of the road or licensing conditions. This could be accompanied by special demerit point scales for novice drivers, whereby they have lower thresholds for punitive action than other drivers. However, it is often difficult to target young, novice drivers in particular, although special plates can be helpful in this way. Thus, effective general enforcement is required, although this may focus on areas where young people – especially young men – are particularly over-represented, such as alcohol, speed, drug-driving and non-use of seat belts, and at times and locations where young people are particularly active.

New technologies

New technologies, such as black boxes, smart keys and alco-locks, offer opportunities to ensure compliance with the conditions attached to licensing. Furthermore, Intelligent Speed Adaptation, Adaptive Cruise Control and Electronic Stability Control could reduce both voluntary and involuntary dangerous driving among all drivers, including the young. More research is required where many of

these technologies are concerned, noting that some of these may be of particular benefit in assisting young drivers with the driving task and in addressing problems specific to young and novice drivers.

Communications and education

Countermeasures, especially enforcement, should be accompanied by communications and education efforts aimed at altering the fundamental attitudes that exacerbate risk, targeting, in particular, inexperienced drivers, high-risk lifestyle groups, and males. It should also be noted that many safety-related attitudes are established well before the driving age, and are highly susceptible to the influence of role models. Parents and other adult role models could also be provided with information regarding how they might assist in reducing young drivers' risk levels.

Non-road safety measures

Non-road-safety measures – such as the availability and cost of public and school transport, the cost of operating a vehicle, the location of services of interest to young people, and regulations regarding the availability of alcohol – can also have an impact on risk. All public policy decisions should take into account their potential road safety impact.

Global co-operation

International co-operation in the sharing of research and best practices will assist in reducing the costs of combating young driver risk. Dissemination of relevant advice from OECD/ECMT countries, including research findings from this report on young drivers, will be valuable and help a wide group of developing countries deal with some of the major road safety problems they are facing. Countries can work together, through such mechanisms as the UN Road Safety Collaboration, to ensure that all countries attain the highest possible levels of road safety.

How do we manage change?

There is often resistance to change; the public and stakeholders may be reluctant to accept new measures, particularly if they impose higher costs or make it more difficult to obtain a licence, and decision-makers may be reluctant to support measures that are unpopular. Overcoming such barriers to the acceptance of effective measures can be facilitated by carefully managing the process of change.

To begin with, proposed countermeasures should be realistic, and based on thorough research of the problem and the costs and benefits of proposed solutions, which must be clearly communicated. Senior-level decision-makers must show courage and leadership in publicly acknowledging the problem and the need to act. Different agencies within government and levels of government should co-ordinate closely, sharing resources and ideas. Stakeholders should be consulted, including young drivers, parents, employers, driving instructors, testing agencies, the police, the health and education sectors, the insurance industry, and road users in general. In some instances, stakeholder groups will play a key role in educating decision-makers and the public regarding the nature of the problem, and in proposing solutions. Finally, countermeasures should be phased in, showing concrete results at each step. Careful consideration needs to be given to ensuring that they do not impact unequally on more disadvantaged sectors of society. They should also be subject to analysis, and adjusted where they are not showing desired or adequate results.

Taking Action

Countermeasures need to be implemented in a strategic manner that shows results both immediately and over the longer term. In doing so, particular attention should be paid to the key elements that underlie and exacerbate risk. Furthermore, there are important differences between the various countermeasures in terms of their impact, their costs, and the timelines within which they can be implemented, which will condition the options for action. In particular, those that require new legislation will take considerable time to implement.

The following is a suggested step-wise implementation of countermeasures:

1. *Increase public awareness of the problem.* This could involve undertaking communications campaigns, based on well-researched information, sensitising the public to the nature of the risk and encouraging changes in attitudes and behaviour. Also, political leaders could highlight the problem in speeches and other interventions. This countermeasure may be undertaken immediately. In itself, it is not expected to yield high reductions in risk; however, it is a prerequisite for achieving greater public understanding of the problem and encouraging acceptance of other countermeasures. Furthermore, the combination of other countermeasures, particularly enforcement, with communications can yield changes in attitudes towards safety risk over the longer term. There are obvious costs involved, although these are likely to be uncontroversial, given the importance of the message and the fact that the public is accustomed to seeing communications campaigns from public authorities.

2. *Implement overall road safety improvements that address young driver risk.* This includes ensuring the existence of appropriate legislation and rigorous enforcement of road safety law, focusing on areas where young driver risk is especially high, including speeding, alcohol, drugs and seat belt use. It is an area where immediate action can be taken, based on existing laws and regulations, and short-term gains will be seen. There will be important costs, in the form of resources applied to enforcement, as well as in the implementation of high standards of safety in vehicles and infrastructure. Effective communication will thus be required to gain public support. However, public resistance may be expected, particularly to enforcement.

3. *Introduce high levels of pre-licensing accompanied practice.* This is potentially one of the most effective countermeasures. However, it may require new legislation, meaning that it cannot be implemented in the immediate term. Costs are relatively low both to administrations and the public, and primarily consist of demands on the time of young, novice drivers and those who accompany them. In countries where licensing begins at 18 years-old, resistance will be less if the accompanied practice is allowed to occur before that age. In countries where licensing begins earlier, there will be resistance from young drivers themselves, as this countermeasure will mean an effective increase in the age for unrestricted solo driving. However, consultation with the community, including co-operation with relevant community groups, may well reveal a widespread demand for action to reduce young driver risks.

4. *Implement protective restrictions during initial solo driving.* This countermeasure holds considerable potential. It should include BAC levels of no more than 0.2 g/l. Limited driving at night and/or with passengers should also be considered. Again, legislation is likely required, although the minimal BAC restrictions could possibly be implemented under existing drink-driving laws. The effective enforcement discussed in Point 2 is a key pre-requisite to such measures. There will also be additional administrative costs associated with

changes to the licensing system. Considerable resistance can be expected to these measures from young drivers themselves, although an effective communications strategy may reveal substantial support among society in general.

5. *Provide effective disincentives to inappropriate driving behaviour*. Enforcement of road safety law and special licensing measures will only be effective if they are backed up with concrete repercussions for non-compliance. Novice drivers should be subject to probationary periods during which inappropriate behaviour could result in loss of driving privileges or obligatory retraining, and this could be reinforced by way of special demerit point scales. Such countermeasures may require new legislation, but would not add important additional costs to those associated with enforcement, as discussed above. While they may be subject to considerable resistance from young drivers, they would likely not be unpopular with society as a whole. Additional disincentives to unsafe driving by young drivers could be provided through vehicle insurance premiums, and road safety administrations and insurance companies could examine means of co-operating in this area.

6. *Improve driver training and testing, including more focus on self-awareness and understanding the circumstances that lead to safer driving.* Such changes will need considerable prior analysis, and, probably, legislative action, meaning that they will require time for implementation. While they are important, they likely will not have the same impact as countermeasures that effectively limit exposure to risk and increase experience prior to solo driving, such as those noted in Points 3 and 4. Initially, there will be new costs associated with changes to the licensing system, and resistance may be particularly expected from the driver instruction industry.

7. *Consider the road safety ramifications, especially for young drivers, of public policy decisions that are not directly related to road safety.* This includes, among others, such issues as the availability and cost of public transport, the availability of parking at schools and other areas frequented by young people, the locations of bars and discos, and rules regarding the availability of alcohol. The immediate impact of this may not be expected to be particularly large, although over time it could have important cumulative effects. This is an area where action could begin immediately, but more time would be required to formalise such practice. Resistance would be particularly expected in instances where decisions limit the options of individuals and businesses.

8. *Understand the benefits of technological solutions for monitoring and enforcement, and for assisting the novice driver with the driving task, and selectively implement these where they prove to be effective.* This is a longer term initiative, particularly as it will involve research and development. While the potential is high, the actual gains to be achieved from new technologies are unknown. These will initially generate new costs for implementing technology in vehicles, which could result in resistance from drivers and vehicle manufacturers. Concerns regarding the legal ramifications of new technologies will also need to be addressed, particularly if they are perceived to relinquish the driver of full responsibility for operating the vehicle.

NOTES

1. Two-wheeled motorised vehicles (*i.e.* motorcycles, scooters, etc.) are not covered in this report.
2. Based on figures from the International Road Traffic Accident Database (IRTAD).
3. In Sweden, in 1993, the minimum age for accompanied learning was lowered from 17½ to 16, while the minimum solo driving age remained 18. Approximately 45-50% of 16 year-olds obtained their learner's licence during the first 2½ years of the new programme. This resulted in an increase to a mean of 117.6 hours of accompanied learning before licensing, compared to a mean of 47.6 hours before the change. In the follow-up period of two years, the crash risk of young, novice drivers who had begun accompanied learning at 16 was reduced by 40%, adjusted to account for confounding factors, and the overall young, novice driver crash risk was reduced by 15%.

INTRODUCTION

Youth is a time of growth, experimentation and powerful emotions, of exploring limits and pushing boundaries. It is also when many people first learn to drive. Unfortunately, this combination results in much higher traffic safety risk for young drivers than for any other segment of the population, which translates into a great many fatalities and serious injuries for young drivers, their passengers and other road users.

The daily deaths and injuries associated with road use represent a major public health problem in all countries, exacting huge human and economic costs. Young drivers are vastly over-represented in these grim statistics. Traffic crashes are the largest cause of death among 18-24 year-olds in OECD countries. Worldwide, in 2002, traffic crashes were the second greatest cause of death for persons aged 15-29, and the greatest for men in the same age group.

Much has changed since the Organisation for Economic Co-operation and Development (OECD) last studied the question of young drivers, in 1975[1]. In particular, overall road safety has improved, especially as a result of measures targeting key areas, like speed, alcohol, seat belt use, and vehicle safety. However, while young driver deaths have decreased since then, they have remained consistently much higher than those of older drivers, meaning that this remains an essential problem area.

The European Conference of Ministers of Transport (ECMT) has established the target of a 50% reduction in deaths due to traffic crashes between 2000 and 2012. Similar targets exist within the European Union, and at the national level in many countries. The United Nations Road Safety Collaboration, led by the World Health Organisation (WHO), is seeking to reduce the impact of traffic safety on human health. These objectives will not be reached without tackling the problem of young, novice driver risk. ECMT Ministers specifically recognised the gravity of this problem, and the need to address it, in a 1985 resolution.[2]

The purpose of this report is to identify the key elements of young driver risk, the factors behind it, and countermeasures that address it. The report seeks to provide concrete policy advice that will assist governments and other actors in taking steps to reduce this risk, and the human and economic costs associated with it.

The report focuses on young, novice drivers of passenger vehicles, meaning people who begin driving before the age of 25. The high levels of risk among this age group result from combined factors of inexperience, physical and emotional maturity, youth-related lifestyle, and the sex of the driver. However, many of the conclusions reached are relevant to novice drivers of any age.

Throughout the report, the authors seek to be as specific as possible regarding which sub-group of drivers they are referring to. The term “young, novice drivers” is used to denote those who are both under 25 years-old, and relatively new to the driving task. This is an important distinction, in that some young people may have gained extensive experience by the time they are in their mid-twenties, including as professional drivers. Where the report refers to all drivers under 25, regardless of their level of experience, the term “young drivers” is employed. Similarly, “novice drivers” is used to denote recently licensed or apprentice drivers of any age.

The various countries represented in the analysis have different systems for training and licensing novice drivers, conditioned by legal traditions, social norms, geography and history. Thus, countermeasures to the problem will necessarily need to be tailored to local conditions. However, all countries face the same general problem where young, novice drivers are concerned, and the factors behind this problem are essentially the same. As a result, all countries must find ways to allow novice drivers, particularly the young, to become experienced, skilled and safe in a way that minimises their, and other road users', exposure to risk.

NOTES

1. OECD (1975), *Young Driver Accidents*, OECD, Paris.
2. ECMT Council of Ministers, *Resolution No. 46 on Measures to Reduce the Accident Risks of Young Drivers*, 1985.

CHAPTER 1.

THE PROBLEM OF YOUNG, NOVICE DRIVERS

Abstract

This chapter considers the scope of young driver traffic safety risk. It then discusses the key characteristics of the problem, focusing on age, experience and gender-related factors, as well as the circumstances under which it is aggravated. Finally, the chapter looks at the possible economic costs, as well as the impact on countries at different levels of motorisation.

1.1. Introduction

Drivers under the age of 25 account for the greatest share of traffic crashes[1] and fatalities in most countries. This is the result of factors of age, experience and gender.

This chapter describes the scope of the problem of young driver risk, as well as its basic characteristics and the specific circumstances under which this risk is aggravated. The factors explaining this problem are discussed in Chapter 2, known effective countermeasures in Chapter 3, and potential new countermeasures in Chapter 4. Chapter 5 provides strategic policy advice regarding the choice of countermeasures, and Chapter 6 discusses means of implementing change. Chapter 7 discusses the question of young drivers in the context of countries at different levels of motorisation, while Chapter 8 provides a full listing of all conclusions and recommendations in this report.

1.2. Young Driver Crash Data

In developing this report, we have sought to present the most up-to-date and relevant material available for a wide variety of countries. The reader will note that data are presented in various ways, including in terms of per capita, or in terms of kilometre driven in order to show exposure. Essentially, this reflects the availability of statistics, and we feel that enough material is presented to provide an irrefutable overall picture of the scope and severity of the problem.

Most tables and figures were generated using the International Road Traffic and Accident Database (IRTAD), which is the main source for traffic crash statistics in Organisation for Economic Co-operation and Development (OECD) countries. An important benefit of IRTAD is that it allows for comparisons of countries from different continents[2] and, thus, for comparisons of accurate traffic safety data in an international context.

However, there are some limitations in these data that, in certain instances, explain the way in which the problem is presented statistically. For example, crash data are only available on an aggregate level, and information is lacking for some countries. Also, while crash data are relatively complete for OECD countries, they are not for the rest of the world, including non-OECD members of the European Conference of Ministers of Transport (ECMT); this point is considered in more detail in Chapter 7.

Many of the figures and tables shown have a strong emphasis on driver fatalities, as these are more reliable and interpretable than data on injuries. Using IRTAD ensures that all countries share the same definition of traffic fatalities, namely death within 30 days as a result of a crash. Injury data are notoriously less reliable, as different countries have their own practices with regard to whether the cause of an injury is noted by police or hospital staff.

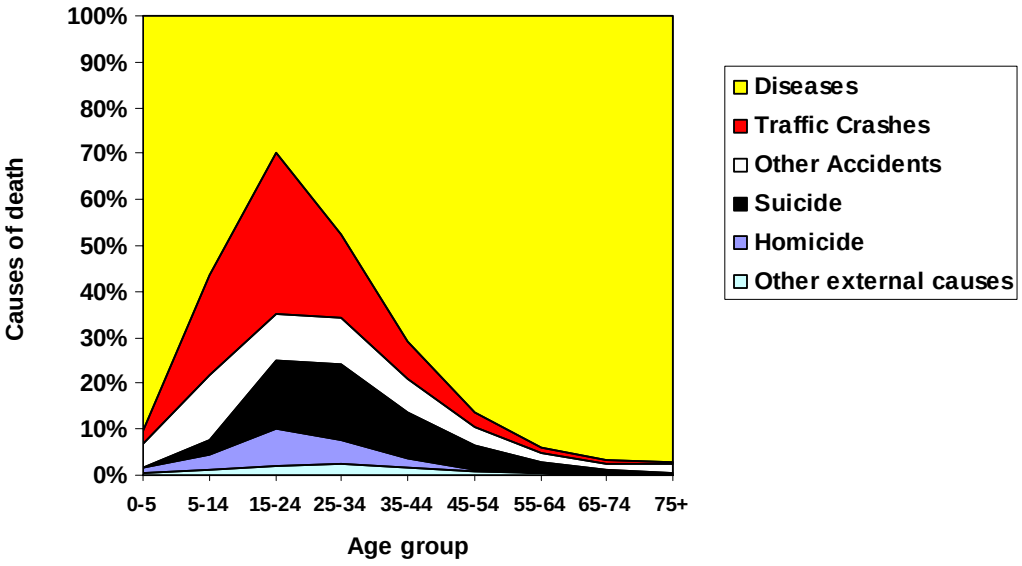
In some cases, in order to exemplify specific elements of the problem, we also provide data taken from individual countries, which we feel to be indicative.

Except where otherwise noted, all data and figures below deal with passenger vehicles only.

1.3. Quantifying the Problem

Traffic crashes are the single greatest killer of persons aged 15-24 in OECD countries, accounting for 35% of all deaths, or approximately 25 000 people[3] annually in recent years.

Figure 1.1. **Causes of Death in OECD Countries**



Source: World Health Organization Mortality Database.

Note: Most recent data from the following countries: Australia (2001), Austria (2002), Belgium (1997), Czech Republic (2002), Denmark (1999), Finland (2002), France (2000), Germany (2001), Greece (2001), Hungary (2002), Iceland (2001), Ireland (2001), Italy (2001), Japan (2002), Netherlands (2003), Norway (2001), Poland (2002), Korea (2002), Luxembourg (2002), Spain (2001), Sweden (2001), United Kingdom (2002) and United States (2000).

As Figure 1.1 shows, traffic crashes as a cause of all deaths spike in this age group, and then quickly drop off among older population groups. Worldwide, in 2002, traffic crashes were the second greatest single cause of death for persons aged 15-29, and the greatest for men in the same age group.[4]

Table 1.1. **Young Driver and All Driver Deaths in OECD Countries, 2004**

	A	B	C	D	
	Young Drivers	**All Drivers**	**Young as % of all Driver Deaths**	**Young as % of Total Population**	**C/D[a]**
Drivers Aged 16-24					
Canada	262	935	28.0	12.9	2.2
N. Zealand	51	205	24.9	12.9	1.9
USA	3 999	13 209	30.3	12.8	2.4
Drivers Aged 17-24					
Australia[e]	195	771	25.3	11.2	2.3
Austria	110	368	29.9	9.9	3.0
Great Britain	330	1 106	29.8	10.2	2.9
Iceland[f]	2.6	10.6	24.5	11.6	2.1
Ireland[b]	31	110	28.2	13.1	2.2
Drivers Aged 18-24					
Belgium[c]	154	617	25.0	8.6	2.9
Czech R.	90	495	18.2	9.9	1.8
Denmark	35	139	25.2	7.6	3.3
Finland	43	151	28.5	8.9	3.2
France	645	2 445	26.4	9.1	2.9
Germany	750	2 329	32.2	8.2	3.9
Greece[d]	105	549	19.1	10.2	1.9
Hungary[c]	53	397	13.4	10.3	1.3
Italy	n/a	n/a	n/a	n/a	n/a
Japan	326	1 519	21.5	8.3	2.6
Korea	128	939	13.6	11.0	1.2
Luxembourg	n/a	n/a	n/a	n/a	n/a
Mexico	n/a	n/a	n/a	n/a	n/a
Netherlands	74	269	27.5	8.3	3.3
Norway	25	119	21.0	8.4	2.5
Poland	313	1 441	21.7	12.0	1.8
Portugal[b]	80	393	20.4	10.0	2.0
Slovak Republic[g]	41	264	15.3	11.6	1.3
Spain	322	1 689	19.1	9.1	2.1
Sweden	40	198	20.2	8.1	2.5
Switzerland	49	165	29.7	8.3	2.6
Turkey	n/a	n/a	n/a	n/a	n/a

Source: OECD, IRTAD.

Note: a. This column shows the relationship between young drivers killed as a proportion of all drivers killed, and young people as a proportion of the total population in that country – in other words, column C divided by column D. Thus, for Canada, in 2004, the proportion of 16-24 year-old drivers killed per killed driver was 2.2 times greater than the proportion of 16-24 year-olds in the population.

b. Data from 2003.

c. Data from 2002.

d. Data from 2000.

e. Australian data provided by the Government of Australia.

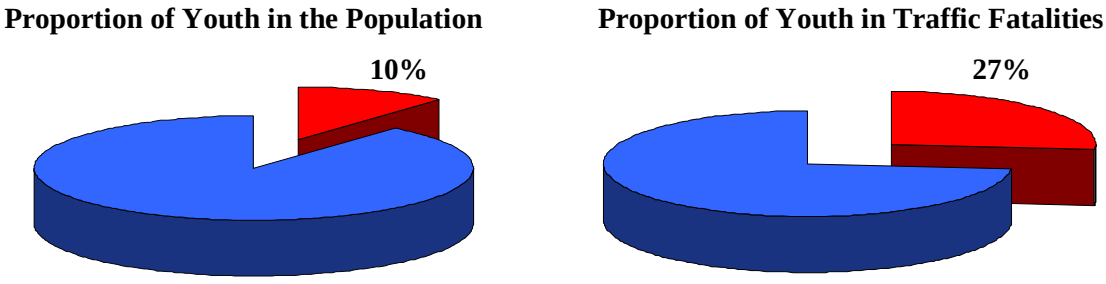
f. Given Iceland's small population, an average of 2000-2004 data has been used for numbers of deaths.

g. Slovakian data provided by the Slovak Republic

Table 1.1 shows the percentage of young drivers killed in comparison to drivers of all age groups in OECD countries in 2004. Countries have been divided into groups according to when their young people first begin solo driving.[5] Invariably, young drivers represent a far larger proportion of all driver deaths than the proportion of people of that age group in the overall population, varying between 1.2 and 3.9 times greater. Those countries with the lowest percentages of young driver deaths per capita are also those where there is likely less access to passenger vehicles, an issue discussed in greater detail in Chapter 7.

Figure 1.2. **Proportion of Young People in Traffic Fatalities and Population,**

OECD Countries,
2004



Source: IRTAD, Based on Table 1.1.
Note: "Young" refers to driving age people under 25 years-old, as per Table 1.1.

Across those countries shown in Table 1.1, about 27% of all drivers killed in crashes are young drivers. However, only about 10% of the population falls within this age group. This relationship is shown in Figure 1.2.

The figures above represent a disquieting number of young lives lost. It is estimated that over 8 500 young drivers lost their lives in OECD countries alone in 2004.[6] Furthermore, these are the drivers alone, and, for each of these deaths, it must be assumed that other deaths and serious injuries likely occurred in the same crashes, including to young passengers travelling with the driver.

Table 1.2. **Distribution of Fatalities and Serious Injuries Resulting from Young Driver Crashes**

Netherlands, 1999-2003

	Killed	**Seriously Injured**
Young driver (18-24)	43%	36%
Passengers in young driver's car	25%	20%
Other persons	32%	44%
Totals	*100%*	*100%*
Total non-driver	57%	64%

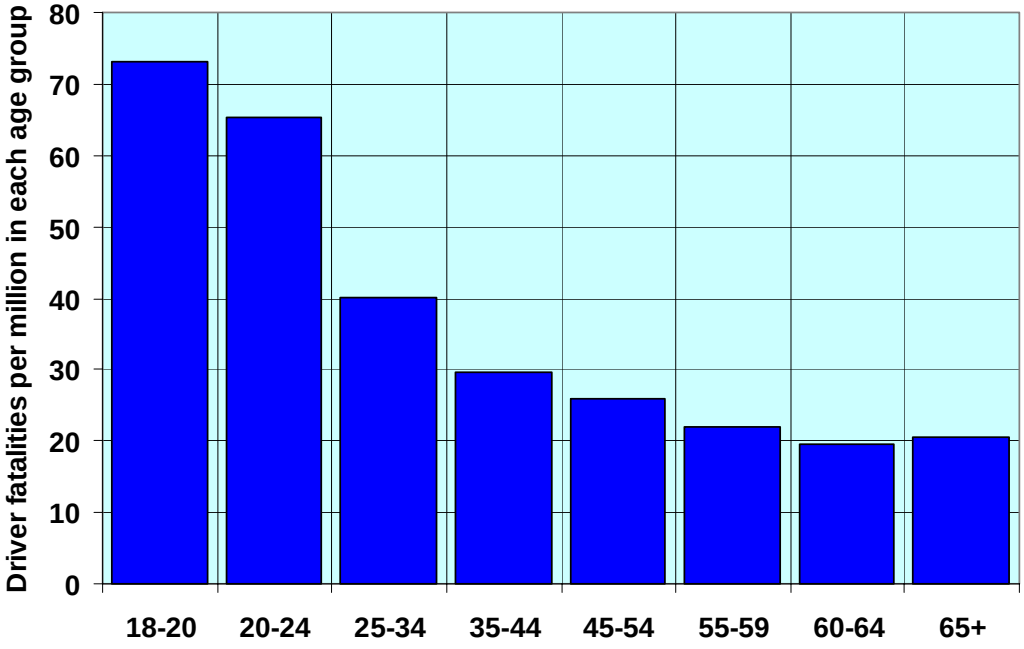
Source: SWOV data

For instance, research in the Netherlands indicates that, for every 10 young drivers killed, almost six passengers in the young drivers' car and over seven other road users also died in the same crashes. Table 1.2 shows the ratio between young drivers and others killed and seriously injured in the same crashes in the Netherlands during the period 1999-2003. This indicates that, for every young driver killed, approximately 1.33 other people died, and for every young driver seriously injured, approximately 1.8 others were also seriously injured.

Data for the US indicate that, over the period 1999-2003, an average of 1.47 other people died in the same crashes for each fatality of a young driver aged 15-20 (NHTSA, 2004). In the US in 2003, for the 3 657 15-20 year-old drivers killed, 2 384 passengers in their vehicles, 1 979 other vehicle occupants and 646 non-vehicle occupants died in the same crashes, translating into 1.37 other deaths for each young driver killed, a figure that is largely consistent with the Dutch findings above (NHTSA, 2003a).

Figure 1.3. **Driver Fatalities per Million Population for Different Age Groups in Selected OECD and ECMT Countries where Solo Driving begins at 18 Years-old**

2004



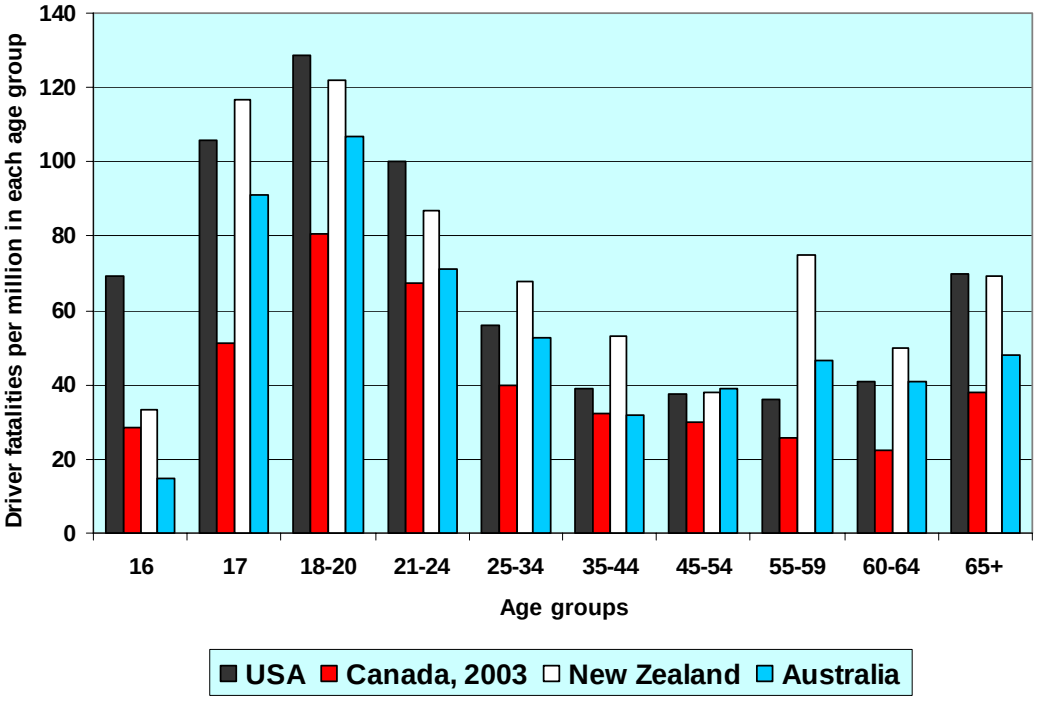
Source: OECD, IRTAD

Note: Data from the Czech Republic, Denmark, Finland, France, Germany, Japan, Korea, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland and Slovenia.

Figure 1.3 illustrates the distribution of car driver fatalities per million people in different age groups in selected countries where solo driving begins at 18 years-old. The rates for 18-20 and 21-24 year-olds are much higher than those for any other age group.

Figure 1.4. **Driver Fatalities per Million Population for Different Age Groups in Selected OECD Countries where Solo Driving begins before 18 Years-old**

2004

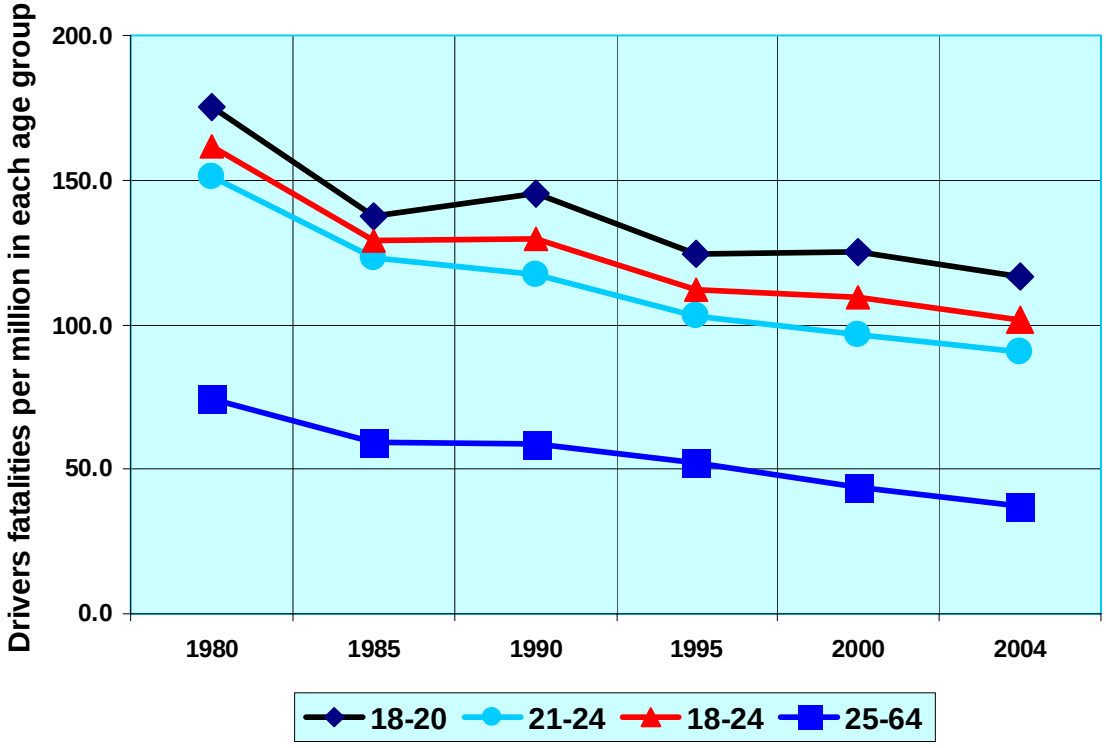


Source: IRTAD

Figure 1.4 shows similar patterns for countries where initial licensing for solo driving begins before 18 years-old. Again, fatality levels for drivers under 25 are generally substantially higher than for any other age group. Lower levels for 16 year-olds likely reflect the fact that not all persons of this age get their licences as soon as they are legally able, and that many do so under the restrictive conditions inherent to graduated licensing (GDL) systems.

Figure 1.5. **Driver Fatalities per Million Population for Different Age Groups, Over Time**

Austria, Great Britain, the Netherlands, Sweden, Switzerland, US

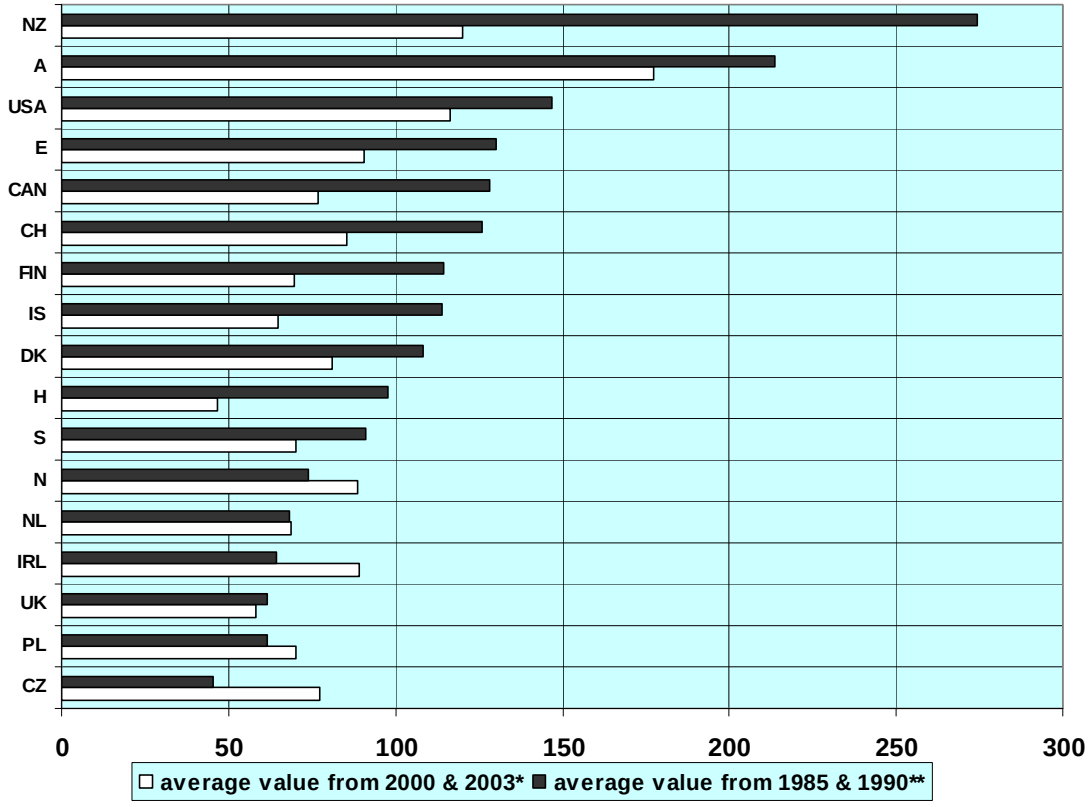


Source: IRTAD.

Figure 1.5 shows that, since 1980, overall driver fatalities have decreased collectively in Austria, Great Britain, the Netherlands, Sweden, Switzerland, and the US. While this is largely representative of the situation across the OECD, it is not the case in many other regions of the world. Although young drivers have had the strongest absolute downward movement of the age groups shown, the decline in young driver fatalities has largely mirrored that for the population overall. For example, driver fatalities per million population[7] declined by 49.8% for drivers of 25-64 years of age, and 37.1% for those 18-24. In other words, the fundamental problem – that young drivers are proportionately much more often victims of traffic fatalities than other age groups – has not substantially improved, and the risks associated with this age group continue to exact a particularly heavy toll.

Figure 1.6. **Development of Fatalities per Million Population of 18-24 Year-old Drivers**

Various OECD and ECMT Countries



Source: OECD, IRTAD.

Note: * Data from 2000 and 2002 only: Canada, Spain, Ireland.

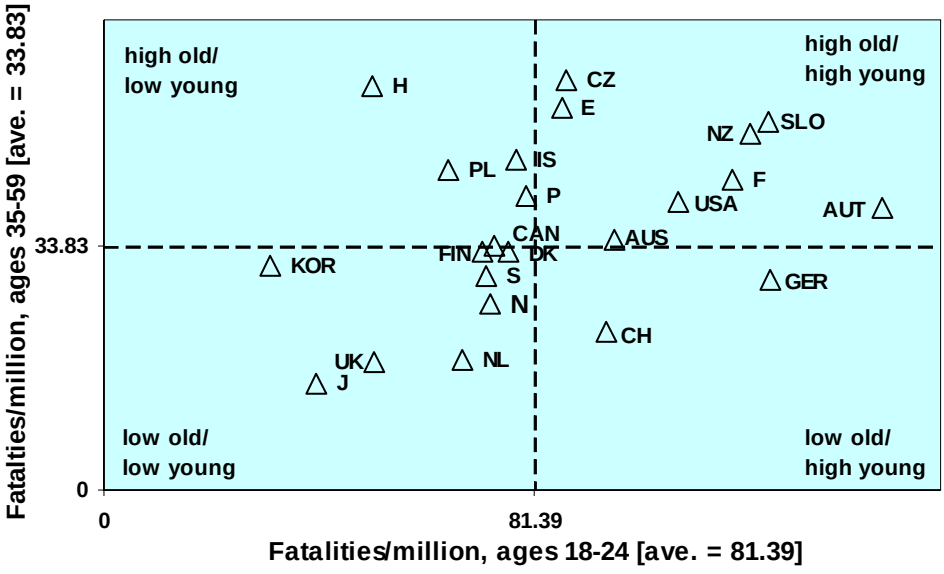
** Data from 1990 and 1995 only: Finland, Ireland, Hungary, Norway, Poland and UK.

Abbreviations: A: Austria, CAN: Canada, CH: Switzerland, CZ: Czech Republic, DK: Denmark, E: Spain, FIN: Finland, H: Hungary, IS: Iceland, IRL: Ireland, KOR: Korea, NL: Netherlands, NZ: New Zealand, N: Norway, PL: Poland, S: Sweden, UK: United Kingdom, and USA: United States of America.

Figure 1.6 shows different developments of the number of driver fatalities among 18-24 year-olds over time in various OECD and ECMT countries. Obviously, these numbers are subject to various country-specific factors, such as the number of licensed drivers, the quality of infrastructure, and the type of driving typically engaged in. Ireland, Poland and the Czech Republic show increases in young driver deaths for the period cited, probably linked to the effects of rapid economic growth and/or related motorisation discussed in Chapter 7. In Norway, while fatality rates are very low, they decreased over the cited time period less than the decrease in the number of people in the young driver age group, leading to an increase in driver fatalities per million population.

Figure 1.7. **Relative Risk: Driver Fatalities per Million Population for the 18-24 and 35-59 Age Groups**

Selected OECD and ECMT Countries, 2003



Source: OECD, IRTAD.

Note: Data from year 2003, except for Australia (1999), Canada (2002), Hungary (2002), Japan (2002) Spain (2002) and average value of period 1999-2003 for Iceland.

Abbreviations: AUT: Austria, AUS: Australia, CAN: Canada, CH: Switzerland, CZ: Czech Republic, DK: Denmark, E: Spain, F: France, FIN: Finland, GER: Germany, H: Hungary, IS: Iceland, J: Japan KOR: Korea, N: Norway, NZ: New Zealand, NL: Netherlands, PL: Poland, P: Portugal, SLO: Slovenia, S: Sweden, UK: United Kingdom, and USA: United States of America.

Figure 1.7 shows the relative situations in various OECD and ECMT countries, comparing young (18-24) and older (35-59) drivers. The dotted lines on the graph show the average for the age groups studied, and thus allow us to divide the figure into four quadrants. The upper left quadrant shows countries where driver deaths are relatively higher for older drivers and lower for younger ones; the lower right shows the inverse situation – higher younger driver deaths and lower older driver deaths. The lower left and upper right show the relatively best and worse performing countries, respectively, in terms of both age groups. This figure indicates that countries that have relatively better overall road safety performance tend to be safer for young drivers, and that those that have poorer overall road safety performance are also relatively more dangerous for young drivers. The higher concentrations of countries in these two quadrants indicate that those countries with overall high levels of road safety will likely also be those with fewer deaths resulting from young drivers' crashes, and that those with lower road safety levels will have more young driver deaths. It should be noted that in Australia, Canada, New Zealand and the US, full licensing begins before 18 years of age; thus, the graph likely under-estimates the extent of young driver deaths in those countries.

Table 1.3. **Fatality Rates for Licensed Car Drivers Aged 17-20**

UK, 1992-2004

Year	Deaths	Full Driving Licence figures (Thousands)	Rate**
1992/94*	167	1 326	12.6
1993/95*	160	1 224	13.1
1994/96*	162	1 143	14.2
1995/97*	168	1 107	15.2
1996/98*	172	1 138	15.1
1997/99*	162	1 157	14.0
1998/2000*	154	1 125	13.7
1999/2001*	154	1 001	15.4
2002	181	920	19.7
2003	192	806	23.8
2004	178	787	22.6
*3-year averages			
** Deaths per 100 000 17-20 year-old licence holders			

Source: UK Department for Transport

However, the data in Figures 1.5-1.7 may not necessarily reflect the full reality of countries' situations. As seen in Table 1.3, data for the UK – which has a relatively very good overall road safety record – reflect an important decrease in the number of 17-20 year-olds possessing a full licence from the early 1990s to 2004, without a commensurate drop in driver fatalities in the same age group, resulting in an important increase in the number of killed drivers per licence-holder in recent years. Over the same period, the number of killed 17-20 year-old drivers per million 17-20 year-olds in the overall population did not fluctuate significantly.[8] Furthermore, fatal crashes per kilometre have also increased in this age group in the UK (see Figure 1.12). This illustrates that young driver crashes are not solely affected by general safety levels, but, rather, even in relatively safer countries their prevalence is affected by youth-specific factors. These factors are discussed in more detail in Chapter 2.

In summary, traffic crashes are the greatest killer of youth in OECD countries and one of the greatest worldwide. Young drivers are greatly overrepresented in crash fatality data, and their crashes also impact heavily on other road users. Even though young driver mortality has decreased in most developed countries in recent years, the relative proportion of young drivers killed compared to all drivers has remained much higher, indicating that the specific problem of young, novice driver risk has not been addressed. However, countries with better overall safety records also tend to have higher levels of young driver safety.

1.4. Basic Characteristics of Young, Novice Driver Risk

1.4.1. Age and experience

Research in various countries has shown that the risk of involvement in a crash during the first year of driving decreases substantially along with any increase in the age at which one begins driving, and that these differences are most pronounced among younger drivers. This reveals that age-related factors are an important determinant of novice driver risk.

For example, a British study (Maycock *et al.*, 1991) of self-reported accidents from a sample of about 13 500 drivers found that mileage-adjusted accident liability decreased with the age at which the first solo driving occurred, as well as with increasing experience. Male drivers had higher accident liabilities than females, but for both sexes the age and experience effects combined produced very steep declines in accident liability during the early period of unsupervised driving. Similar results were found in the British "Cohort Study" (Forsyth *et al.*, 1995) and the results of all this work are summarised by Maycock (2002a). Maycock (2002b) extended these findings by investigating the effects of age and experience on the risk of injury accidents reported to the police, and found a similar pattern to that described above.

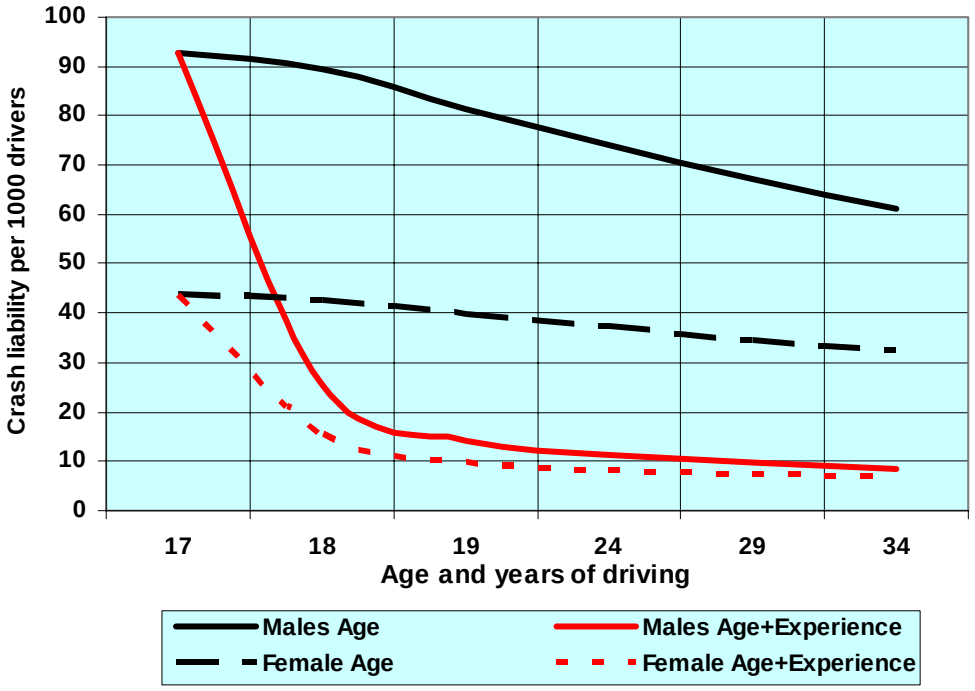
Similar outcomes were found in a Canadian investigation of crashes among novice drivers aged 16–55 (Cooper *et al*., 1995), which showed that, while all ages had a higher initial crash involvement in causal crashes, 16 year-olds had the highest initial risk. A Danish study (Carstensen, 2002) found that young, novice drivers had more crashes than older novice drivers. This was the case looking at crashes per person as well as crashes per kilometre driven, although the difference disappeared after two years of driving.

At the same time, research indicates that lack of experience is the most important cause of the high crash rate among young and novice drivers (Maycock *et al.*, 1991; Maycock and Forsyth 1997; Maycock, 2002a). Results have illustrated that there is a sharp decrease in crash liability during the first few years of driving, mainly associated with experience rather than age. In several analyses of month-by-month crash statistics after licensing, it has been shown that initially very high crash involvement decreases rapidly during the first half year of driving.

For example, a Norwegian study (Sagberg, 2000) showed that the reduction of crashes per 1 000 drivers was about 50% during the first 8 months. Similar results were shown for Sweden (Gregersen, 2000a, 2000b), Germany (Schade, 2001) and Nova Scotia, Canada (Mayhew *et al*., 2000). In the Swedish study, the general crash reduction was about 50% during the first 8 months; in Germany, about 50% during the first nine months and 90% during the first 2.6 years; and, in the Canadian study, 41% during the first 7 months. Data from Victoria, Australia, show a rapid decline in crash involvement during the first year of solo driving under probationary conditions, and that it takes about 2.5 years for the driver to reach a level after which the decline is slow and steady (Howard, 2004; VicRoads, 2005). These findings indicate that age is of less importance than experience-related factors, as it can be assumed that age factors are not changing dramatically during these few months of initial licence holding.

Figure 1.8. **Age and Driving Experience – Crash Liability Among Male and Female Novice Drivers**

Great Britain

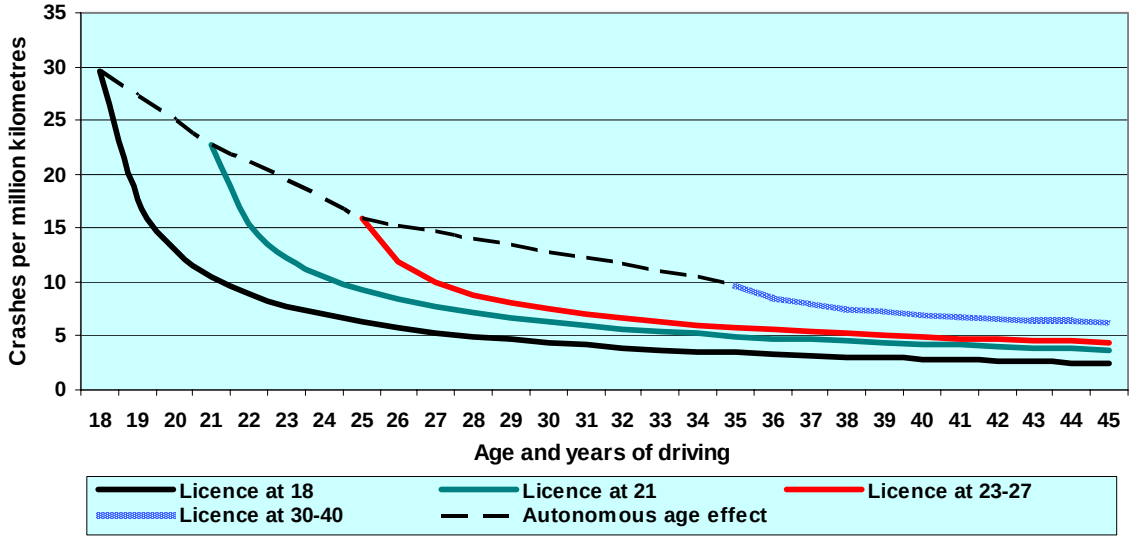


Source: Adapted from Maycock, 2002b.
Note: Based on police-reported data

The impacts of both age and experience are shown in Figure 1.8, where the black lines represent the crash risks of men and women first getting their licence at each different age level, and the red lines show the progression of the crash risk level of men and women who get their licences at 17 years of age. In other words, the black lines show the impact of age, while the red lines show that of experience and age combined. In this analysis, the effects of annual mileage have been controlled by statistical modelling. The predictions in Figure 1.8 apply to drivers doing 8 500 miles (13 680 kilometres) per year.

Figure 1.9. **Age and Driving Experience – Crashes per Million Kilometres Driven for Drivers who Attain Licences at Age 18, 21, 23-27 and 30-40**

The Netherlands, 2003



Source: Vlakveld, 2004

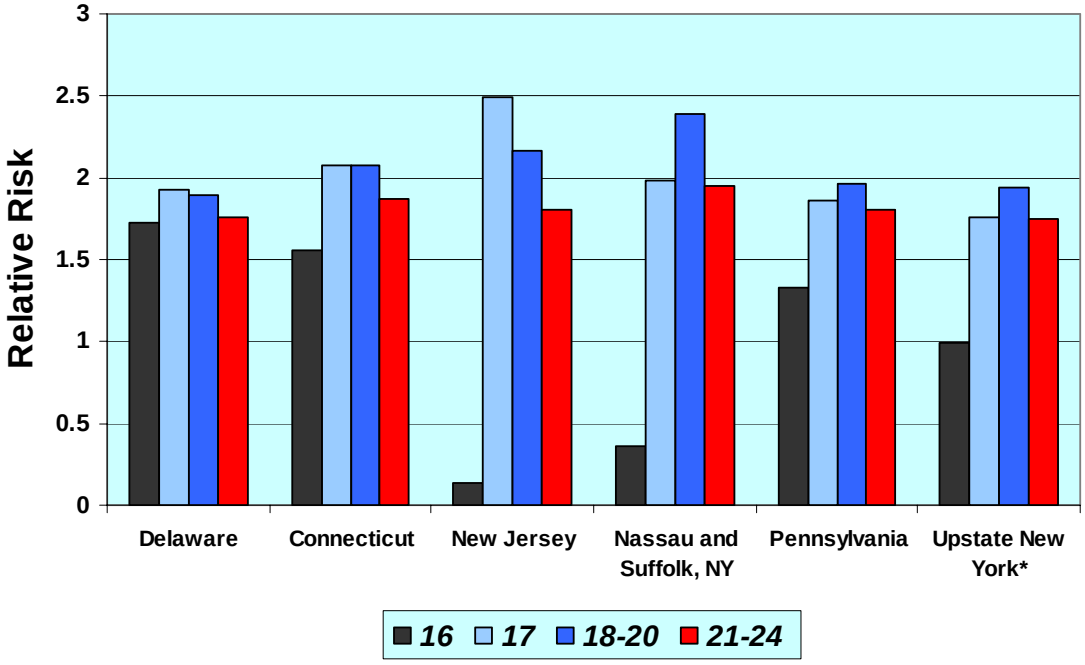
Figure 1.9 shows similar results for novice drivers in the Netherlands. In this case, a simpler adjustment for exposure was used, the results being presented in terms of crashes per million kilometres. Again, risk is lower when one begins driving later, although it also drops off quickly as soon as one begins driving.

Figures 1.8 and 1.9 show that the effects of experience are greater than those of age. Looking at the Dutch figures, drivers who began driving at 18 years-old experienced a drop in crash risk of approximately 66% by the time they are 21. Had the same drivers begun driving at 21, their initial crash risk would only be about 25% less than if they had begun at 18. Also, while gaining experience is a challenge for all new drivers, the impact of experience over time appears to be much greater when the novice is younger. [9]

However, the impact of age cannot be ignored. Again, looking at Figure 1.9, it is clear that, if driving began at a later age – say 21 – the crashes of 18 to 20 year-olds would be avoided. However, there would also be more crashes among 21 year-olds just beginning driving. There would also be a cost to society from limiting the mobility of 18-20 year-olds by denying them access to the social and economic opportunities associated with driving.

Figure 1.10. **Relative Rates of Crash Involvement**
(Adjusted for population, 25-29 year-olds' crash rates 1.0)

Various US Jurisdictions, 1988-1990



***** Excludes the counties of Clinton, Essex, Franklin, Fulton, Hamilton, Jefferson, Lewis, Oswego, St. Lawrence, Warren, Washington, Nassau and Suffolk.

Source: Ferguson *et al.*, 1996.

Note: New Jersey from 1988 and 1989 only.

Research conducted in 1996 by Ferguson *et al*. compared contiguous US jurisdictions that had different licensing age practices, including different ages for full licensing and night-time curfews. New Jersey, where full licences were not available before 17 years-old, showed higher crash involvement at 17 than in Delaware and Connecticut, where solo driving began at 16.[10] However, when data for 16 and 17 year-olds were combined, the cumulative result for New Jersey was significantly lower. In other words, there were net positive gains from delaying the licensing age by one year. The New Jersey crash rate for 18-20 year-olds remained higher than in the other states, and for 21-24 year-olds it was higher than in Delaware and lower than in Connecticut. These results are shown in Figure 1.10, where crash rates are compared to the rates in each state for 25-59 year-olds, which are set at 1.0.[11]

Notably, the lowest crash risk at all ages was in jurisdictions imposing night-time curfews. This relates to the discussion in Section 3.6 regarding protective restrictions that allow young people to begin driving, but also limit their initial risk.

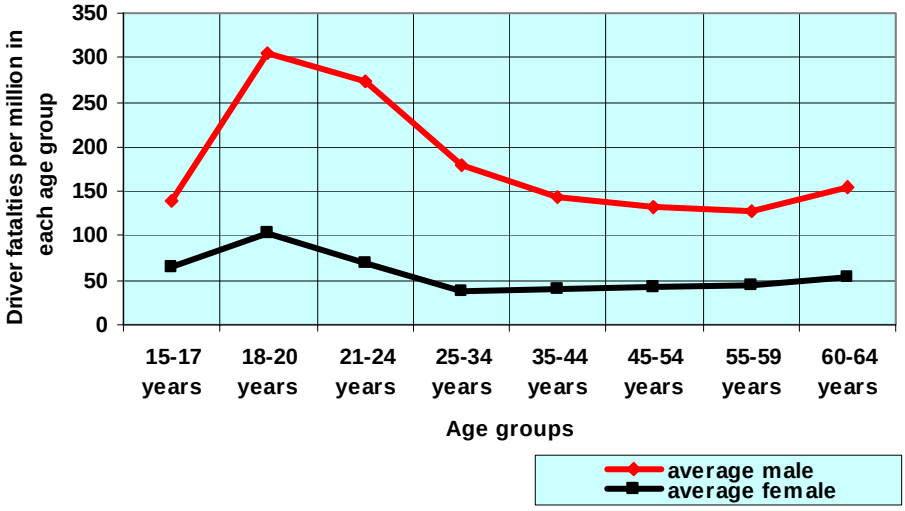
In summary, it is precisely the combination of experience and age-related factors that makes the question of young driver risk distinct from that of novice drivers in general.

1.4.2. Gender differences

The third key factor that underpins young driver risk is gender. Men have more crashes than women, and their crashes tend to be more severe.

Figure 1.11. **Road-user Fatalities by Gender and Age, per Million Population**

Various OECD and ECMT Countries, 2003



Source: OECD, IRTAD.

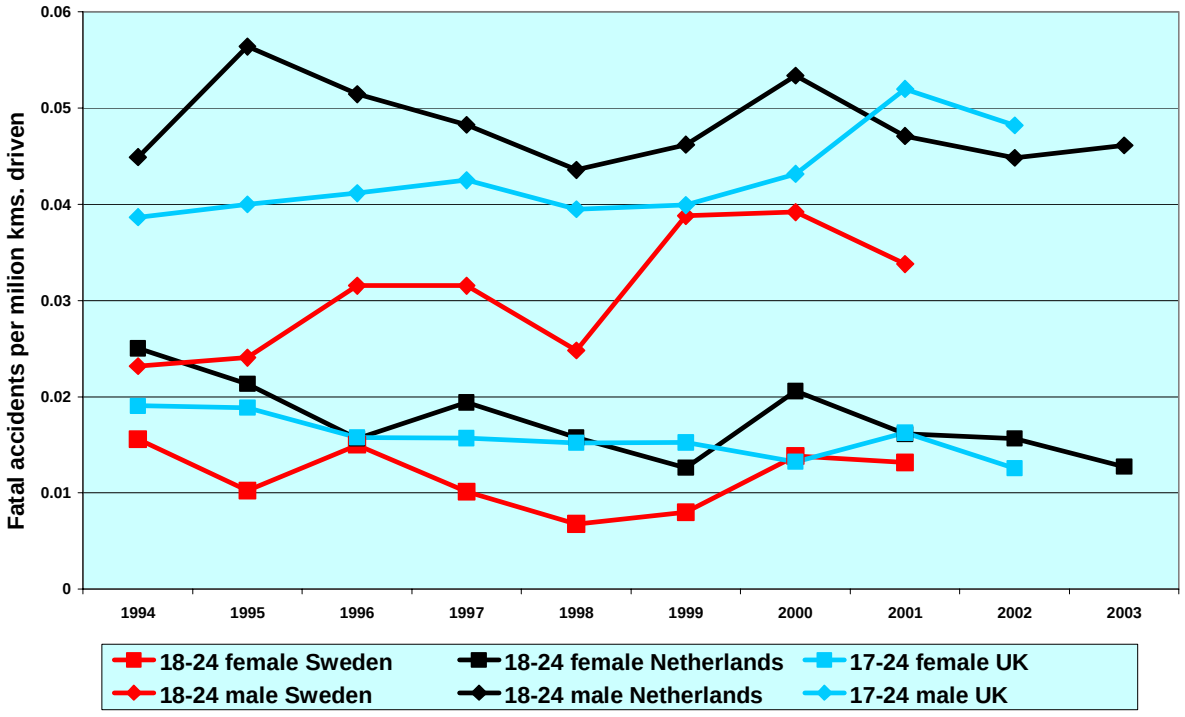
Note: Assuming an equal distribution (50:50) of sexes, data is from 2003 for the following countries: Austria, Australia, Czech Republic, Denmark, Finland, France, Germany, Iceland, Japan, Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, Sweden, Switzerland, United States and United Kingdom.

Figure 1.11 reveals important differences with regard to the road traffic fatalities of males and females – across various OECD countries, 18-20 and 21-24 year-old males show a 3-times higher involvement in fatal road crashes than their female counterparts. While this pattern continues into middle age, sex-related factors combine with age and experience among young drivers, to make their overall fatalities higher than those of older drivers, where both men and women are concerned.

It is sometimes suggested that these differences primarily result from the fact that men typically drive more than women. For example, a study from Western Australia (Ryan *et al.*, 1998) revealed that female drivers aged 17–19 had a substantially lower number of crashes and crash rate per population than male drivers of the same age, although, when taking mileage into account, the difference disappeared and the risk per 100 million kilometres was the same for both sexes.

Figure 1.12. **Involvement in Fatal Crashes of Young Male and Female Drivers per Million Kilometres Driven**

The Netherlands, Sweden and UK, 1994-2003

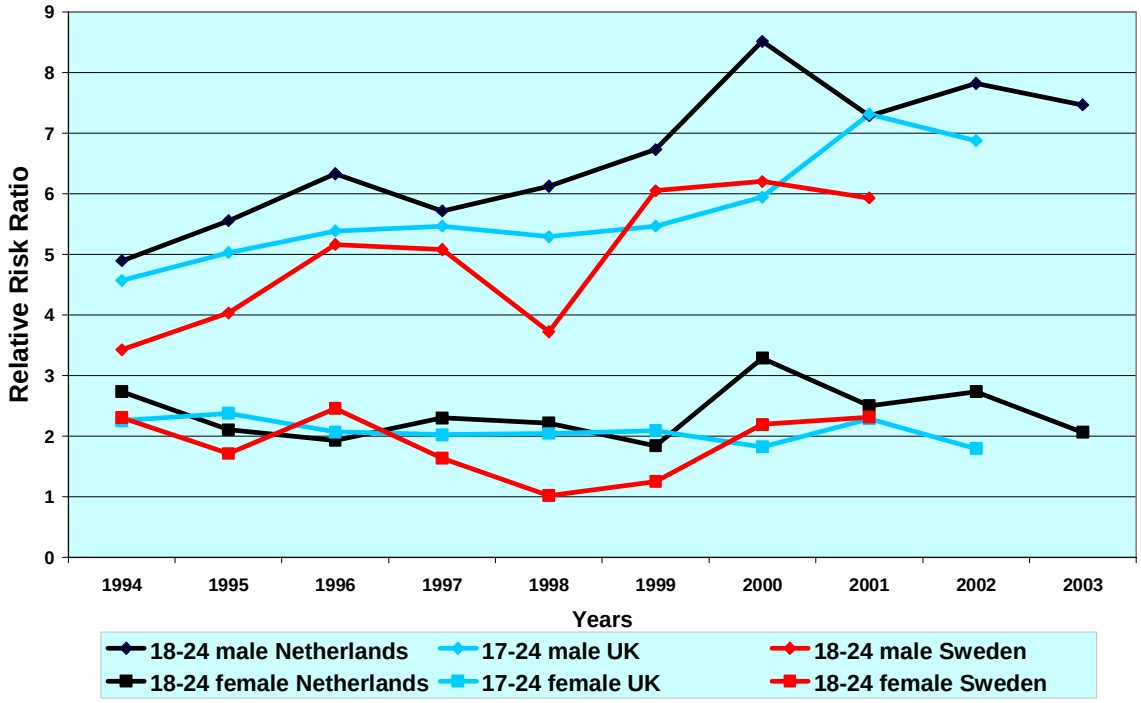


Source: Lynam *et al.*, 2005

However, ample evidence exists from other jurisdictions to suggest that the problem persists even when data is adjusted for exposure. For the period 1992-97, the crash risk among 18–19 year-old Swedish drivers who started practising after 17½ years of age was approximately 10 crashes per 10 million kilometres for male drivers, and 8 for females (Gregersen *et al.*, 2000a). The nation-wide US Fatality Analysis Reporting System (FARS) database, analysed by Kweon and Kockelman (2003), showed that there was a difference between under-20-year-old male and female drivers of private cars both in terms of crash counts (1.3 times higher for men) and crash risk per million miles (1.2 times higher for men). The sex difference in crash risk disappeared in the mid age group (20–60 years) and reversed in the oldest, as was the case for the Swedish data described above. Similarly, Figure 1.12 shows that, in the three European countries with the best overall road safety performance – the Netherlands, Sweden and the United Kingdom – young men have substantially more fatal crashes per million kilometres driven, including over three times more.

Figure 1.13. **Relative Risk of Involvement in Fatal Crashes for Young Male and Female Drivers**

The Netherlands, Sweden and UK, 1994-2003



Source: Lynam *et al.*, *2005*

This is seen in an alternative manner is Figure 1.13, which shows, for each year, the number of fatal crashes in which male and female young drivers were involved per kilometre, divided by the number of fatal crashes that all drivers aged 30 to 59 were involved in per kilometre. Thus, when the figure for a particular country for young female drivers is two, this means that young female drivers in that country had twice as many fatal crashes per kilometre as all drivers in the same country between 30 and 59 years of age. The numbers have risen substantially for young men in all three countries, but not for young women.

Where exposure is concerned, it might also be noted that, overall, those who drive more typically have fewer crashes per kilometre (Pelz and Schuman, 1971; Spolander, 1983). This does not mean that drivers with high exposure are safer, as their lower crash risk per kilometre is offset by more crashes per driver, and annual mileage has been shown to be one of the strongest predictors of crash involvement (Massie *et al.*, 1997). However, it does make even more poignant the fact that young men have more crashes per kilometre driven than young women, despite driving more.

In any event, the fact that so many more young men than young women die in traffic crashes, in absolute terms or adjusted for exposure, reveals a particularly serious problem where this segment of the population is concerned, both in public health and road safety terms.

1.5. The Specific Circumstances of Young, Novice Driver Crashes

While young drivers are over-represented in most types of crashes, there are areas where this over-representation particularly stands out, and which provide important insights into the problem. These are discussed in the following sections.

1.5.1. Single-vehicle crashes, loss-of-control and turning across oncoming traffic

Young, novice drivers are heavily over-represented in single-vehicle and loss-of-control crashes. Swedish statistics from 1994–2000 show that 27% of crashes among 18–19 year-old drivers were single-vehicle crashes, while the share for other ages was 14% (Gregersen and Nyberg, 2002). Of fatal crashes, 32% were single-vehicle among the younger age group, and 24% among others. A similar pattern has been reported from several other countries, such as the UK, where 22% of crashes among 17–19 year-old drivers involved no other vehicle (Clarke *et al*., 2001), and the US state of Maryland, where the figure was 25.6% for 16 year-old drivers' crashes (Ballesteros *et al*., 2000).

Clarke *et al*. *(*2002), Harrison *et al*. (1999), and Laapotti and Keskinen (1998) show similar findings for loss-of-control crashes. Harrison *et al*. analysed crash data from Victoria, Australia, and found that loss-of-control accounted for 18% of causal injury crashes among young drivers. Laapotti and Keskinen found that loss-of-control among male drivers more often led to single-vehicle crashes, while the typical outcome from loss-of-control crashes among female drivers was collisions.

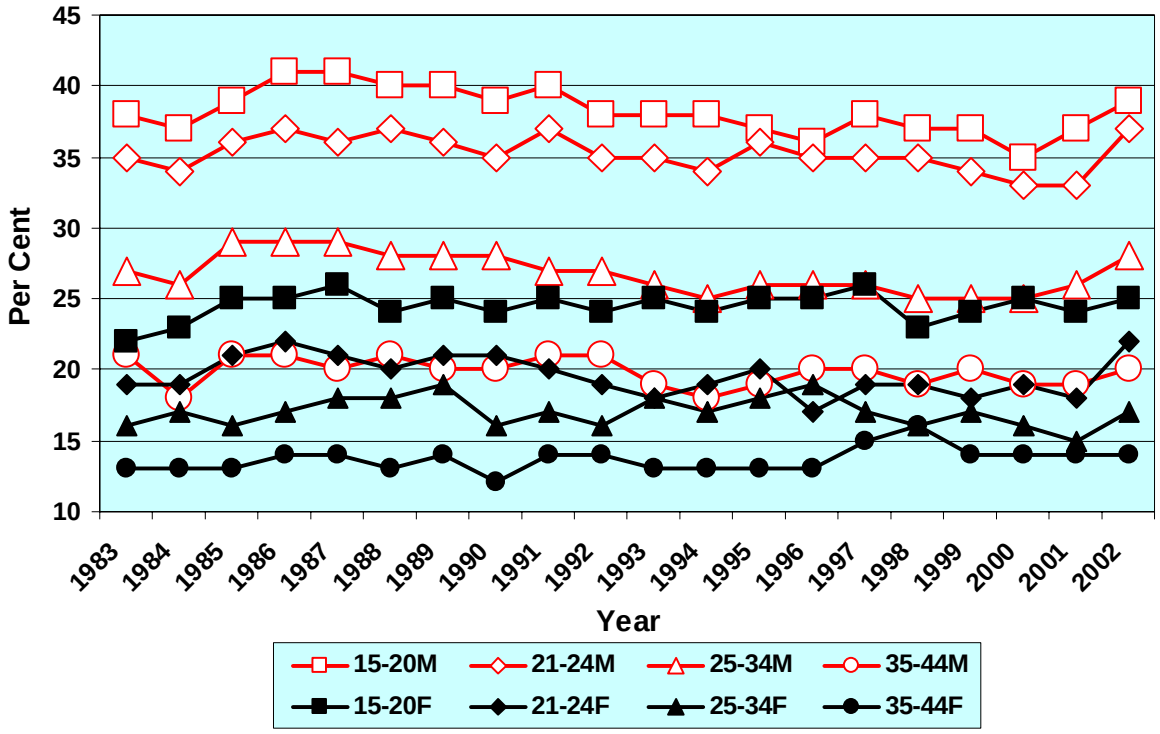
Younger drivers are also over-represented in crashes involving turning across oncoming traffic. A study of young driver crashes in Kentucky by Kirk and Stamatidis (2000) showed that the involvement in left-turn crashes was approximately 2.5 times more common among 16 than 20 year-olds. No significant gender difference was found in their data.

1.5.2. High-speed crashes

Analysis in California and Maryland (McKnight and McKnight, 2000) found that driving too fast was estimated to contribute to approximately 20% of young driver crashes. Among those crashes, failure to adjust to traffic or road conditions was the single largest (approximately 9%) subcategory. In an analysis of crash data from Victoria, Australia, Harrison *et al*. (1999) also found that young drivers were clearly over-represented in speed-related crashes. Speeding was most common among male drivers (almost 30% of all causation crashes) compared with females (about 21%); in comparison, speeding was found to contribute to approximately 15% of older drivers' crashes. The same study also found that speeding had the highest over-representation among young drivers on roads with bends, subject to speed limits of 70–90 km/h. Higher speed in combination with the fact that young drivers often have more passengers in the car also results in more people injured (Jonah, 1990; Evans, 1991; Twisk, 1994).

Figure 1.14. **Proportion of Drivers Speeding at the Time of Fatal Crashes, by Gender and Age Group**

US, 1983-2002



Source: Adapted from data provide by US NHTSA

Note: For each age group the gender of some drivers involved in fatal crashes was not identified.

The role of speed in young, novice driver fatalities is graphically represented in Figure 1.14, showing data for the US. Speeding is much more likely to be a factor in a fatal crash when the driver is under 25 years-old. Also, the younger the driver is, the more likely speed is a factor. This is particularly the case for young males. In fact, while speed is more likely to be prevalent in women's crashes when they are younger, women aged 21-24 have approximately the same level of involvement in speeding-related fatal crashes as men aged 35-44; this indicates that speed is particularly a male problem at any age, but worse among the young. It should also be noted that there is always a correlation between speed and the severity of crash injury, at any speed.

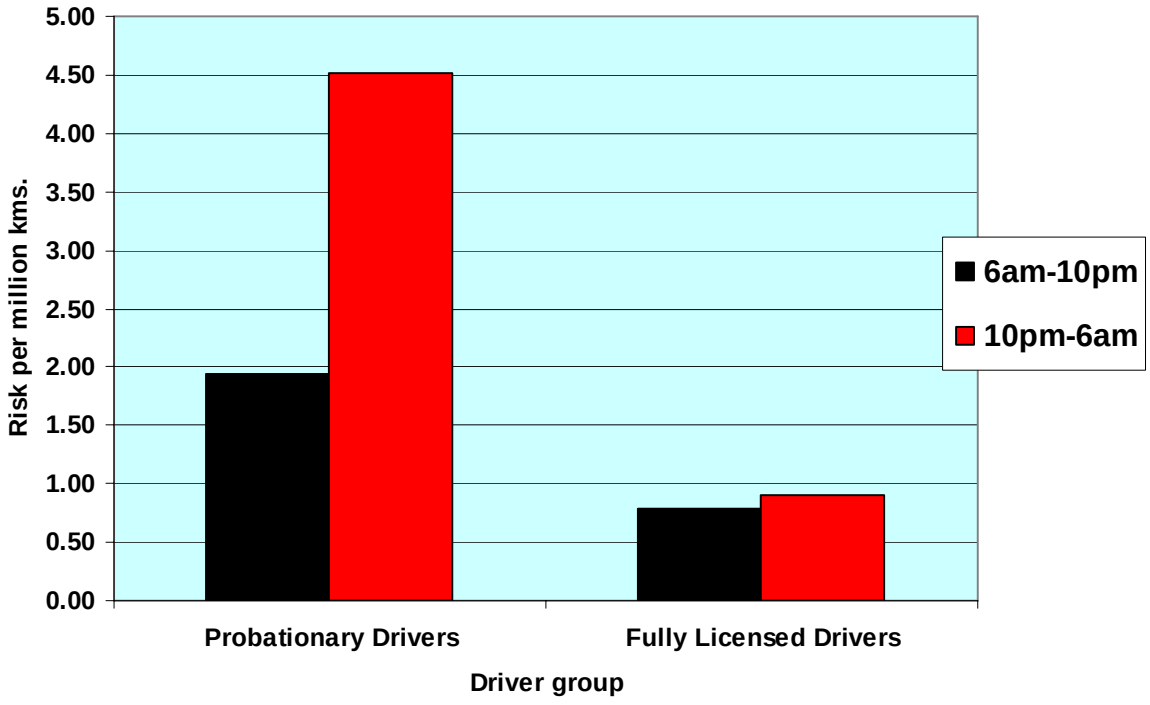
1.5.3. Time of day

There are relatively few studies that provide statistics on crash occurrence relative to time of day, and that also take into account distance driven. Swedish data from 1994 to 2000 on time distribution of crashes showed that 18–24 year-old drivers were over-represented at all times, but especially during night hours (Gregersen and Nyberg, 2002). In particular, 32% of 18-19 year-old drivers' crashes occurred during darkness, while the corresponding share for other ages was 22%. The difference was especially high on Friday nights between 19:00 and midnight, and Saturday nights between 19:00 and 2:00 am.

An American study (Williams, 1985) has shown a markedly increased risk per kilometre driven during night hours, a difference that was clearest among young male drivers. Williams established that, although just 20% of 16-19 year-olds' driving took place at night, 50% of their fatal crashes occurred during this period. The excess risk was particularly notable during weekends. Laapotti and Keskinen (1998) also found that fatal loss-of-control crashes involving young male drivers typically took place during evening and night-time hours, although, in these figures, there was no control for exposure differences. According to Twisk (1995), even older, more experienced car drivers have a higher crash risk at night, but the difference is less than in the case of young drivers.

Figure 1.15. **Probationary and Fully Licensed Drivers' Risk of Involvement in Casualty Crashes per Million Kilometres Driven**

Melbourne, Australia, 2000-2002

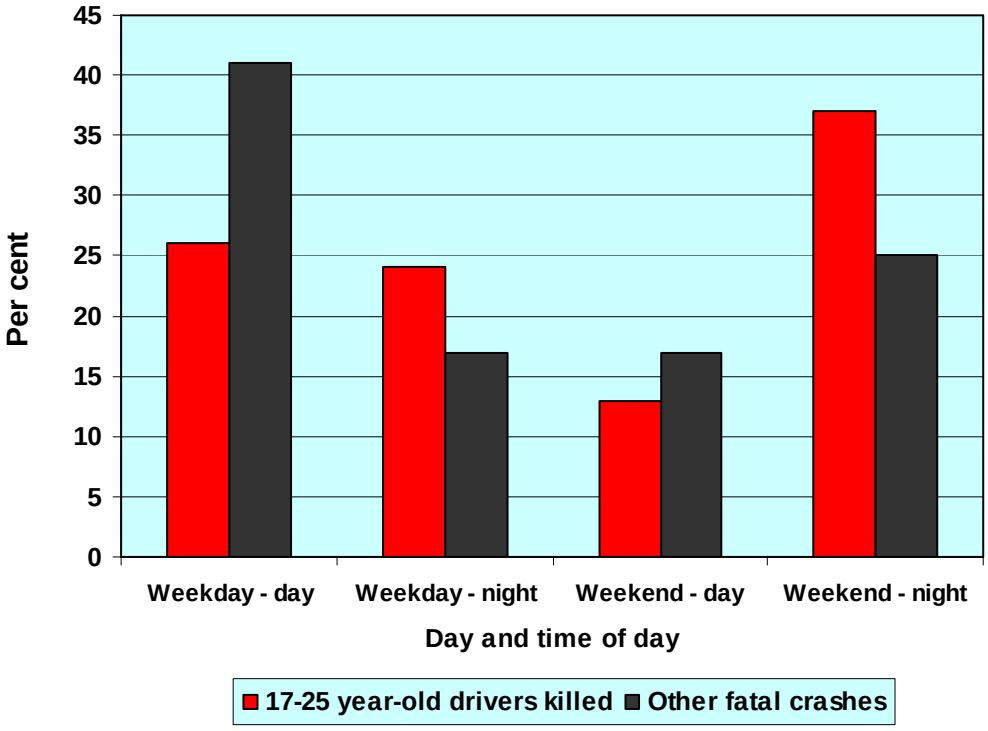


Source: Adapted from VicRoads, 2005.

Figure 1.15, with data from Melbourne, Australia, shows that, per distance driven, probationary drivers – defined as drivers in the first 3 years of solo driving – have higher casualty risk at any time of day, although their risk in relation to fully licensed drivers is almost five times higher during night-time hours, and only about twice as much during the day.

Figure 1.16. **Proportion of Fatal Crashes by Time of Day and Age Group**

Australia, 1993 to 2003



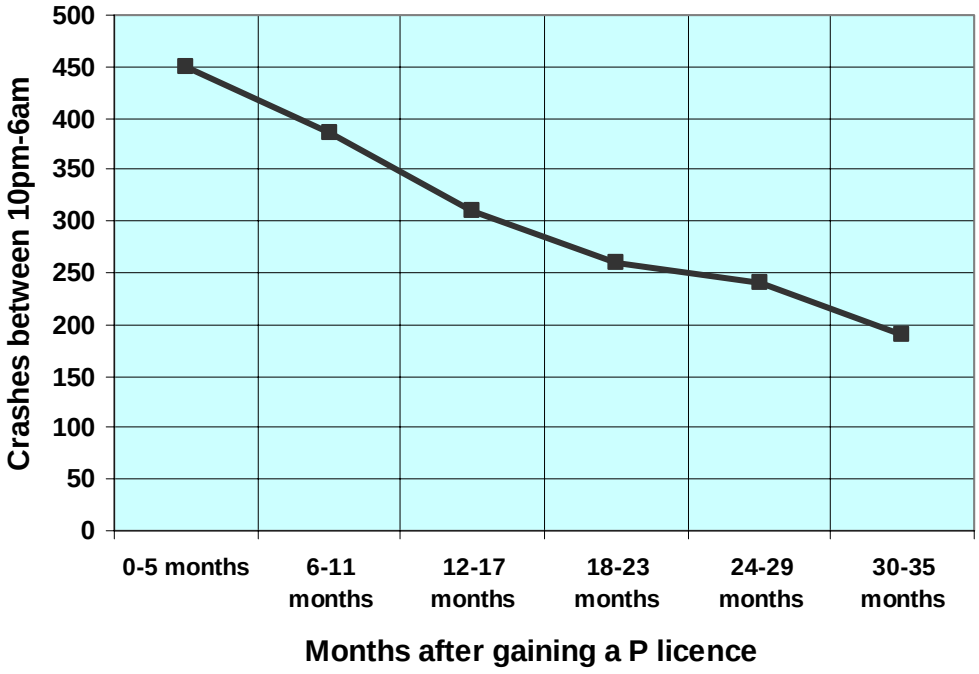
Source: Adapted from Australian Transport Safety Bureau, 2004.

Note: "Other fatal crashes" means crashes where someone other than a young driver is killed. Night means from 18:00 to 05:59.

Figure 1.16 shows that, for all of Australia, over 60% of young drivers' fatal crashes occur at night (between 18:00 and 05:59), including over 35% that occur at night on weekends.

Figure 1.17. **Late Night (10pm-6am) Casualty Crashes for Probationary Drivers**

Victoria, Australia

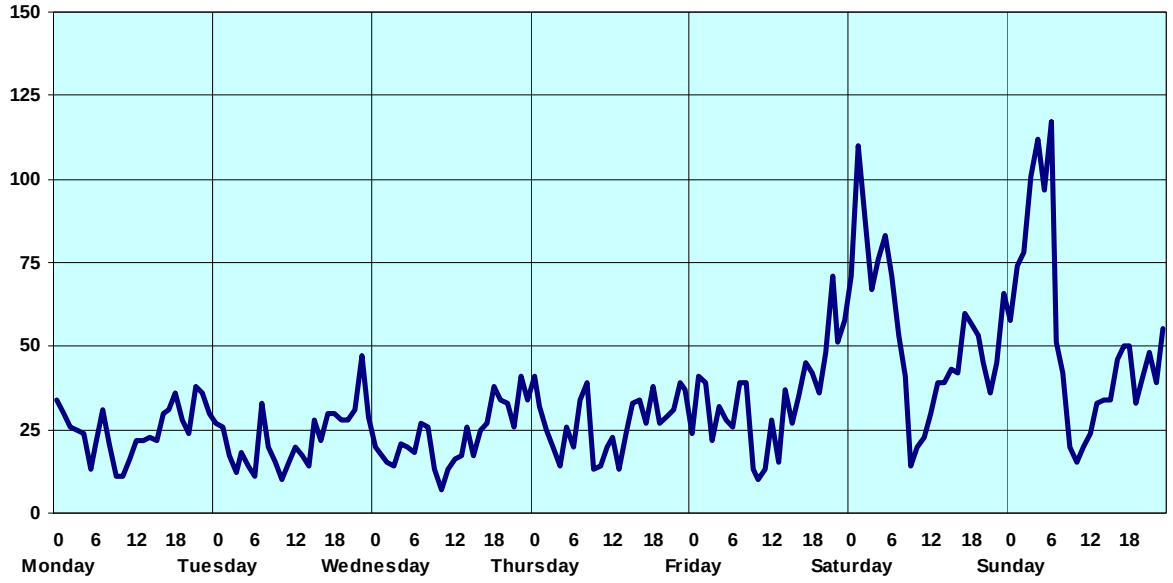


Source: Adapted from Howard, 2004.

Figure 1.17 shows that involvement in late night crashes reduces steadily with the number of months of experience.

Figure 1.18. **People Aged 18-25 Killed in Road Crashes, by Hour and Day of the Week**

EU 15 (minus Germany), 2004



Source: CARE (EU road accidents database)

Figure 1.18, with data from the initial 15 European Union members (minus Germany) in 2004, provides an indication of the impact of this increased risk in terms of overall fatalities for young drivers. These fatalities peak drastically in the early hours of Saturday and Sunday mornings. On weekdays, they are lower during daytime hours, when many people would be expected to be at work or in an educational facility, and rise swiftly at night-time, peaking before midnight.

US data also indicate that young driver risk is particularly high when travelling to and from school. A Transportation Research Board (TRB, 2002) report notes that, in 1991-1999, passenger vehicles driven by adolescents accounted for 16% of miles travelled by school students during "normal school travel hours", but resulted in 51% of all student traffic injuries and 55% of deaths in the same time periods. In contrast, 20% of student traffic deaths in normal school travel hours occurred while in a car driven by an adult, 16% occurred while walking, and 6% occurred on bicycles. It is difficult to directly compare between modes, because different age groups employ different means of getting to school; however, the high overall proportion of student deaths during school hours while in a vehicle driven by young people indicates a serious area of concern.

1.5.4. Fatigue

It is very difficult to estimate what proportion of all crashes is fatigue or sleep-related. Unlike alcohol, it is not possible to measure the degree of the driver's fatigue after a crash or have road-side fatigue testing. Depending on the method used (national crash databases, questionnaires or in-depth crash analyses), it is estimated that between 7% and 30% of all personal injury crashes are caused by fatigue or sleep (Sagberg *et al.*, 2004). In a literature review, Milanovic and Klemenjak (1999) note that drivers that are younger than 25 years of age are one of the groups with a higher-than-average risk for fatigue-related crashes. In interpreting these findings, it should also be borne in mind that fatigue as a crash cause is probably underreported.

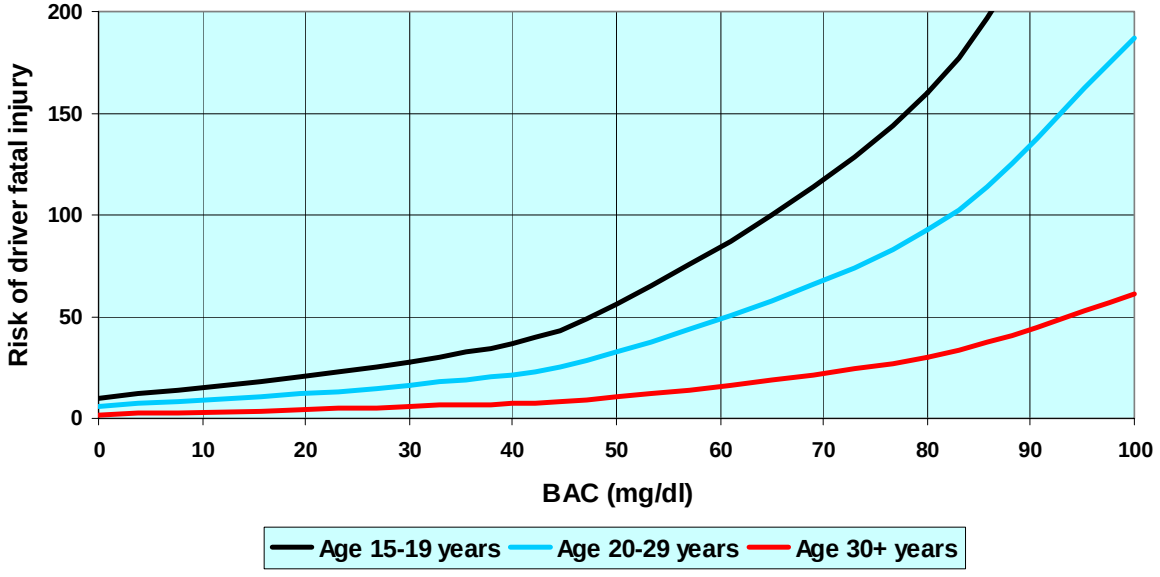
Corfitsen (1994) and Pack *et al*. (1995) (referred in Clarke *et al*., 2002), have shown that fatigue is an especially common problem among young male night-time drivers. Pack *et al*.'s study showed that, in the US, crashes that could be attributed to drivers falling asleep peaked at the age of 20. A study by the UK Department for Transport (DfT) showed that men aged 30 years and under are more likely to have a sleep-related vehicle crash (Flatley *et al*., 2001). However, this high representation in sleep-related crashes disappears when compared with each age group's total number of crashes.

1.5.5. Alcohol and drugs

Alcohol is a key element in many young driver crashes, particularly when combined with other factors, such as speed, night-time driving and passengers.

Figure 1.19. **Risk by BAC (mg/dl) and Age Group, Relative to Risk of Sober Driver Aged 30 or More**

New Zealand, 1995-2000



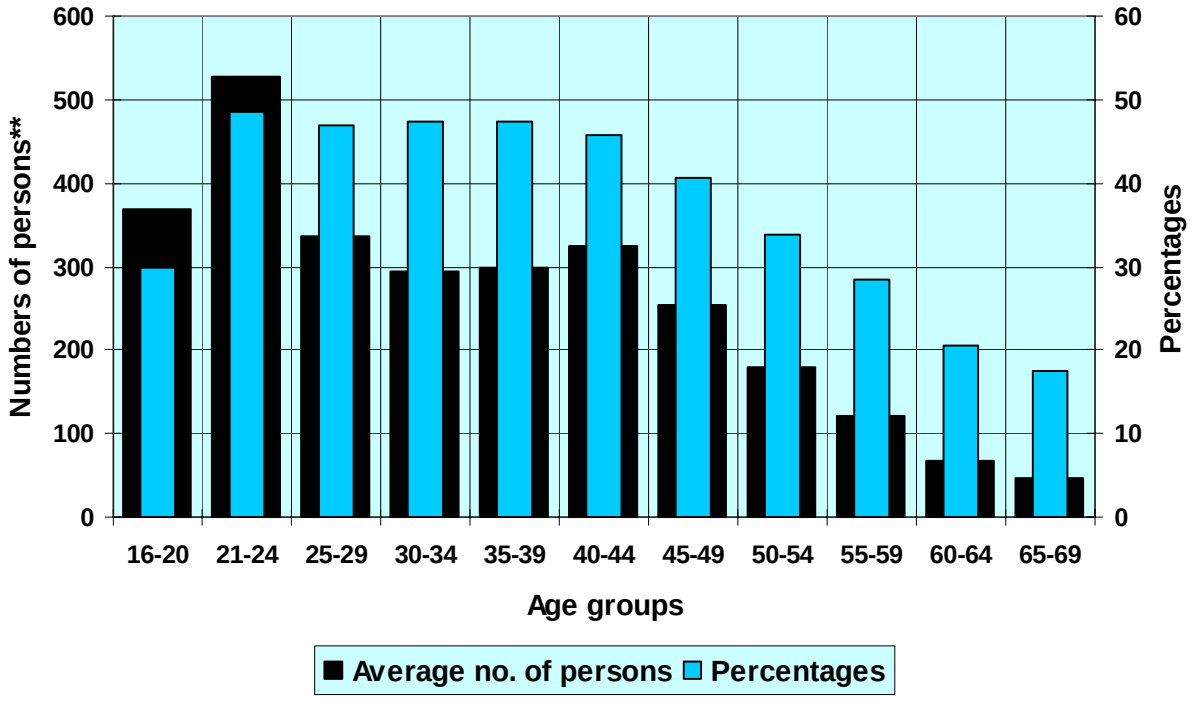
Source: Adapted from Keall *et al*., 2004.

While drink-driving is dangerous at all ages, the impact on young drivers is even more severe than for older drivers. As shown in Figure 1.19, a New Zealand study (Keall *et al*., 2004) revealed that the relative risk of a driver sustaining fatal injuries increases much more quickly along with each drink for younger drivers. The study also found that the risks to young drivers relative to the risk to sober drivers aged 30 or more doubles with each 20 mg/dl alcohol increase. A Norwegian study (Glad, 1985) found that if the fatality risk for a sober driver is set at 1, the corresponding relative figure for a drunk (BAC > 0.5 g/l) 18-25 year-old is 901, and 142 for a drunk (BAC > 0.5 g/l) person aged 25–49.

Preusser (2002) used the technique of induced exposure in which "not-at-fault" crashes were used to estimate different age groups' exposure. Based on the US Fatality Accident Reporting System (FARS) database and the BACs of fatally injured passenger car drivers for the years 1987-1999, he confirmed that young people's risk levels are more greatly affected by alcohol, even at relatively low levels, than those of older people. For example, at zero g/l BAC, a driver aged 21-24 has a 1.79 times greater crash risk than a driver aged 35-49. At 0.4-0.5 g/l BAC, the driver aged 21-24 has a 2.48 times greater risk than the driver aged 35-49.

Figure 1.20. **Number and Percentage of Persons Killed in Alcohol-Related* Vehicle Traffic Crashes, by Age**

US, 2003



Source: Generated from data provided by NHTSA (2003b), from the Fatality Analysis Reporting System (FARS).

Note: *"Alcohol-related" refers to crashes where alcohol was found in the driver or a non-occupant.
**Average values.

Also, keeping in mind that young people have more crashes than other age groups, even the same proportion of alcohol-related crashes will likely translate into a much higher absolute number of crashes and fatalities. Figure 1.20 provides an example from the US, whereby the percentage of 21-24 year-old fatalities in alcohol-related crashes[12] is somewhat higher compared with persons in age groups between 25 and 44. However, in 2003, this meant that an average of 527 21-24 year-olds died in crashes involving alcohol readings of 0.8 g/l or greater, compared to 337 for 25-29 year-olds and 294 for 30-34 year-olds.

These figures are only indicative, inasmuch as they do not refer specifically to the vehicle drivers; however, the much higher numbers of deaths among young people remain significant. A key explanation is that this relates directly to the high numbers of young, novice driver crashes. In other words, if young people drink and drive in the same proportions as others, the extent of alcohol-related fatalities among young drivers and their passengers will still be disproportionately higher.

The highest percentages of persons killed in alcohol-related crashes are among 23 and 24 year-olds. However, numbers are relatively high among 16-20 year-olds, despite the fact that it is illegal to buy alcohol at these ages in all of the US.

While alcohol remains a far more serious problem in most jurisdictions, drugs are increasingly a factor in crashes. In the UK in 1985, alcohol was present in 35% of fatalities, licit drugs in 5% and illicit drugs in 3%. In 1999, alcohol was still present in 35% of fatalities, licit drugs in 6% and cannabis in 17% (DETR, 1998). British surveys by the Transport Research Laboratory between 1985 and 1999 found that crashes involving drivers who had taken illegal substances increased 6-fold in this period (Department for Transport, 2005). A recent French study found that, for drivers considered at fault in fatal crashes from October 2001 to September 2003, 8.8% tested positive for the presence of cannabis in the blood (Laumon *et al.*, 2005). These studies do not pinpoint the impact of drugs on the young driver population. However, as seen in Section 2.3.2, studies in many countries are showing that drug use is particularly prevalent and growing among young people.

A separate French study tested the presence of illegal drugs in the blood of drivers under 30 years-old killed in crashes in France in 2003 and 2004, and found that THC (Tetrahydrocannabinol, the most active of the principle constituents of marijuana [cannabis sativa]) was present in 28.9%, compared to 16.9% in a study three years earlier. Between the same two studies, the presence of cocaine metabolites had increased from 0.2% to 3%, and of amphetamines from 1.4% to 3.1% (Mura *et al*. 2005). These studies show that the prevalence of illicit substances in crash–involved, younger drivers has increased. However, this pattern may simply reflect the prevalence of the substance in the (young) driver population.

With respect to safety impact, the Laumon *et al.* (2005) study estimated cannabis to be a causal factor in at least 2.5% of crashes, versus at least 28.6% for alcohol. The same pattern is seen in British studies, where alcohol was present in 35% of fatal accidents. This indicates that alcohol is still, by far, the most dangerous substance. These studies also reveal that the combination of alcohol and drugs is particularly dangerous (Raemakers *et al.*, 2004; Laumon *et al.*, 2005). Furthermore, the high prevalence of mixing alcohol and drugs confounds the ability to fully ascertain the impact of isolated drugs on crash risk (Turnbridge *et al.*, 2000; Longo *et al*., 2000).

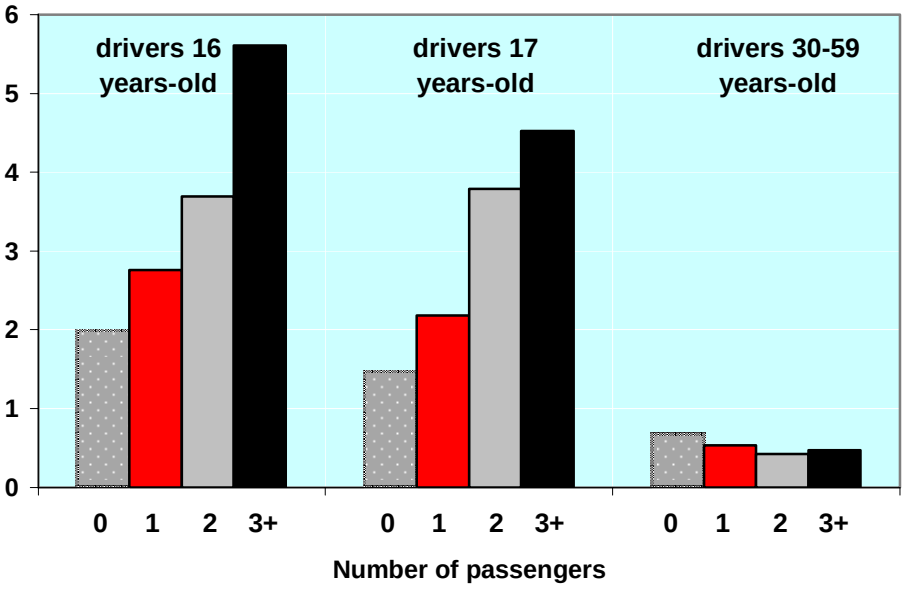
1.5.6. Passengers

Various studies have shown that young drivers' crash risk is significantly increased by the presence of similarly aged passengers in the vehicle, particularly if both the driver and passengers are men (Rothe, 1986; Preusser *et al*., 1998; Ingham, 1991a, 1991b).

In a crash register study of teenaged drivers, Williams (2000) found that crash risk increased with the number of passengers in the car. Among 16–17 year-old drivers, the crash risk was 4 times higher with 3 passengers than when driving alone. Among 18-19 year-olds, the risk was double and among older drivers the risk decreased with passengers. Data from Victoria, Australia, shows that passengers are present for 26% of fatal crashes involving "P-plate" (probationary) drivers, although only 9% of P-plate driving occurs with passengers in the vehicle (Howard, 2004).

Figure 1.21. **Driver Death Rates by Driver Age and Passenger Presence per 10 Million Trips***

US, 1992-97



Source: Chen et al., 2000.

* The authors did not consider possible differences in the nature of trips taken by younger and older drivers.

The negative impact of driving with passengers is demonstrated in research conducted by Chen *et al*. (2000), using data from the US Fatality Analysis Reporting System (FARS) (1992-97), Nationwide Personal Transportation Survey (NPTS) (1992-96) and General Estimates System (GES) (1992-97). These findings are shown in Figure 1.21, which reveals that the risk of driver death among 16 and 17 year-olds is much higher with passengers, and increases along with the number of passengers, although this is not the case for older (30-59) drivers. Notably, teenage drivers' fatality rates did not increase when carrying passengers who were 30 or more years-old.

The same research concluded that carrying passengers dramatically increased the risk levels among 16 and 17 year-old males; for example, fatality risk was 3.48 times higher for a 16 year-old male with passengers as opposed to the same person with no passengers. Carrying passengers "significantly" increased the risk for females in the same age group, but to a lesser extent (Chen *et al.*, 2000).

It is also important to note that, apart from increasing crash risk, the presence of passengers also increases the potential severity of crashes, if only because it increases the number of people who can be injured in a given crash. In the US in the period 1999-2003, an average of 3 659 drivers aged 15-20 died per year, and an average of 5 384 other people died in the same crashes, of which 46.8% were passengers in the young drivers' vehicles. Young drivers' passengers therefore accounted for 27.8% of all fatalities in these crashes (NHTSA, 2004).

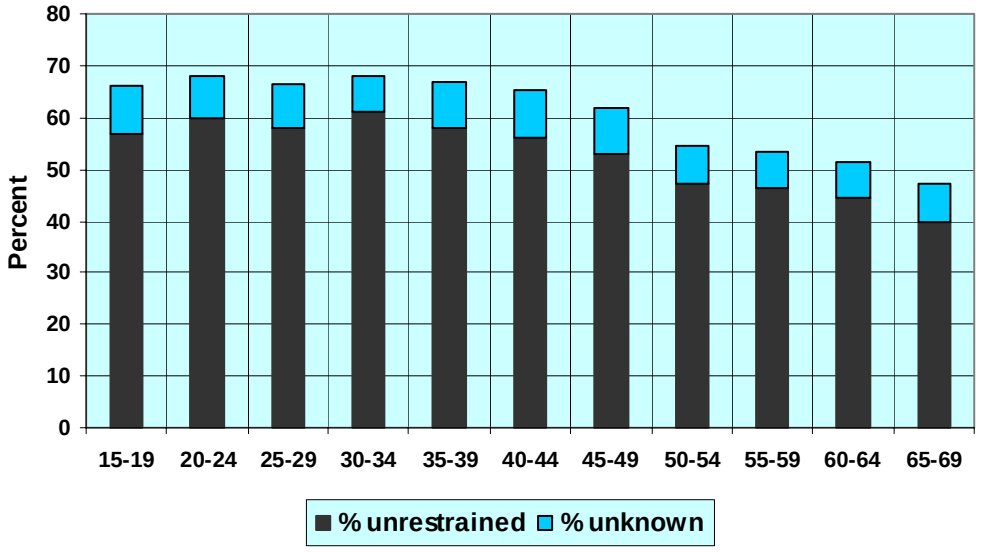
1.5.7. Non-use of seat belts

The non-use of seat belts has an important impact on the severity of young driver crashes, particularly with regard to the number of drivers and passengers killed and seriously injured.

In many countries, young drivers, especially males, are less likely than others to wear seat belts. In the European SARTRE (Social Attitudes to Road Traffic Risk in Europe) studies, approximately 17 000 European drivers from 15 countries were questioned about their opinions, attitudes and norms concerning traffic issues. Goldenbeld (1999) reported from these studies that half (50%) of the young male drivers in Europe reported not always wearing a seat belt in towns. Also, only 72% of young males reported that they always wear a seat belt on motorways. In annual observation studies of seat belt usage at a selection of roundabouts in Sweden, it is continuously shown that young male drivers are the most typical non-users. Approximately 83% of young male drivers (18–25 years-old) used a seat belt, compared with a 90% wearing rate for drivers of all ages. In fatal crashes, the seat belt was not used in 40% of the cases, a number that is even higher among young male drivers (Cedersund, 2002). In a closer analysis of seat belt usage among novice drivers, Matsuura *et al*. (2002) showed that novice male drivers started with a high (97%) wearing rate during the first 10 000 kilometres but reduced it to 76% during the following 10 000 kilometres.

Figure 1.22. **Proportion of Passenger Vehicle Occupants Killed in Crashes, by Age Group, Who were Unrestrained at the Time of the Crash**

US, 2003

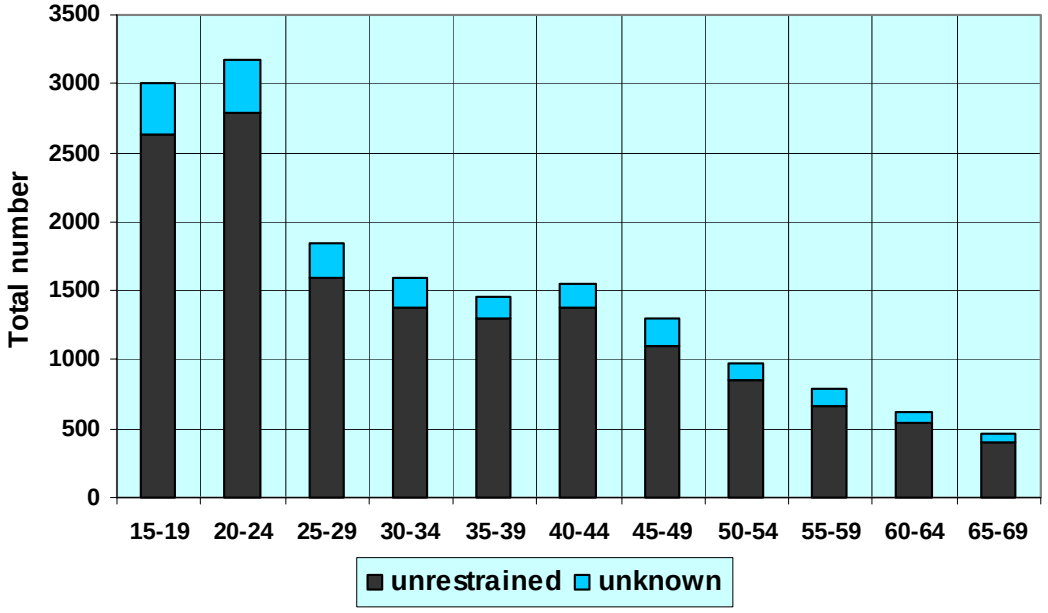


Source: Generated from data provided by NHTSA (2003c), from the Fatality Analysis Reporting System (FARS).

According to data provided by NHTSA, in the US, the proportion of passenger vehicle occupant deaths that are unrestrained at the time of the crash is not substantially higher for young occupants than for those aged 25-44. It is not until the mid-forties onward that this proportion starts to drop substantially (see Figure 1.22).

Figure 1.23. **Total Number of Passenger Vehicle Occupants Killed in Crashes, by Age Group, Who were Unrestrained at the Time of the Crash**

US, 2003



Source: Generated from data provided by the NHTSA (2003c), from the Fatality Analysis Reporting System (FARS).

However, given that young people have more crashes, and often involving circumstances that increase the repercussions, such as speed, this still likely results in higher numbers of young people dying in crashes where they are not wearing seat belts. Figure 1.23 shows the same situation from a different perspective, noting the total numbers of vehicle occupants dying in crashes where they are not wearing seat belts. The numbers are approximately double for young people than for other age groups, and are in the thousands. For the US in 2003, the total number of 15-24 year-old vehicle occupants dying unrestrained was 5 368, as well as an additional 764 where seat belt use was unknown. These data do not show that young people were at the wheel when the crashes occurred. However, as with the case of drink-driving, we should assume that the disproportionate overall representation of young people in these data is linked to higher levels of young driver crash risk.

1.6. The Costs of Young Driver Risk

The high numbers of fatalities and injuries related to young drivers' crashes pose an enormous economic burden on societies. The Netherlands' Institute for Road Safety Research (SWOV) has conducted the following analysis specifically for this project.

The costs of road crashes consist of:

- Medical costs.
- Production loss.
- Material costs.
- Settlement costs.
- Quality of life loss (also referred to as "human costs" or "human losses").

With the exception of quality of life, these costs can be estimated by using market prices. However, it is clearly impossible to place such a value on the loss of quality of life, which refers to immaterial costs, such as suffering, pain or sorrow. Thus, the concept of the "value of a statistical life" (VOSL) was developed, which is based on people's "willingness to pay" for a decrease in crash rates. This can be a payment for measures that are likely to decrease crash rates, but the concept of "payment" could be extended, for example, to include the willingness to choose a safer, but more time-consuming route to get to a destination. This information is derived from questionnaires that directly or indirectly elicit from people their "stated preferences" with regard to how much they are willing to pay to reduce crash rates (SWOV, 2005). The value placed on risk reduction is then used to measure the value of the "statistical lives" that would likely be saved by the crash rate reduction that people would be willing to pay for. This proceeds from the assumption that people constantly make decisions – whether consciously or not – that involve increasing risk in exchange for other "benefits", an example being speeding, whereby a driver increases his or her (and others') risk levels in exchange for arriving more quickly at a destination and the pleasures associated with driving fast. Obviously, VOSL is not an attempt to place an economic value on any individual life, which we presume to be impossible.

To give an indication of the overall costs of young driver fatalities in OECD countries, SWOV used estimates of costs per fatality from two sources:

1. ECMT (1998): ECMT proposes using 1.5 million euros per fatality (price level 1998) for human losses and loss of consumption. This figure is based on estimates of the VOSL for five countries. ECMT differentiated this figure to 17 European countries by using Purchasing Power Parity (PPP). For those countries SWOV used the ECMT estimates. The main advantage of this source is the comparability of the total costs of young driver crashes between countries; there are no differences in types of costs and valuation methods between countries.[13] SWOV then calculated other costs (settlement costs, medical and net production loss[14]) by assuming that they represent 10% of the total costs, based on Nellthorp (2001) and ECMT (1998). These costs do not include medical costs that are paid by insurance companies, or material costs. To calculate the human losses (which are part of the VOSL), SWOV estimated that these are about 70% of VOSL and that the other 30% is consumption loss.[15]

2. An overview by Sælensminde (2003) of costs per fatality for 22 countries. This study has been used for countries that were not included in the ECMT study. It draws a distinction between human losses and other costs for some countries. Only the estimates for these countries have been used here. As Sælensminde notes, the costs per fatality differ between countries for various reasons, like differences in methods used and cost components included.

Table 1.4 summarises the results.

Table 1.4. **Cost Calculations of Young Driver Fatalities for Various OECD Countries**

(*Note:* Includes young driver alone, and not other fatalities in the same crash)

2004

	Number of young driver fatalities	Cost per fatality including human losses (million euros, 2004)	Total costs including human losses (million euros, 2004)	Total costs excluding human losses (million euros, 2004)
Australia (1)	195	1.16	227	179
Canada (1)	262	1.37	360	-*
NZ (1)	51	1.66	85	-*
USA (1)	3 999	3 58	14 333	3 715
Iceland (2)	3	2.19	6	2
Austria (3)	110	1.78	196	72
Belgium (3)	154	1.83	281	104
Denmark (3)	35	1.86	65	24
Finland (3)	43	1.70	73	27
France (3)	645	1.80	1 159	429
Germany (3)	750	1.82	1 362	504
Greece (3)	105	1.65	173	64
UK (3)	330	1.85	611	226
Ireland (3)	31	1.93	60	22
Netherlands (3)	74	1.96	145	54
Norway (3)	25	2.04	51	19
Portugal (3)	80	1.72	137	51
Spain (3)	322	1.83	591	219
Sweden (3)	40	1.77	71	26
Switzerland (3)	49	1.85	90	33

Source: SWOV, based on figures in Table 1.1

(1) Source of calculations: Sælensminde (2003)

(2) Source of calculations: Calculations by SWOV

(3) Source of calculations: ECMT (1998)

* Equivalent data not including human losses was not available for Canada and New Zealand.

It should be noted that these are based on estimates for the average driver. The costs of young driver crashes may differ from these estimates for various reasons. For example, the medical costs might be lower and production losses are likely to be higher. For several countries there are no cost estimates available. Only for Iceland did SWOV calculate the costs per fatality based on the ECMT estimate, correcting for differences in income.[16]

All cost estimates are expressed at the 2004 price level by correcting for inflation (using GDP deflators published by the OECD) and in the same currency (euros) using PPPs published by Eurostat. The costs per fatality were then multiplied by the number of young driver fatalities for each country, resulting in an estimate of the total costs of young driver fatalities, including human losses.

The calculations indicate that the total costs of young driver fatalities in the countries mentioned are about 20 billion euros (price level 2004). A large part of these costs, about 14 billion euros, are human losses. The other costs (medical costs, gross production loss and settlement costs) are about 6 billion euros.

Victims of young driver crashes killed along with the young drivers are not incorporated into the calculations in Table 1.4, nor are the costs of injuries. Thus, obviously, the full costs of young drivers' crashes would be much higher. SWOV also sought to calculate these full costs for 2003, taking the Netherlands as an example. Along with 91 young driver fatalities in the Netherlands in 2003, 48 passengers and 64 others were also killed. Furthermore, 784 young drivers were hospitalised (SWOV, 2004). To calculate the total costs of young drivers crashes in the Netherlands, SWOV used the cost estimate of 1.5 million euros proposed by the ECMT and 0.2 million euros per severe injury (price level 1998)[17]. On that basis, the costs of people killed along with the young drivers are about 200 million euros, in addition to the initial 170 million euros represented by the young drivers themselves. The costs of young driver injuries are about 150 million euros. This means that the total costs of young driver crashes in the Netherlands amounted to more than 500 million euros in 2003.[18]

The US provides another example. In 2002, the US government estimated the economic costs of police-reported crashes involving drivers between 15 and 20 years-old to be $40.8 billion (NHTSA, 2002). US officials subsequently confirmed that, when NHTSA calculates the cost components, it includes productivity losses, property damage, medical costs, rehabilitation costs, travel delay, legal and court costs, emergency services (medical, police, fire, etc.), insurance administration costs and the costs to employers. Values for more intangible consequences, such as physical pain or lost quality of life, are not included in the estimate.[19]

A point worth noting is that, currently, many resources are employed dealing with the aftermath of crashes. By spending more in successfully preventing crashes, the social costs would be substantially reduced. This question is explored more in Chapter 6.

1.7. Countries at Different Levels of Motorisation

Data specific to young drivers is less available outside of the OECD countries. While Chapter 7 provides a more complete treatment of non-OECD countries, the following points are worth noting in the context of a general overview of the situation where young, novice drivers are concerned.

While road safety figures are largely improving within the OECD, this is not generally the case elsewhere, including in many ECMT countries.

Linked to this is the fact that traffic fatality risk tends to increase rapidly along with income growth up to a certain level of national income, then decline steadily (WBCSD, 2004; Kopits and Cropper, 2005; Koornstra, 2006). Obviously, the OECD countries have reached the point of income where their overall fatality levels would be expected to drop, although most other countries have not. For example, Kopits and Cropper (2005) predict a 66 percent overall rise in the global road death toll to 2020, compared to a 28% decline among developed countries, although Koornstra (2006) notes that fatality levels will also eventually drop in developing countries. This includes a projected 97%

increase in China and 147% increase in India (Kopits and Cropper, 2005), as well as increases in various Commonwealth of Independent States countries that are also part of the ECMT.

The impact on young, novice passenger car drivers of this overall rise in risks is unclear, particularly as the higher risk levels associated with lower income are partially the result of more motorcycles and scooters. However, there are indications that initial increases in income levels could be accompanied by a rise in risk levels specifically for drivers, as more people gain access to passenger vehicles. Based on the experience in the OECD countries, it should be assumed that the situation of young drivers in most countries will be substantially worse than that for drivers overall. Furthermore, as the populations in developing countries are generally significantly younger than those in the OECD countries, this indicates that there will also be more potential young drivers.

As noted in Chapter 7, more research is required on this particular issue. Furthermore, international co-operation, such as the UN Road Safety Collaboration led by the World Health Organization[20], are important to reduce the impact of road safety risk in general, including for young people.

1.8. Conclusions

This chapter has sought to reveal the scope of the young driver problem, as well as some of its specific characteristics. These data are particularly important, as they provide essential information regarding the need to take action, as well as the elements that must be addressed to resolve this problem.

We have seen that the high levels of traffic crash risk of young, novice drivers and related fatalities and injuries constitute a serious public health problem, endangering the lives and health of tens of thousands of people across OECD and ECMT countries every year, and resulting in huge costs to their societies. While numbers of young driver fatalities have diminished in OECD countries along with overall improvements in road safety, an important gap has stubbornly remained between the safety levels of younger and older drivers, indicating that this particular problem has not been sufficiently addressed. Overall road safety levels, including for the young, have decreased in many other countries, including some that are ECMT members.

The key factors behind these high levels of young driver risk are experience, age and gender. Inexperience has an enormous impact on risk, particularly in the few years immediately following licensing. At the same time, risk levels decrease as the age of initial solo driving increases, meaning that age itself is an important contributing factor. Men have much greater fatality risk than women at most ages, and this is particularly pronounced among younger drivers. It is this combination that makes driving by young novices particularly dangerous for themselves, their passengers and other road users.

Young, novice driver risk is also known to be exacerbated under various conditions. In particular, young drivers are over-represented in crashes while driving at high speeds, at night, with other young passengers and under the influence of alcohol and drugs, as well as in single-vehicle crashes. Furthermore, non-use of seat belts increases the severity of their crashes. In all of these circumstances, young men are particularly over-represented.

The next chapter seeks to explain the reasons behind these factors and circumstances.

NOTES

1. According to Evans (2004), a traffic crash is defined as the act of a vehicle striking anything. Throughout this report, we refer to "crashes" and not "accidents" to highlight the fact that traffic crashes are not unavoidable acts of fate, but rather the avoidable results of circumstances and human acts.
2. Countries covered by IRTAD in 2006 were: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxemburg the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and the United States of America.
3. Calculated from the WHO Mortality Database. The actual figure was 24 921, including only those countries cited in Figure 1. Therefore, this is likely a rather conservative estimate.
4. Data provided directly by officials of the World Health Organization.
5. Age groups were chosen to capture the fatalities of young drivers from the point at which they can drive solo, although in many countries' systems people first start driving under protective restrictions. Unfortunately, national-level data do not reflect the licensing age differences among states and provinces within a given country, such in the US and Canada; thus, the ages chosen for these countries are intended to reflect when the majority of people are first allowed to drive solo, even if under protective conditions.
6. The figures in Table 1 add up to 8 254 young driver deaths. However, keeping in mind that data were not available for Italy, Luxembourg, Mexico and Turkey, it must be assumed that the numbers are significantly higher. 8 500 is a relatively conservative estimate.
7. Note: This refers to fatalities per million persons in that age group.
8. Data provided by the UK Department for Transport.
9. It is important to note that there are individual factors that explain why some people get their driving licences as soon as possible and why others wait several years. This implies that what is shown in the graphs above may not only be caused by age and driving experience alone, but can also be due to personality differences between people who choose to drive at an early age and people who start to drive later. It is not possible to correct the diagrams for this self-selection bias.
10. It should be noted that licensing systems have changed since this report was written. Notably, graduated licensing (GDL) systems have been implemented throughout the US. See Annex A.
11. An alarming additional point resulting from this research is that between 58 and 35 per cent of questionnaire respondents reporting driving before the legal learning age. Interestingly, these numbers were lower for those jurisdictions where the legal driving age was higher.
12. This refers to crashes where either a driver or non-occupant (*e.g.* cyclist or pedestrian) showed signs of alcohol consumption.
13. The ECMT figures do not take into account, however, differences between countries' circumstances, such as their productivity.
14. Net production loss is (gross) production loss minus consumption loss.
15. This can be calculated from INFRAS/IWW (1995), which is the main source of the ECMT figures. The VOSL of 1.5 million euro is based on VOSL studies in five countries. Consumption loss turns out to be about 30% of the VOSL in these countries.
16. SWOV calculated this the same way as ECMT (1998) did, including an income elasticity of the VOSL of 0.3.

17. A recent study shows that the VOSL in the Netherlands is 2.2 million euro (price level 2001; SWOV, 2005). The costs of a fatality are therefore higher than the ECMT estimate. For comparability with the figures above, SWOV used the ECMT figures.

18. Note: This is still an underestimate, as medical costs that are paid by insurance companies and material costs, which are not included in ECMT figures, are not taken into account.

19. As the basis for these calculations is different from that used by SWOV, the results are difficult to compare directly. Any differences between the SWOV calculation and the US figures can likely be explained by (1) inclusion of other deaths ('multiplier effect'), (2) inclusion of injuries and (3) inclusion of property damage.

20. www.who.int/violence_injury_prevention/road_traffic/en/

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CHAPTER 2.

YOUNG, NOVICE DRIVERS' BEHAVIOUR AND RISK EXPOSURE: FACTORS BEHIND THE PROBLEM

Abstract

This chapter seeks to explain why young, novice drivers are subject to higher levels of crashes and crash fatality risk. In doing so, it notes that the key, overarching factors behind this problem are age, experience and gender, and that this risk is exacerbated by the circumstances in which many young people often drive, including at night, with young passengers, at high speeds, and without proper use of in-vehicle safety measures. We see that young people are subject to, inter alia, a complex blend of emotional and physical immaturity, personality and gender-related factors, the lifestyles and social norms associated with youth, the challenge of learning to drive, emotions, and in-vehicle distractions, all of which combine to make them more at risk behind the wheel than older, more experienced drivers.

2.1. Introduction

The young driver problem has drawn the attention of many traffic psychologists in recent decades and a vast amount of research is available. Chapter 1 noted that the factors that influence young, novice drivers' high crash risk are age, experience and gender. It also highlighted the characteristics of crashes in which young, novice drivers are over-represented, notably single-vehicle, loss-of-control, and high speed crashes, and those on weekend nights, in the presence of passengers of the same age group, and involving alcohol. These broad factors and crash characteristics are only indicative; they do not explain *why* young novice drivers have such high crash risk. This chapter provides an overview of current knowledge regarding the underlying causes of that risk, with a view to supporting the countermeasures proposed in Chapters 3 and 4.

In presenting this material, it is important to underscore a key starting point for our analysis. It is clear from Chapter 1 that young drivers themselves are a high-risk sub-group of all drivers, and that young males are a further high-risk group. However, this does not make all young drivers, or all young males, high risk. Indeed, we must assume that most young drivers genuinely want to drive safely, and that only a small minority intentionally engages in high-risk behaviour. It should be noted that the universal problem of young, novice drivers is inexperience and, as most people learn to drive while they are young, this explains much of the high levels of young driver risk. Beyond this, a minority of young drivers fails to manage a complex range of additional risk factors and is thus involved in a further disproportionate number of fatal crashes. The extent of risk decreases as the age of first solo, unrestricted driving increases, and young men are more likely to have serious crashes than young women.

With those points in mind, this chapter focuses both on elements that are common to all young drivers, such as the impact of experience and age on the execution of the driving task, and on those that are specific to individuals, such as personality types or social circumstances. At the same time, it should be clear that current knowledge does not allow us to identify individual high-risk drivers before they engage in dangerous behaviour, and this will condition potential countermeasures, as seen in Chapter 3.

The simplest structure for presenting the factors and aspects of young, novice driver risk would be a break-down between age and experience-related causes. However, the problem with this is that, to a large extent, both are interrelated, and certain factors (*i.e.* gender) have an age, as well as an experience, component. Indeed, none of the many existing models and taxonomies regarding driving behaviour is capable of clustering related aspects and factors in a couple of categories without any overlap. Thus, we have chosen a "bottom-up" approach for structuring this chapter, focusing on the principle subjects mentioned in the literature, which leads us to the following main categories:

1. General "nature" and "nurture" aspects of young, novice drivers, not directly related to driving.
2. Acute impairments (alcohol and drugs, fatigue, distraction and emotions).
3. The acquisition of driving skills (including the improvement of hazard perception skills).
4. The willingness to drive safely, and self-assessment (including motivation).
5. Risk-enhancing circumstances (elements of exposure).

It is important to note that no organisational structure for the presentation of this information can be perfect, and many issues will be relevant to more than one of these categories.

2.2. General "Nature" and "Nurture" Aspects of Young, Novice Driver Risk

This category deals with the very fact of being young and being part of society as a young person. Elements in this category are biological factors (*e.g.* developmental stage), gender differences, personality traits, lifestyle, peer group pressure and driver behaviour as a general expression of life.

2.2.1. Biological factors

The biological and physiological aspects of development are not often discussed in relation to driving behaviour. However, they are clearly relevant.

Neurobiology research has shown that the specific wiring of each individual's brain is causal to behaviour output, and research findings regarding brain development provide important insights, although no work has been identified directly focusing on this issue in the context of driving. Longitudinal studies with the aid of MRI scans, mainly emerging from the US during the last decade, have researched brain development during adolescence. These studies have demonstrated that, beyond the age of 18, the human brain is still developing, especially those areas in the frontal lobe that deal with "executive" functions like planning, impulse control, reasoning and the integration of information (*i.e.* "thinking before acting") (Sowell *et al.*, 1999; Gogtay *et al.*, 2004; Giedd, 2004). These findings could have an important influence on the discussion regarding how to counteract young driver risk, particularly as the combined ability to take responsibility, reflect on consequences and control impulses plays an important role in driving safely. However, much research remains to be done in order to disentangle the processes that may be influenced by education and experience from those that are solely dependent on physiological development of the brain, especially as physiological and psychological maturation are closely linked and dependent on each other.

Furthermore, the late maturation of parts of the brain is not the only biological aspect relevant to young drivers' traffic safety risk. Sixteen year-old boys have about 20 times more of the sex hormone testosterone in their body than they had just before puberty. Girls' testosterone levels also increase during puberty, but only four-fold, and the amount of testosterone is already much lower in girls than in boys during their infancy (Arnett, 2002). Daitzman *et al.* (1978), Dabbs and Morris (1990) and Bogaert and Fisher (1995) found a positive correlation between sensation-seeking and testosterone levels, providing one very basic explanation for why men are more prone to risky behaviour patterns than women.

Other studies (*e.g.* Gerra *et al.*, 2000) discuss a relationship between neurotransmitters like serotonin or dopamine, and sensation-seeking and risk-taking behaviour. For example, there is significant evidence to suggest that high levels of serotonin can result in aggressive behaviour under certain circumstances, and levels of both serotonin and dopamine tend to be different between boys and girls. However, exact cause-and-effect relationships between the sexes' driving behaviour and different levels of bodily substances are not yet established (Ellingrod *et al.*, 1997).

In another example, Barkley *et al.* (2003) found that adolescents and young adults with attention deficit hyperactivity disorder were more likely to receive traffic citations, had more crashes, and had more serious crashes.

Because of the biology-driven aspects of behaviour, some believe that the effects of education and training will always be marginal when the proper biological developmental stage has not yet been reached. However, this conclusion is rather too fatalistic. Biological development is not completely autonomous and, to a significant extent, is influenced by experience. Biological factors alone do not explain why young drivers experience higher risk, indicating that an integrated approach, including

social and context factors, would be more appropriate for explaining driving behaviour patterns. However, due to the fact that there is close interaction between the nurture and nature domains, when developing educational programmes one should always be aware of the limitations posed by the biological aspects.

2.2.2. Differences between men and women

As shown in Chapter 1, it is clear that young male drivers' risk levels are much higher than those of young females, even when exposure is taken into account.

Young males drive more than females. In Finland, for example, women drive half as much (Laapotti, 2003). However, the type of driving is also important. Qualitatively, females' driving exposure often includes less exposure to risk than that of males. Young females drive proportionally more in built-up areas, where crashes are likely to be less severe, and more often prefer to avoid bad weather conditions (Forsyth *et al.*, 1995; Laapotti, 2003). Young males typically drive more during leisure time and at night, with friends and passengers, and have more crashes under these circumstances (Rolls *et al*., 1991, 1992; Begg and Langely, 2001; Laapotti, 2003).

According to Laapotti (2003), young males and females behave differently as drivers. Overall, female drivers tend to be more safety-oriented than males (Meadows and Stradling 1999; Laapotti 2003). Laapotti *et al*. (2001) conclude that gender differences in young drivers' behaviour may be explained by their different "goals for life and skills for living". The meaning of driving is different to females and males. While females tend to travel directly from one place to another, males spend more time simply driving for the sake of driving. Gregersen and Berg (1994) and Schulze (1990) have also related males' high traffic crash risk to a greater propensity to take risks in their everyday lives, in comparison with females.

In a questionnaire, Schulze asked young drivers what was important to them in life and what they preferred to do in their leisure time. The subjects in the questionnaire ranged from what they did in their leisure time (*e.g.* visiting discotheques), the style of music they preferred, the type of movies they watched, the clothes they wore, the different youth cultures (*e.g.* punks, soccer fans) they related to, and their drinking habits, as well as their driving behaviour. On the basis of this he identified three distinct lifestyles that were associated with risky driving behaviour, and the overwhelming majority of the subjects in these were male. Schulze provided the following typology for the participants in these dangerous lifestyles:

1. The *Action Type*: Action types like to visit pubs and discos, cars are important to them and much of their driving is just for fun. They like to be cool and sexy, prefer action films and are not interested in intellectual subjects.

2. The *Fan Type*: Fan types like soccer and visiting discos. Like action types, they like to drive for fun, although, apart from soccer, discos and driving, there are no other leisure activities they derive pleasure from.

3. The *Nonconforming Type*: Nonconformists dislike common beliefs and values and popular activities (*e.g.* soccer matches). They relate to environmental activists and pacifists and strongly dislike the fan type.

The consumption of alcohol in these three dangerous lifestyles is above average.

Gregersen and Berg (1994) also conducted a survey with a questionnaire that covered even more lifestyle aspects than in Schulze's study. Their work identified four lifestyles with higher traffic crash risk and two lifestyles with lower traffic crash risk. Young drivers that belonged to the first dangerous lifestyle group are seldom active in sports and often drink. They like cars, use their cars quite often and have more extra motives (such as showing off and sensation-seeking) when driving than the average person. Seventy-nine percent of the subjects classified as belonging to this lifestyle group were men.

Members of the second dangerous lifestyle group also drink more than average but, unlike the first group, they do not often drive just for fun or to alleviate boredom. However, they like cars and use them quite often. They score high on cultural activities and are interested in clothes. Sixty-two percent of the members of this lifestyle group were men.

Young drivers showing the characteristics of the third dangerous lifestyle group drink less then average. For them driving is primarily a means of expression. They are interested in cars and drive much, especially during night hours. They are not as interested in social engagement as the average person, but they like clothes, films and going out. Seventy-nine percent of the subjects in this lifestyle group were men.

The fourth and last dangerous lifestyle group differs from the others in that they socialise much less. Just like the third dangerous lifestyle group, driving for them is primarily a means of expression. They do not drive very often, but, when they do, they drive mainly without any destination in mind. They are not interested in clothes and are not socially engaged. Sixty-one percent in this group were men.

The first safe lifestyle group (having a traffic crash risk that is lower than average) seldom drives and is not interested in cars. They rarely drink alcohol and score higher than average on cultural, romantic and social engagement. Sixty-nine percent in this safe lifestyle group were women. The members of the second safe lifestyle group are fond of sports and very seldom drink alcohol. When they use a car, it is for driving to parties. They are not interested in films, clothes and cars. Sixty-eight percent of the subjects in this safe lifestyle group were women.

In general, women are more concerned about safety-related issues. They are also, to a larger extent than males, afraid of getting injured or killed in crashes (Dodd and Mills, 1985). One study showed that young males are more interested in competing and generally have a higher learning interest towards technical subjects, such as the functioning of cars and computers, whereas women appear to be more interested in learning about health and interpersonal relationships (Jones *et al.*, 2000).

In an Icelandic study on the traffic offences and driving behaviour of young drivers (Gylfason *et al.* 2004), several important differences between young men and women were found when observing speed and driver gender. Young men were more likely than young women to drive above the speed limit. When the speeds of those who drove above the speed limit were examined it was also found that men and women exceeded the speed limits equally. One explanation for the difference in speeding tendency was revealed in a questionnaire study in which male drivers were found to believe that they could drive faster without being stopped by the police. In the same questionnaire, 16% of drivers, mostly men, reported having a radar detector in the car. Also in the Icelandic study, men were shown to be clearly overrepresented in driving through red lights and drink-driving (Gylfason *et al.* 2004).

In a UK cohort study (Forsythe *et al.*, 1995), speeding was found to be by far the most common offence among both male and female young drivers. They also found that the number of offences for

speeding increased during the first three years of driving. In observation studies by Waylen and McKenna (2002), young drivers in the UK were found to drive significantly faster than older drivers, and male drivers significantly faster than female drivers. They also observed speed choice in a curve judged to be dangerous and found that young male drivers chose speeds that were higher than those chosen by either younger female drivers or older drivers of either sex.

In the European SARTRE (Social Attitudes to Road Traffic Risk in Europe) studies, questions were asked about speed choice. Thirty-five percent of young male drivers reported that they drove faster than other drivers and a similar share (33%) said that they drove above the legal speed limit (Goldenbeld, 1999). The percentage of speeding drivers was found to decrease with increasing age and was substantially lower among women of all ages. These results are in line with those of Begg *et al.* (1999), in their longitudinal study of a cohort of 1 037 young drivers in New Zealand, where 38% of the males and 11% of the females reported that they often drove faster than 120 km/h on the open road where 100 km/h was the speed limit.

Waylen and McKenna (2002) found, on questioning school children aged 11-16, that many of the attitudes and behaviours associated with risky drivers are actually present in individuals at ages much younger than 17, and gender differences were also apparent. Boys were more confident about their knowledge of driving than girls, and thought that learning to drive would be easier. They also reported that they would be more inclined to be influenced by the expectations of their friends, and were found to have a greater affinity for speed than girls. When asked questions about hypothetical driving violations (*e.g.* whether it is acceptable to run red lights), although they did not condone these overall, boys condoned violations to a greater degree than girls. Older children also thought that listed dangerous driving activities were less dangerous than did younger children. Boys scored higher in sensation-seeking and were more prone to anti-social behaviour than females. Boys were more competitive, and became more competitive with age. These differences in individual characteristics associated with risk-taking show the same patterns generally found in drivers – males report more sensation-seeking, anti-social and competitive behaviour than females. These individual characteristics are also positively associated with speed choice and violations.

There are also differences between men and women when looking at driver education. Although gaining driving experience varies from one country to another, some general results exist. Females take more lessons than males before the driving test and still find it more difficult to pass both the theoretical and practical tests (Maycock and Forsyth, 1997; Laapotti *et al.*, 2003). While female drivers have more problems than males with formal driving instruction and examination, as independent drivers, young females behave and manage on average better than their male counterparts (Maycock and Forsyth, 1997). This could also indicate a male bias in many current instruction and examination techniques.

The proportion of female driving licence holders has increased over recent decades in Western countries (Laapotti, 2003; Mayhew *et al.*, 2003). Recent research has yielded contradictory findings, both that the driving behaviour and car use of young females have largely remained the same in recent years (Laapotti, 2003; McKenna *et al.*, 1998), and that females' behaviour is increasingly resembling that of males (Forward *et al.*, 1998). Some studies have shown that females' alcohol-related crashes have increased (Pikkarainen and Penttilä, 1989; Popkin, 1991; Wylie, 1995), although these are relatively old and do not reflect changes over the last decade. More research into gender behaviour in traffic is thus needed.

2.2.3. Personality

The parameters which may have significance for driving behaviour and crash involvement also include the driver's personality. Personality traits can be defined as dimensions of individual differences in the tendency to show consistent patterns of thoughts, feelings and behaviour (Tellegen, 1991; McCrae and Costa, 1995). Although researchers have taken interest in measuring individual differences in such traits for more than 50 years, agreement about which types of traits exist and how these should be measured had not been reached until within the last decade.

Today, there is a general consensus about the "Big Five" model of personality, which suggests that the structure of personality traits can be represented as five higher-order factors, each consisting of eight more specific traits. The five factors are: Extraversion, Neuroticism, Conscientiousness, Agreeableness and Openness. For instance, the higher-order factor Neuroticism is divided into eight more specific traits: Aggression, Anxiety, Depression, Impulsivity, etc.

Clarke and Robertson (2005) conducted a meta-analysis on the effects of the Big Five personality factors and crash involvement in both occupational and non-occupational settings. Their findings revealed that, for traffic crashes, the dimensions Extraversion, low Conscientiousness and low Agreeableness were consistently associated with high crash involvement. Whether this is also the case for young, novice drivers is not certain, as, often, personality tests are normed on adults. Sherry *et al.*, (2003) discovered that there are group differences between adolescents and adults on the NEO Personality Inventory-Revised test (on the "Big Five"). This may indicate that there is still some personality development during adolescence.

The belief that most crashes are caused by a small number of individuals who possess certain stable personal characteristics was, in fact, one of the earliest theories of why road crashes occurred (see Farmer and Chambers, 1939; Tillman and Hobbs, 1949). However, this belief has largely been abandoned, mainly due to the lack of empirical support for it (see Elvik, 1991, for a review). Still, several studies suggest that some stable individual characteristics are related to crash involvement. Most evidence comes from a longitudinal study conducted by Häkkinen (1979), which included an extensive battery of psychological tests on 66 bus and streetcar drivers in Helsinki repeatedly over a period of 10-27 years. The results indicated a high consistency of individuals' crash involvement between the initial testing and 10-27 years later. Häkkinen also found that high crash drivers differed from low crash drivers on several of the personality tests applied.

Cross-sectional studies conducted later have found personality traits to be weakly, but consistently, associated with crash involvement in traffic (see Arthur *et al.*, 1991 for a meta-analysis; Beirness, 1993 for a review). In particular, the impact of the "sensation-seeking" personality trait has been studied. Sensation-seeking is defined as a need to experience novelty, excitement and danger (Zuckerman, 1979). Zuckerman has divided this into four dimensions: Thrill and Adventure Seeking (seeking dangers), Excitement Seeking (seeking unusual sensations), Disinhibition (mild social deviance), and Boredom Susceptibility (intolerance for repetitive experiences). Several researchers have suggested that risky driving is motivated on the basis of the sensation-seeking thrill this causes for some individuals (Arnett, 1990, 1991; Jonah, 1997). This assumption has been confirmed in several studies finding sensation-seeking to be associated with a risky lifestyle and risky driving (Wilson and Jonah, 1988; Arnett, 1990, 1991, 1996; Yu and Williford, 1993; Jonah, 1997). By using Zuckerman's scale, Moe and Jensen (1990) and others have shown that there is a link between sensation-seeking and crash risk.

The suggested motivational influence of sensation-seeking on risky driving behaviour is further supported by findings demonstrating that sensation-seeking explains a large part of the variation in the propensity to commit driving violations, but accounts for very little of the variance in the tendency to commit driving errors, as the latter are thought to be unrelated to drivers' motives (Rimmö and Åberg, 1999). Several other personality factors are also related to risky driving and, to some extent, crash involvement. The most prominent ones are mild social deviance, hostility, aggression, impulsiveness, emotional liability, locus of control, antisocial motivation and low altruism (Hilakivi *et al*., 1989; Arthur *et al*., 1991; West and Hall, 1997; Lawton *et al*., 1997; Underwood *et al*., 1999; Ulleberg and Rundmo, 2003; see also Beirness, 1993; Elander *et al*., 1993 for a review).

Palamara and Stevenson (2003) conducted a longitudinal study on psychosocial risk factors for speeding offences among young drivers. The drivers were tested just before licensing, and one and two years after licensing. The test battery included the Driver Behaviour Questionnaire (DBQ), a test on normative beliefs and attitudes toward speeding partly based on the DBQ and partly derived from the theory of planned behaviour, a self-rated driving style and driving skill test, and the Zuckerman-Kuhlman Personality Questionnaire. Only the impulsivity and sensation-seeking scale and the confidence-adventurousness scale of this last test appeared to be good predictors for speeding offences. An earlier Australian questionnaire study by Palamara and Stevenson (2000) found that male drivers with high scores on risk-taking, driver confidence and adventurousness and low scores on positive health-related behaviours had the greatest likelihood of receiving a speed infringement notice during their first 12 months with a licence.

Ulleberg (2002) and Vaa (2003) have suggested that personality trait is a type of deeper-lying motivation that (unconsciously) may influence drivers' attitudes, motives and information processing, which, in turn, influence the propensity to conduct driving violations and, ultimately, crash involvement. Ulleberg and Rundmo (2003) found support for this hypothesis based on a study of 2 500 young Norwegian drivers. Personality traits (aggression, sensation-seeking, anxiety, altruism and social deviance) explained 47% of the variance in the drivers' attitudes towards traffic safety, suggesting that a driver's attitudes and personality are strongly connected. In turn, attitudes explained 68% of the variation in self-reported driving violations. These attitudes were previously found to relate to self-reported crash involvement (Ulleberg and Rundmo, 2002). Consequently, Ulleberg and Rundmo (2003) suggested that attempts to change drivers' attitudes towards risk-taking may be difficult due to the influence of stable personality traits on these attitudes. Similar results have also been seen in a study of young Israeli male drivers conducted by Yagil (2001), who found that sensation-seeking, locus-of-control and aggression affected the drivers' attitudes towards violations, which in turn influenced their intentions to commit violations.

All of the studies mentioned so far have investigated the impact of personality traits on driving behaviour and crash involvement separately for different traits. This approach, however, fails to capture possible interactions between different personality traits pertaining to driving behaviour and crash involvement. A small number of studies has instead investigated how the combinations of certain traits relate to driving behaviour and crash involvement. These studies have aimed at empirically identifying such subtypes of drivers on the basis on their scores on various personality traits, by the use of cluster analysis.

Donovan *et al*. (1988) found three clusters of high-risk drivers based on a sample of drivers who had been convicted of traffic offences. One was characterised by high levels of impulsiveness, aggressiveness, sensation-seeking and hostility. Another cluster reported hostility, depression and low emotional adjustment. The third was described as well-adjusted, meaning that this cluster did not show elevated scores on any personality dimension. Wilson (1991) found four clusters of high-risk drivers based on drivers who were convicted of traffic offences or for driving while intoxicated. One cluster

was characterised by high levels of thrill-seeking, hostility, and irresponsibility. Another cluster also displayed high levels of hostility, but low levels of thrill-seeking, and was thus described as emotionally unstable. A third cluster was characterised by depression and personal problems, whereas the fourth was defined as well-adjusted.

Two other studies were based on young drivers and their scores on various personality measures. Deery and Fildes (1999) identified five subgroups of young Australian drivers. Two of these were labelled high-risk on the basis of their behaviour and crash involvement. These were characterised by high levels of sensation-seeking, hostility, aggressiveness and driving-related aggression. One of the two groups also demonstrated high levels of depression and irritability, and low levels of emotional adjustment. Ulleberg (2001) found, in examining Norwegian drivers aged 18-22, that a six-cluster solution seemed to be the most valid and the most interpretable. The subtypes were found to differ on self-reported risky driving behaviour, attitudes towards traffic safety, risk perception, estimation of own driving skills, and crash involvement. Two of the subtypes were identified as high-risk groups in traffic. The first high-risk group consisted of mostly men, characterised by low levels of altruism and anxiety, and high levels of sensation-seeking, irresponsibility, and driving-related aggression. The second high-risk group displayed an angry-hostile profile, in that it reported high scores on aggression, anxiety, and driving anger. The subtypes were also found to differ on how they evaluated and responded to a traffic safety campaign. The results indicated that the campaign appealed most to the low-risk subtypes and least to the high-risk subtypes.

Although these four studies have used different sampling methodology (the first two used a sample of drivers who had been convicted, whereas the latter two used more representative samples of young drivers), their results seem to be quite comparable, leading to the conclusions that similar combinations of personality traits appear to be related to high-risk driving.

A general finding of many of the studies mentioned so far is that there is a relatively weak, but consistent, relationship between personality traits and road crash involvement, but a relatively strong relationship between personality traits and the propensity to commit driving violations. This is, however, not an unexpected result, since personality traits are primarily believed to influence behaviour, which in turn may influence the chance of being involved in a road crash. Road crashes are, on the other hand, not merely a consequence of the driver's behaviour, but also of numerous other factors, such as randomness, weather conditions, etc. (see Fridstrøm *et al.*, 1995 for an empirical study).

2.2.4. Social norms

Part of the problem of young drivers is the fact that they are young. They are in the midst of a socialisation process by which they are freeing themselves from their parents' influence and making their own way in the world as progressively more adult and independent people. This effort can be expressed in lifestyle and youth culture, in group identity, role expectations and various degrees of social dependency. The significance of social norms in the driver's decision-making process is described in various contexts, for example in various applications of Fishbein's and Ajzen's theories on "reasoned action" and "planned behaviour" (Ajzen and Fishbein, 1980; Ajzen, 1991).

Common among these theories is the importance of "subjective norms" for behaviour, which refer to norms that are believed to exist in the social environment, among people who are closely associated. These may also be reinforced and even heightened by popular culture, which often promotes the image of youth as a period of rebellion. The term subjective is used since it is the personal assessment of the norm that is important, not the actual norm. In the process of becoming more independent from their parents, young people are more dependent on conformity with certain

parts of the social context. There is an individual difference concerning which context is important. Hermansson (1988) defines peer-related versus parent-related lifestyles, in terms of who one tends to turn to. For many young people with a peer-related lifestyle, peers are of significant importance and thus also the primary source of subjective norms. Parker *et al*. (1992) reported findings from a questionnaire study showing that young drivers experienced higher peer pressure than older drivers to commit violations such as speeding, driving under the influence of alcohol or dangerous overtaking.

In driving, peer pressure may be expressed through passenger influence on the driver's behaviour. Chapter 1 clearly showed the link between the presence of similarly aged passengers and increasing risk levels. The number of passengers is an expression of a choice concerning with whom the driver is driving. McKenna and Crick (1994) have shown that young drivers, both male and female, drove faster and with shorter following distance in junctions if they had young passengers in the car. Their results were supported in a later study by Waylen and McKenna (2002). In a study by Baxter *et al*. (1990) similar results were found, but only for young men having young men as passengers. In two other studies, by Doherty *et al*. (1998) and Chen *et al*. (2000), it was also shown that passenger influence on driving behaviour was largest among young drivers.

Regan and Mitsopoulos (2001) carried out a study with the aim of investigating the potentially constructive role that passengers can play to positively influence drivers' behaviour. From the driver's perspective it was found that their role types were affected by the passengers' age, sex and relationship. The presence of a young passenger, especially males, was more likely to stimulate risky and anti-social driving compared to older passengers or children. A male passenger was more likely to have a negative influence on female drivers than the other way around. In focus groups, one finding was that passengers could have a constructive role. Simons-Morton *et al*. (2005) and Lerner and Singer (2005) have noted positive effects under given circumstances from the presence of a young, female passenger, on both male and female drivers.

2.2.5. Driving behaviour and vehicles as tools for achieving goals in life

A motor vehicle is a means of transportation, which, as part of everyday life, enables movement from one place to another. While driving, a young driver's behaviour is influenced by his or her general frame of mind, which, among other things, reflects the situation just left behind or approaching (Englund *et al*., 1996). Furthermore, a car is more than just a form of transportation; it can also consciously be used as a means of self-expression. Thus, when a young person drives his or her car, a number of different motives are at stake. Some of these are closely related to individual or social aspects of youth life.

Gregersen and Berg (1994) found that driving with extra motives, such as showing off and sensation–seeking, is a characteristic aspect of the lifestyle profile of high risk drivers. In another study, Berg (1994) found that driving was used as an outlet for aggression. These and similar studies show that some young drivers use driving as a way of self-expression, leading to a motivation to use a particular driving style. In addition, these studies underscore the relevance of including knowledge about the role and function of driving in the youth's life when trying to understand driving behaviour.

A study by Møller (2004) placed special emphasis on the psychosocial function of driving in the life of the young driver, and subsequent influence on driving behaviour. An example is using driving to achieve status and recognition among friends through risk-taking behaviour, such as racing. Racing not only has a physical dimension, it also has psychological and social dimensions, regarding the self-perception of the driver as well as his or her (usually his) position within the social hierarchy among friends.

Thus, several motives are at stake and influence driving behaviour based on reward/punishment. Often the result of this process is that motives related to self-expression outweigh those related to risk and safety, because the former lead to a greater perceived reward. Møller's study also showed that driving with extra motives, such as status-seeking, was more common among young drivers with an impulsive lifestyle oriented towards friends. The consequence of a lifestyle oriented towards friends is that driving style, to a large extent, is influenced by the subjective norms of driving existing within the peer group, and the driver is also more exposed to group pressures. As a result, the young person's driving behaviour not only reflects individual aspects of his or her life, it also reflects the lifestyle and social context within which the driving behaviour is executed.

Our discussion in Section 2.2.3 also notes key differences in the safety motivations of young men and women, as well as the impact of personality traits. It cites studies that indicate a link between lifestyle and driving habits, for example the time of day during which one drives and the purpose of the journey, among other issues. It is this type of link that authorities are trying to control in many American states and Canadian provinces with the imposition of night-time curfews on young drivers, as discussed in Section 3.6 (Preusser *et al.*, 1984; Williams *et al.*, 1985).

Marthiens and Schulze (1989) have described the relevance of recreational activities on crashes involving young drivers and the over-representation of so-called "disco-crashes". Klemenjak and Hutter (1988) found that two main groups of teenagers visited discotheques: "disco-fans" who spend the entire evening at the disco and those who visit the disco on the spur of the moment later in the evening. The second group is described as less safe, as they drive long distances and their decision to visit the disco is more often taken after drinking alcohol.

Beirness and Simpson (1991) compared a group of drivers involved in crashes with a group not involved in crashes. In their study, the crash-involved group showed an over-representation of people who smoke and drink; sleep less than 8 hours a night; have a poor relationship with their parents, teachers and other adults; and suffer from behavioural problems. Similar results were found by Shope (1997) in a questionnaire study reflecting Problem Behaviour Theory, combined with the state of Michigan's (US) driver history records among students in six public school districts. She found that, for both women and men, living with both parents was a protective factor, and the propensity to use intoxicating substances was a risk factor for high-risk driving. For women, friends' use of substances and, for men, parents' leniency toward teenagers' drinking were risk factors. The availability of substances was a risk factor for both genders. Shope also found that the combination of substance use and poor school performance were factors for high-risk driving.

This emphasises the complexity of the problems of both driving behaviour and traffic crashes, with implications for the measures that can be adopted. Jessor (1988) suggests that risk behaviours among youth are not necessarily separate events. They also seem to be related in typical patterns. He states that these interrelations between problem behaviours are "systematic and robust enough to suggest that there is a syndrome of adolescent problem behaviour and that it may be useful to deal with it as part of a lifestyle rather than as separate or discrete behaviours."

Youth is a period during which one undergoes a number of processes that make life more intense, and various sequences follow the same pattern seen in crash involvement, such as the over-estimation of abilities and breaking (traffic) rules. This is part of development and the process of "breaking free", whereby young people want to test limits and prove their ability to manage on their own. It is important to realise that driving a car is only a form of expression of a small part of these over-riding, far more complex phenomena related to coming of age.

Socio-economic factors can also play a role. Hasselberg (2004) found that a young driver whose parents were lower-level white-collar workers, blue-collar workers, farmers or entrepreneurs had significantly more injuries than those with middle and high-level white-collar parents. In another register study by Murray (1998), it was shown that young drivers with low school grades, mainly in theoretical subjects, had a higher crash involvement. Murray's study also showed that young persons with blue-collar and farmer parents were involved in more crashes than those with white-collar parents.

2.3. Acute Impairments

This section is about factors that reduce capabilities, such as alcohol, drugs, fatigue and emotions, as well as distraction (*e.g.* the influence of peers in the car while driving and the performance of secondary tasks like operating the stereo).

2.3.1. Alcohol

The linkages between alcohol and crash involvement, in general, need little elucidation. However, drink-driving is particularly dangerous among the young.

As noted in Chapter 1, Glad (1985), Preusser (2002) and Keall *et al.* (2004) have shown that young people's fatal injury risk increases substantially faster than that of older people, along with each drink consumed (see Figure 1.19). As a result, it is not surprising that alcohol-related crashes are common among young drivers. This may also help to explain why young people have been shown to suffer more alcohol-related fatalities, even in countries where they are not found to drink drive more than older drivers (see Figure 1.20).

There are various likely reasons why alcohol affects the driving capabilities of young, novice drivers more severely. In the first place, young people's tolerance for alcohol is often lower, as their bodies are not accustomed to it. Secondly, for novice drivers, the driving task is more demanding than for an experienced driver. Even at relatively low BAC levels (*i.e.* below 0.5 g/l), most people can divide their attention less adequately and are less vigilant. As novice drivers have to allocate more of their attentional resources to the driving task than experienced drivers, the effects of alcohol on their driving performance are more severe than for experienced drivers. A third possible explanation is that, after having consumed even small quantities of alcohol, social inhibition is reduced and one begins to act and feel more emotional. While this is the case for people of all ages, self-control mechanisms are less well-developed in younger people, which is probably why alcohol has a stronger motivational and emotional impact on them; thus, under the influence of alcohol, young drivers may get more euphoric and impulsive, and exhibit more risk-taking behaviour than older drivers. Finally, Assailly (1995) found that 40% of teenagers underestimated their real BAC levels, and Beirness *et al.* (1993) revealed a 50% underestimation.

There is an obvious link between these findings and the patterns of young driver crashes noted in Chapter 1. Young people who drink-drive most often do so during weekend nights, and it is primarily at that time that young drivers are over-represented in alcohol-related crashes. Young people are disproportionately involved in speed-related crashes, some of which are alcohol-related. Alcohol is often associated with socialising, which links to findings regarding increased crash risk in the presence of similarly aged passengers. Furthermore, several studies have shown that the combination of excessive speed and alcohol is an important and crucial cause of single-vehicle crashes, especially among young men, and young people are over-represented in this type of crash (Brorsson *et al.*, 1993; Twisk, 1994).

While all countries are different, in some instances young people have been found to drink-drive with considerable frequency. In New Zealand, for example, Begg and Langley (1999) conducted a questionnaire study of a 21 year-old cohort, and found that 49% of the males and 32% of the females had been drinking and driving within the last 30 days.

2.3.2. Drugs

Much work is required to fully assess the impact of drugs on road safety, including with specific respect to young drivers, and this is an area that should be subject to further research. Different drugs have different effects, especially when taken in combination, or with alcohol. Patterns of drug use change, and vary according to country, including the drugs available and their potency. Drugs can be illicit or prescribed medication, and drugs that are illegal in one country may not be in another.

Drug use is clearly an issue that affects youth. Among Europeans, illicit drug use generally increases with age from 15 to 25 years, then decreases, and figures for youth are twice those of adults. Cannabis is the most commonly used illicit drug, and is more often detected among young drivers, except in the UK, where it is also frequently detected among 40 to 60 year-olds (EMCDDA, 2001). While use of legal drugs is more frequent among girls, alcohol, cannabis and ecstasy are more commonly used by boys. The EU's IMMORTAL[1] (Mathijssen and Houwing, 2005) study found that, in the Netherlands, drug use was concentrated among young male drivers in the 18-24 age group, where 1 in 6 drivers had used drugs or a combination of drugs, although the vast majority of those who tested positive had used cannabis. However, in Europe, sex differences are decreasing, alcohol use is stabilising, and cannabis use is increasing, sometimes becoming more important than alcohol (EMCDDA, 2002). Researchers have also noted increasing cannabis use in Canada since the early 1990s (Boase *et al*., 2004; Brault *et al*. 2004). US data notes that use of all drugs other than heroin by 12th grade high school students more than doubled between 1992 and 2000, then levelled off in recent years, although "ecstasy" use in particular had increased (National Institute on Drug Abuse, 2005). Recent testing in Victoria, Australia, showed that one in 50 drivers tested positive to the presence of at least one of THC (Δ^9 tetrahydrocannabinol, the most active of the principle constituents of marijuana [cannabis sativa]). or methamphetamine, which compares to a one in 250 average for impaired alcohol levels in drivers.[2]

Due to increasing consumption of illicit drugs, many countries are conducting studies in this area, including road surveys, and surveys of weekend drivers, suspected drug drivers, and drivers involved in crashes. The European Union's ROSITA[3] project is evaluating various toxicological measures, such as the analyses of urine, saliva, sweat and hair. A European research structure (The Pompidou Group) has been initiated to compare the magnitude of the problem in each country. France enacted the so-called "Gayssot Law" in 1999, stipulating that the detection of illicit drugs should be mandatory for every person involved in a fatal crash.

As it currently stands, various factors confound the analysis. In some instances, the political debate regarding the legalisation of drugs, especially cannabis, taints the discussion. Furthermore, testing for drug use is not necessarily as clear-cut as it is for alcohol. For example, the main active ingredient in cannabis is THC. Often, it is not the amount of THC in the blood or urine that is measured, but its inactive metabolite, although this metabolite remains in blood and urine for days after impairment (see Ramaekers *et al*., 2004a, 2004b).

Having said that, it is clear that drugs, in general, represent a source of risk for young, novice drivers.[4] Based on the outcomes of an epidemiological case control study (Mathijssen and Houwing, 2005) in which the prevalence of drugs in the driver population in the Netherlands was compared with that of drugs in seriously injured drivers, it was concluded that drivers using illegal

drugs and combinations of drugs have a 25 times higher risk of serious injury. The combination of drugs and alcohol leads to even higher risks, by a factor of 35. In general, based on observations of the effects of illicit drugs on driving style and users' statements, cannabis and heroin increase risk of sleepiness, cocaine augments impulsivity or irritability, LSD results in risk of hallucinations, and ecstasy limits speed perception. Amphetamines can affect vision, cause dizziness and loss of co-ordination, and induce anxiousness or hostility and a false sense of alertness, and drivers can be subject to microsleeps when the effects wear off (VicRoads, 2006). Experimental studies have repeatedly shown that THC impairs cognition, psychomotor function and actual driving performance in a dose-related manner (Ramaekers *et al*., 2004a).

One area where cannabis is particularly dangerous is in combination with alcohol, and the high prevalence of combined cannabis and alcohol consumption can make it difficult to fully assess the impact of the former on traffic safety risk (Rameakers *et al*., 2004b). Around 24% of cannabis-positive drivers were also found to have been drinking in the Turnbridge *et al.* (2000) study, and up to 60% in other studies (Longo *et al*., 2000). A recent French study found that 8.8% of drivers at fault in fatal crashes between October 2001 and September 2003 tested positive for cannabis in the blood, and almost 42% of these also had an illegal blood alcohol concentration (Laumon *et al*., 2005).

The risks associated with cannabis also increase in specific driving situations, such as emergency manoeuvres, and long and tiring trips (Longo *et al*., 2000). Recent research (Blows *et al*., 2005) has also revealed a strong association between habitual use of marijuana and car crash injury, although the nature of this relationship is unclear and should be researched further.

Recent years have seen an increase in the popularity of "raves", especially among younger people, as well as associated drugs, such as "ecstasy", the street name of MDMA (3,4-methylenedioxy-methamphetamine). In a study using a driving simulator (De Waard *et al*., 2000), 20 drivers varying between 21 and 36 years-old were tested on their driving performance one hour after ingesting MDMA. They were also tested when they were not under the influence of drugs. The results showed that the lower level driving processes, such as steering, were not affected by MDMA. However, the higher cognitive processes, such as pattern recognition and accuracy of task performance, did deteriorate. It also appeared that risk acceptance was higher after MDMA was used. Some of the tested drivers not only had used MDMA but other illicit drugs as well. After multi-drug use, driving performance deteriorated considerably more in comparison to driving performance after MDMA alone.

Ramaekers *et al*. (2004b) tested drivers under the influence of MDMA in an instrumented vehicle in real traffic situations. It appeared that tracking performances on the road were even better when intoxicated by MDMA than in drug-free conditions. Car following was just as good with as without MDMA. However, there was impaired performance on spatial and verbal memory tasks. MDMA's detrimental effect on spatial memory may be of particular relevance as it indicates a reduction of situation awareness. Furthermore, when MDMA or cocaine were used in combination with other illicit drugs or alcohol (in most cases drivers that had used MDMA or cocaine also had consumed alcohol), the increase in relative risk was substantial.

Modern social psychology teaches us that, in order to reduce the tension produced by cognitive dissonance[5], people will sometimes re-structure their knowledge and attitudes on the basis of their own behaviour. In other words, it is not always what people know or think that determines what they do, it may also be what they do that determines what they know or think. As a result, cannabis and ecstasy users feel that their consumption does not present any risk, and opiate users feel that driving under the influence is far less risky than things they do in other aspects of their lives. Chronic users of cannabis or heroin are more likely than occasional users to underestimate the associated risk, and to believe that

alcohol presents a greater risk. Such denial is not specific to drug users, but is also observed among regular drink-drivers and speeders. Furthermore, these attitudes are reinforced where laws are unclear and detection difficult (De Joy, 1989; Delhomme, 1991; McKenna *et al*., 1991; DETR, 1998).

2.3.3. Fatigue

Research has shown that fatigue is an important direct cause behind many crashes. Fatigue is not only caused by the number of hours behind the wheel (the time on the driving task), but also by time spent on other tasks before one starts to drive, the length and quality of sleep (*e.g.* because of a sleeping disorder, medication or lifestyle) and stressful situations. Another factor behind fatigue is whether driving occurs during the normal waking or sleeping hours, whereby in the latter period the driver is more crash prone. This issue is relevant, as the relative crash risk for driving at night is higher for young drivers than for those between 25 and 65 years of age and, in many countries, young people drive relatively more at night (Keall and Frith, 2003; Keall *et al*., 2003).

Schagen (2003) has concluded that fatigue affects many aspects of the driving task, like position on the road, reactions to slowly developing changes, and headways. Drivers compensate for their fatigue by either increasing the task demands, like driving faster, or lowering the task demands, like driving with larger headways; however, these compensations are not sufficient to eliminate the increased crash risk. These studies also show that falling asleep is not the only cause of fatigue-related crashes, but that fatigue also increases crash involvement due to "driving without awareness", which means driving without sufficient attention dedicated to the task.

Adolescents need as much sleep as children (around 9 to 9.5 hours each night), but often sleep less. Many adolescents stay up late and, because school or work starts early, also wake up early, which can cause a sleep deficit. The results of a high school survey (O'Brien and Mindell, 2005, mentioned in Groeger, 2006) showed that adolescents who reported going to bed later at weekends and having problems sleeping also reported significantly higher levels of risk-taking behaviour. Carskadon *et al*. (1998) studied the effect on sleep duration and the quality of sleep between adolescents that had to rise earlier and those that had to rise 45 minutes later (due to a later starting time of school). Both the length and the quality of sleep improved significantly with later school starting times.

That the impact of fatigue may be greater in inexperienced drivers was shown in a case-control study of truck drivers. The crash involvement of inexperienced truck drivers increased after 6 hours on the job, while in expert truck drivers' crash involvement increased after 10 hours on the job (Modde and Veling, 1991).

There are very few studies that look at the effect of fatigue in relation to age and/or driving experience, and further research is needed in this field.

2.3.4. Distraction

Drivers have to perform complex information-processing tasks that include perception, diagnoses, prognoses and decision-making. The attention that has to be allocated to performing the driving task can be insufficient if the attentional resources are low, as in the case of fatigue, or if the driver is paying attention to other tasks, such as eating and drinking, grooming, using and adjusting in-vehicle devices, talking with passengers, tending to children or pets, smoking, taking notes and/or using a mobile phone. The driver's attention can also be involuntarily drawn to events, activities, objects and persons inside or outside the vehicle that are not related to the driving task.

Since the attentional resource requirements of some tasks decline as a function of task experience, for novice drivers, secondary tasks probably interfere more with the driving task than for experienced drivers. After having analysed many crash reports in the US, Stutts *et al.* (2001) found that, of all crashes analysed involving drivers under 20 years-old, in 11.7% the driver was distracted. In crashes involving older drivers, only 8% or lower appeared to have been distracted. Furthermore, drivers under 20 were much more likely than older drivers to have been distracted while adjusting a radio, cassette or CD-player. A recent US National Highway Traffic Safety Administration (NHTSA, 2006) study noted that almost 80% of all crashes and 65% of all near crashes involve a driver looking away from the forward roadway just prior to conflict, and that the rate of inattention-related crashes and near crashes is as much as four times higher for 18-20 year-old drivers than for those over 34.

An aspect closely related to mental workload is distraction caused by the use of mobile telephones and in-vehicle support systems. Young people's enthusiasm for mobile phones and portable music devices is well known, although they are not alone in this. Cases of text messaging while driving are becoming increasingly common.

The use of such additional systems demands attention and mental capacity, which for inexperienced drivers may create particularly great problems. Studies have shown that the largest problem related to mobile phone use during driving is the influence on attention. As one example, a study performed in a driving simulator in Sweden showed that drivers' attention was negatively influenced by telephone conversation, whether it is with a "hands-free" or hand-held mobile phone, and that the former is not safer than the latter (Kircher *et al.*, 2004). A review of epidemiological studies shows that, on average, crash risks during phone calls are about 4 times higher than in normal driving (Dragutinovic and Twisk, 2005). Wilson *et al.* (2003) have also linked mobile telephone use while driving to an overall propensity towards high-risk behaviour, including speeding, impaired driving, non-seat belt use, and aggressive driving.

A survey study among Swedish drivers showed that mobile phone use while driving has increased heavily in the last ten years. Thirty percent of all drivers with mobile phones used them daily while driving. Some drivers – especially younger ones – also send and receive text messages while driving. As a result, drivers were shown to miss exits, fail to observe traffic signals, and forget to adjust speed according to the limit (Gustafsson and Thulin, 2004).

2.3.5. Emotions

Research has indicated that safe behaviour may be affected by emotions. Emotions are defined as mental states that are usually accompanied by a physical change, like facial expressions, and are predominantly aroused when a personal interest is damaged or promoted. An emotion has control precedence, which implies that it supersedes current actions and objectives, and redirects and initiates actions. As an example, a person who feels threatened by another driver's close following may, at the spur of the moment, break abruptly, ignoring all internal safety warnings.

Several studies have shown that task performance can be influenced by emotions. In a literature review, Vlakveld (2005) mentions the effects on vigilance of nervousness and aggression. Furthermore, drivers harbouring angry and aggressive thoughts also reported driving in a more risky manner. Drivers who tend to dwell on issues have deteriorated performance in a driver simulation, resulting in running off the road.

Thus, emotions may affect the decisions taken and the quality of task performance, and are therefore relevant for young drivers in particular, as mood swings are more extreme in adolescents

than in adults. On this point, Arnett (2002) concludes that "[a]lthough many scholars have disputed the stereotype that adolescence is inevitably a time of turmoil, there is good evidence that adolescents have mood swings especially toward the negative end." Furthermore, young drivers are more likely than more experienced drivers to drive in order to "blow off steam". Arnett *et al.* (1997) concluded that adolescents drove more recklessly when in an aggressive mood. Other emotions, like happiness, pride and fear, have not been studied as yet.

Emotions do not necessarily have an adverse effect on one's driving capabilities. They can also be considered as a prerequisite for safe driving, as quick decision-making is vital for safe driving and feelings probably help to speed up the decision-making process. Damasio (1994) concluded that feelings accompany our representations of anticipated outcomes of options. Feelings more or less *mark* response options to real or simulated decisions, and those response options that do not receive a mark will not be included in the decision-making process. This is what Damasio calls the "somatic marker" hypothesis. Somatic markers are directly linked to punishment and reward and originate in previously experienced social situations. Traffic situations, to a certain extent, are social situations. Thus, with increasing driving experience, not only are knowledge and skill enhanced, but probably also the decision-making process. This will only occur, however, when traffic situations in the past have aroused emotions in the driver.

Although it is mentioned in the literature that emotions in adolescents are easily aroused, as yet no study has been directed at the effects of emotion on the execution of new tasks, such as driving.

2.4. The Acquisition of Driving Skills

Inexperience is the primary cause of the young, novice driver problem. Learning to drive takes time and needs extended practice in order to reach a sufficient competence level – this is true for everyone, not just the young. It takes training and practice to master driving skills. In this section the process of skill acquisition is described, including higher-order skills like hazard perception. Furthermore, there are many perceptual and cognitive faculties used while driving, including perception, attention, working memory, long-term memory, diagnoses, prognoses and decision-making. There are differences in the perceptual cognitive processes between young, novice drivers and older, more experienced drivers.

A driver has to perform various actions (*e.g.* steering, braking, shifting gears, etc.) simultaneously in order to manoeuvre the vehicle. These actions have to be executed smoothly and effortlessly, and more or less automatically in order to keep as much attention as possible available for mastering traffic situations. A driver has to scan the environment systematically; know the rules of the road and how to apply them; assess distances, speeds and safety margins properly; assess how the traffic situation will develop; and make quick and proper decisions regarding speed and trajectory. He or she not only has to master all these skills, but also has to know how good his or her own driving capabilities are at any moment in time and act accordingly.

Driving is partially a "self-paced task", meaning that the driver is, to a large extent, responsible for establishing the level of complexity and risk. When a driver increases speed, the driving task will become more demanding. Besides this, certain routes to reach one's destination will be more demanding than others. Drivers have to learn not to overestimate their own capabilities and to only undertake those tasks in traffic that they are capable of, an ability sometimes referred to as "calibration" (Gregersen, 1995; Kuiken and Twisk, 2001). Self-assessment is an important prerequisite for calibration, but self-assessment alone is not enough. A driver also has to develop the willingness to drive safely.

Learning to drive in traffic can take place through controlled and structured education involving both training and the absorption of other people's already-achieved knowledge (explicit learning), but also through spending much time driving a car, thus obtaining the necessary automation of skills, as well as experience (implicit learning).

The following sections deal with what occurs when one learns to drive and what can go wrong in the process. Chapter 3 discusses what the safety objective of driver education should be and the advantages and disadvantages of both explicit learning and implicit learning.

It is worth noting at this point that research is lacking with regard to the psychological competences required to drive safely, such as impulse control and self-assessment. Greater understanding in this area would have important implications for the learning process.

2.4.1. General learning factors

Whether it is explicit learning or implicit learning, extensive practice is an essential prerequisite for developing expertise in a given task. Groeger (2000) believes that the acquisition of driving skills develops in accordance with the "Power Law of Practice" and related "Power Function of Practice" (Newell and Rosenboom, 1981). This means that the gain from practice is considerably greater early in learning than it is later in learning. The formula for Power Function of Practice is:

$$\text{Number of Errors} = \text{Initial Level} \times \text{Amount of Practice}^{-\text{Rate of Learning}}$$

In other words, if it takes 100 trials to half the initial amount of errors, according to the Power Function of Practice, it takes N times N-1 trials (= 9900 trials) to half the number of errors again. It is difficult to prove whether the Power Law of Practice accurately describes the learning curve for driving, as it is almost impossible to count the number of errors systematically in real traffic.

It is far easier to count these errors in a simulator. In the Netherlands, subjects did a training course on a driving simulator that they had never used before (Wierda, 1996). This training course was based on the so-called Personalised Adaptive Cybernetic Training (PACT) system, a training method derived from cognitive psychology theory on how to acquire perception strategies and how to learn to act in time and space. The whole curriculum consisted of 13 modules, each with its own set of training objectives, and one could only start with the next module after having finished the previous one. A strict distinction was made between vehicle manoeuvring skills, the mastery of traffic situations and calibration. In all simulator sessions, skill improvement with regard to vehicle manoeuvring and the mastering of traffic situations was constantly recorded, and it appeared that improvement in both developed in accordance with the Power Law of Practice. However, as it is very difficult to record the number of errors due to lack of calibration skills, it was not possible to verify if skill development in this domain was also in accordance with the Power Law of Practice.

Driver education is not successful when the skills acquired during training are not applied in reality. There is no *transfer* when the training situations are quite different from reality and when students have not developed any conceptual understanding of why they have to execute tasks in a particular way. Notably, many young driver crashes occur in circumstances that are unlikely to be covered in normal training, such as high speeds, at night, with young passengers, etc.

Another important issue is *retention*. Driver education is not effective when the acquired skills can be performed on the driving test, but are soon forgotten afterwards. In general, retention is better when the learning period is long with periods of rest between sessions (Baddeley and Longman, 1978; Dempster, 1988; Shea *et al.*, 2000). Another aspect that influences retention is the way in which tasks

are learned. One can structure training to first practice the same part task repeatedly until it is mastered and then start with another part task. On the other hand, traditional driver training, on the road with an instructor, is varied and difficult to standardise, as much is based on the circumstances coincidentally encountered on the road. This is even more so in implicit learning conditions, such as during accompanied driving. From tests with rather simple tasks it appears that, when mass repetition of part tasks is applied, skill acquisition is quicker than when training is varied; however, retention is much better in the varied condition than in mass repetition (Shea and Morgan, 1979). Wulf and Shea (2002) conclude that mass repetition, as well as observing others when performing a complex task, is beneficial to a certain extent when acquiring complex skills.

It should be noted that studies on retention and transfer are mostly carried out under laboratory conditions using rather simple tasks, and their results are thus difficult to directly apply to a complex task in an uncontrolled situation, such as driving. Given the combined conclusions on transfer and retention, most probably, the best practice for driver education would be a mixture of rather short periods of formal training alternated with long periods of informal training. This is in keeping with the conclusions put forward in Chapter 3.

2.4.2. Skill acquisition and mental workload

Driving while talking with a passenger will, when the task demands of both driving and talking are low, not lead to a decrease in performance of the driving task if the driver is experienced. However, when the driver is inexperienced, the performance of the driving task will deteriorate. Apparently, for experienced drivers, "normal" driving is less demanding than for novice drivers. The fewer resources a task needs, the easier is it to combine it with other tasks.

It is believed that the more routine a task becomes, the less mental capacity is required to perform it. A common explanation of why routine reduces crash risk is that novice drivers go through several phases when they learn to handle the large variety of tasks involved in driving a car. The novice is faced with many new situations and tasks which all require mental resources. The perceptual situation is new and imposes special demands on visual search skills and interpretation of what is happening around the vehicle, and the novice cannot handle this new situation as well as an experienced driver can. The mechanical handling of the car itself also requires mental capacity, with a number of controls, levers, pedals and warning devices that must be used and co-ordinated in a complex pattern. The entire traffic environment, with its regulations and demands on specific behavioural patterns, also increases the mental workload.

Anderson (1982) assumes that there are three phases in the acquisition of skills. These are: "the declarative stage", "the knowledge compilation stage" and "the procedural stage". At first (*the declarative stage*), performance is relatively unstable, as possible strategies are tested and rejected. In the case of distraction, task performance deteriorates considerably. After enough practice, one reaches *the knowledge compilation stage*, during which verbal mediation of performance is far less than previously, and associations between action patterns in familiar conditions become stronger. However, in this intermediate phase, a dual task will still interfere with the primary task. Finally, after more practice and experience, one reaches *the procedural stage*, at which verbal mediation does not exist, and the task performance is highly consistent and requires almost no effort.

Instruction on "how to" and "why", and feedback on how well a task is performed, will enhance the process of skill acquisition. However, there is a drawback. With constant feedback and instruction, the procedural stage is reached sooner, but retention afterwards is poor. Without instruction and feedback, the learning process is substantially longer, but retention afterwards is better. An explanation for this is that, when constant instruction and feedback are provided, the student will not

be able to find indicators by him- or herself regarding how well a certain task has been performed. In order to optimise the learning process, it is essential that, at first, there be much instruction and feedback and that these be gradually withdrawn in the course of the training.

Rasmussen (1986) describes three levels of information processing that are quite similar to Anderson's three stages. The difference is that Rasmussen does not directly link his levels to skill acquisition. The three levels Rasmussen mentions are: the *knowledge-based* level, the *rule-based* level and the *skill-based* level. If these levels are linked to skill acquisition, one could say that behaviour at the *knowledge-based* level is new – there are no ready-to-use solutions. Such behaviour is regulated by reasoned arguments and by know-how acquired from previous experiences relating to other situations, by learning the formal regulations regarding driving, and also by obtaining help from other people. When own know-how and experience is gradually built up and integrated into rules or mental models, this behaviour becomes increasingly controlled by the *rule-based* level. With experience, rule-based behaviour will be increasingly automated and, in its most-developed form, will be executed without conscious attention and control. This is when one reaches the *skill-based* level. Since skills are utilised and developed, more and more subordinate tasks will be linked together, until the entire behavioural complex is undertaken without conscious attention, as long as no unexpected discrepancies occur. As soon as a discrepancy does occur, there is a switch to either rule-based behavioural control, if one has a set of ready-made rules to fall back on, or knowledge-based behaviour if the problem has to be solved from the outset. In a complicated task such as driving a car, there is a frequent switch between different levels, depending on which subordinate tasks are to be tackled.

The theories of Rasmussen and Anderson are intended to be applicable to different types of skill acquisition. When applied to driving, one can regard the formal rules and instructions that are formulated by the authorities and conveyed by the teacher as typical of the first, knowledge-based, stage in learning to drive (Brown *et al.*, 1987). Experiences from other roles in traffic, such as walking or cycling, are also examples of factors that are used to build up usable mental rules or models for behaviour in various traffic situations. As and when one is confronted with an increasing variety of traffic situations, and as more driving tasks are integrated in mental models, attention can be diverted towards interaction with other road users. At this, rule-based, stage of development, behaviour will initially still be greatly governed by formal rules and regulations. However, gradually, formal rules and control skills will become more integrated and perceptions and experiences from the road and interaction with other road users will play an increasingly dominant role in determining driving behaviour, leading to the formation of more informal rules for behaviour. At the final, skill-based, stage, the driving task becomes more automated and it is easier to carry out several subordinate tasks simultaneously, as many of these tasks no longer represent any significant mental workload.

The implication of this is that, at first, a novice driver does not have many ready-to-use rules, but must instead use those that are on offer, namely the formal rules, described in legal texts and official regulations. However, the framework of official regulations is an attempt to regulate traffic in certain specific conditions, and is not comprehensive. This means that traffic is naturally governed by some rules, but that it cannot actually be described by using these rules. There is much else that also has an effect, such as our emotions, mood and motives, and social norms.

Our driving behaviour is also largely shaped by informal "common-sense based" rules, which do not always match the formal rules and which, from the road safety viewpoint, may have both advantages and disadvantages. Increasing attention is given to these informal rules as one frees oneself mentally from focussing on technically operating the car and from formal rules. Examples of informal rules include letting other road users through even if one actually has the formal right of way, and realising that many road users are unpredictable and often ignore traffic rules and that this, therefore, requires extra caution.

Although many studies have shown or discussed mental workload in the driving task, the specific implication for young novice drivers is unclear. However, since the resource requirements of some tasks decline as a function of task experience, inexperienced drivers will have less spare capacity in all driving circumstances, and, thus, sources of additional demand (*e.g.* the radio or a mobile telephone, etc.) will compromise their performance and safety more than for experienced drivers. Several studies have also shown that experienced drivers perceive potential risk situations more quickly than novice drivers (Soliday and Allen, 1972; Quimby and Watts, 1981; Finn and Bragg, 1986; Ahapalo *et al*., 1987), which supports the theory of automatic behaviour and mental workload.

The question is also which driving tasks are automated and which are not. There are studies showing that some tasks are more easily automated while others never are. Shinar *et al*. (1998) studied automation and mental workload development in gear-shifting by comparing novice and experienced drivers' performance detecting road signs when driving cars with manual or automatic gears. They found that the detection of signs was poorer among novice drivers with manual gears than those with automatic gears. No such difference was found among experienced drivers, and this was interpreted as a support for regarding gear shifting as a task that becomes automated over time. However, they also concluded that gear-shifting is a task that is not fully automated, even after a year. Groeger (2000) questions if any routine task ever becomes fully automated. Most probably, even fully automated tasks still require some attention during execution. An indication for this is that patients that have damage to their frontal lobes (the part of the brain where the supervisory attention system is considered to be located) are not able to perform routine tasks without error.

2.4.3. Visual search skills

A study undertaken by Mourant and Rockwell (1972) emphasised young novice drivers' shortcomings in terms of how visual search skills relate to their high mental workload. Their comparison of novice and experienced drivers revealed that the former looked more to the front and right of the car, looked more seldom in the rear-view mirror, moved their point of focus more often, and were less skilled in utilising their peripheral vision. The authors argued that these differences reflected novices' lack of skill and explained their increased crash liability in driving.

Much research has been done in the field of visual search since Mourant and Rockwell's studies. In a laboratory experiment using video sequences, Miltenburg and Kuiken (1990) investigated the relationship between traffic experience and visual search strategies, but their results did not support the findings of Mourant and Rockwell. Miltenburg and Kuiken found that experienced drivers had a larger number of fixations on irrelevant cues than novice drivers. Seen in the light of experienced drivers' lower crash risk, their results may be interpreted as a consequence of reduced mental workload, as the experienced drivers had capacity to look at irrelevant objects.

However, Falkmer and Gregersen (2001) confirmed Mourant and Rockwell's findings in an eye-tracking study comparing novice and experienced drivers. They found that novice drivers concentrate their visual search on a smaller area, closer to the front of the vehicle, in comparison with experienced drivers. They also noted that the search strategies of inexperienced learner drivers were more inflexible, and that experienced drivers had a wider horizontal search pattern.

Crundall and Underwood (1998) found that experienced drivers' scanning patterns appeared to adapt to different road situations, while novices tended to use the same scanning pattern for all road types. They showed that experienced drivers increase their horizontal search relative to the type of road, and that novice drivers' strategies are inflexible. Also, novices fixated for longer durations than experienced drivers, which was interpreted as indicating that novices took longer to process events.

These findings are consistent with the idea that experienced drivers are conducting a more efficient and effective search for hazards rather than simply lowering their criteria for what constitutes a hazard.

Chapman and Underwood (1998) also found that novice drivers had longer durations of fixations than experienced drivers, particularly in hazardous situations. Furthermore, they found that experienced drivers fixated lower and had less vertical variance in fixation locations than novice drivers. These findings were exploited in a later study, in which novice drivers were given a short training programme for increased knowledge, scanning and anticipation. The drivers were informed about their typical pattern of visual search and the need for scanning multiple locations in the visual field for potential dangers. By measuring eye movements, they found notable changes in search patterns for horizontal spread compared with a control group (Chapman *et al*., 2002).

Underwood *et al*. (2002) recorded the eye movements of experienced and novice drivers watching filmed footage of the type of demanding traffic conditions found to generate differences in visual scan. They found that, even in this simulated situation where novice drivers did not have to control the vehicle, the horizontal width of their search patterns was less than that of experienced drivers. They argued that experienced drivers have a more sophisticated mental model of the traffic environment, while the novices' search is restricted by vehicle control requirements.

Novice drivers' reduced ability to make use of peripheral information has also been shown by Williams (1985). In an experimental study he found that the angle from the fixation point within which certain information (letters) could be seen was smaller as mental workload increased. Similar results were found by Lee and Triggs (1976) in an experiment on driving in different traffic environments. These showed that peripheral blinking lights were discovered more often in less demanding traffic environments (rural roads) than on the more demanding urban roads.

In a literature review, Åberg (1981) described so-called "predictive head movements", which means that the head moves before the eyes start moving when searching for an object that appears in the peripheral field of vision. Mourant and Grimson (1977) found that experienced drivers use more predictive head movements than novices, which is interpreted as indicating that novices do not utilise their peripheral vision as effectively as experienced drivers.

2.4.4. Hazard perception

An area that has received increased interest during the last decade is the driver's ability to detect hazards. Hazard perception (HP) includes the process of discovering, recognising and reacting to potentially dangerous situations. Several studies have shown that experienced and expert drivers detect hazards better and faster than novice drivers (*e.g.* McKenna and Crick, 1991 and 1994). For hazards far away from the driver, the difference is even larger (Drummond, 1996), a fact that may also support the theories of automation and mental workload discussed above.

Ahopalo (1987, cited in Groeger and Chapman, 1996) found that drivers with a median age of 24 years-old responded more quickly in a hazard perception test if they had more than 40 000 kilometres of experience and more slowly if they had less than 10 000 kilometres, and that both groups were faster than people of the same age who did not drive. This indicates that experience is likely to be a key influence on hazard perception, independent of age. However, Sagberg and Bjørnskau (2006) found that improved hazard perception was only a minor factor in explaining the rapid decrease in young, novice driver crash risk over the first several months of driving. Ahopalo noted that, to achieve a good score in a hazard perception test, good scanning and anticipation are required. Differences in eye scanning between novice and experienced drivers indicate that different search strategies are being used by these groups.

Renge (1998) compared hazard perception abilities for day and night situations separately among driving students, recently licensed novice drivers, experienced drivers and driving instructors. He found a pattern of improved hazard perception scores with experience, although this was clearer for daytime than for night-time situations. He also tested the correlations between hazard perception scores and risk rating, choice of speed, and safe driving confidence. There was a significant correlation between high hazard perception scores and high risk rating of the situations (r=0.44), and between high hazard perception scores and lower speed choice (r=-0.27), but no significant correlation between hazard perception and driving confidence. Renge's own conclusions were that the results strongly suggest that it is very important for drivers to develop their ability to perceive hazards in traffic and, thus, that the training and testing of hazard perceptual skills should be more broadly and effectively introduced in traffic safety countermeasures.

In order to test the hypothesis that hazard perception could be automated, McKenna and Farrand (1999) tested hazard perception skills among novice and experienced drivers with and without the combination of a secondary task. They found that the secondary task interfered with hazard perception for both groups and that experienced drivers performed even worse than novice drivers on hazard perception when performing the secondary task. Their conclusion was that hazard perception is demanding and, when attention is drawn to other tasks, the ability to detect hazards will decrease. The study gave no support for regarding hazard perception skills as something that will become automated with increased experience. The improvement of hazard perception skills may instead be a result of learning to identify situations in combination with automation of other driving tasks, thus reducing the mental workload and leaving more mental capacity for the hazard detection task.

Although their assessment methods varied to a degree, Watts and Quimby (1979) found a significant correlation between drivers' reaction time to hazards and their road crash frequency over the previous three years (Transport and Road Research Laboratory, 1979), and McKenna and Crick (1991) found that those with a higher number of crashes over the previous two years were worse at the McKenna and Crick hazard perception test, after taking into consideration the effects of age and mileage. Quimby *et al*. (1981 and 1986) and Maycock *et al*. (1991) also showed that hazard perception skills relate to potential for crashes, especially for inexperienced drivers.

The findings reported so far relied on retrospective reports of crash involvement; however, a large-scale prospective study was conducted by the Australian Council of Educational Research (ACER) in 1999 and described by Drummond (2000). They used data from around 100 000 probationary drivers who completed a touch-screen hazard perception test and analyzed their subsequent involvement in police-reported casualty crashes. Poor hazard perception was associated with increased risk of fatal or serious crashes but not minor crashes or crashes overall. Those who scored low in the hazard perception test had double the likelihood of being involved in a fatal crash in the first year post-test.

Mills *et al*. (1998) found that driving instructors' on-road ratings of novice drivers correlated well with both response time and the number of hazards missed in a hazard perception test. Grayson (1998, cited in Groeger, 2000) found that drivers who were rated by driving examiners "as being attentive, safe, and skilful drivers, and as having good anticipation and good speed setting abilities" on the road tended to have faster response times in a hazard perception test.

Crash liability decreases sharply during the first few years of driving and one possible explanation is that drivers become better at hazard perception. McKenna and Crick (1991) found that drivers with more than ten years of experience reacted significantly faster to hazards than those with up to three years experience. In addition, Sexton (2000) found that learner drivers were slower than novices with less than two years experience, who in turn were slower than experienced drivers with

greater than ten years driving. Experienced drivers have also been found to detect a greater number of hazards than novices (McKenna and Crick, 1991; Renge, 1998). It has been noted, however, that when experienced drivers are distracted, their advantage over novices is eradicated. This has practical implications for situations that may distract drivers, such as when using mobile telephones, whether hands-free or not.

2.5. The Willingness to Drive Safely and Self-Assessment

This section discusses factors that might motivate young, novice drivers to choose safer or more dangerous driving behaviour, whether consciously or otherwise. The differences in overconfidence and risk assessment between young, novice drivers and older, more experienced drivers are also considered.

2.5.1. Motivation to drive safely

Motives influencing driver behaviour are created by age and gender-related aspects that have been described in Section 2.2, and by experience and feedback concerning probabilities of crashes and the ability to control driving. The issue of motivation is thus an example of an area where research shows that there is a clear interaction between age, gender and experience-related aspects of driving.

Motives influencing young drivers' behaviour can be divided into two main categories. The first includes motives for driving as opposed to not driving or choosing a different means of transportation. The second category includes motives related to how the young person drives, such as choosing a particular driving speed or following distance (Gregersen, 1996).

In addition, a distinction can be made between two other categories of motives: those specifically related to the individual driver and those rooted in the social context, and therefore in the general life situation of the young driver. An example of the first is when the driver adjusts the driving speed according to his or her feeling of pleasure. An example of the second is when the driver adjusts the driving speed based on the preferences of passengers or on the subjective norms among his or her friends (Berge and Vaa, 2003).

Motives influencing driving behaviour have been of interest since the 1970s, when the conviction that the driver controls his or her own behaviour became mainstream (Engström *et al*., 2003). From the beginning, risk-perception has been regarded as a central motive in relation to young drivers' behaviour. Different models of risk-perception, reflecting distinct underlying models of understanding, have been proposed (see Ranney, 1994, for an overview). However, a shared assumption in most models is that driving is a self-paced task, wherein the driver selects the amount of risk he or she is willing to accept. Consequently, risk-perception is seen as the central factor motivating the driver to speed up or slow down.

Yagil (1998) identifies two aspects of motivation that are particularly relevant in the case of young drivers. The first is a lack of motives promoting safe driving, which has been explained by a number of different factors, such as overestimation of driving skills and underestimation of the risk of being in a crash (Finn and Bragg, 1986). The second is motives leading to deliberate dangerous driving, such as sensation-seeking.

These assumptions regarding the linkages between motives, driving behaviour and crash involvement were also supported in a questionnaire survey of young, novice drivers (Wahlquist, 1996) who were asked to report: 1) how important various motives are in their driving behaviour; 2) how they drive (driving style); and 3) their own crash involvement rate. The study shows a clear pattern,

with certain motives correlating closely with certain driving styles. Drivers who often drive for pleasure, to get rid of their frustrations or to seek adventure have a driving style that is more aggressive – they drive faster and with smaller safety margins than others. These drivers also have a higher crash involvement rate. Young, novice drivers who feel that it is important to prove to themselves that they are responsible and safe drivers adopt a more observant and tolerant driving style. If a driver feels that it is important to show consideration to others, then one result is lower crash involvement.

Safety motivation in driving is related to the learning process that the driver undergoes, including feedback during the acquisition of experience. Certain types of motives affect driving behaviour through the reward or punishment that this behaviour provides. The link between such motives and their reinforcement is not entirely uncomplicated.

Most people want to drive safely (Wahlquist, 1996). The problem is to identify what this means in terms of actual behaviour. For the individual driver, it is not so difficult to draw conclusions regarding driving style; however, the individual may easily draw the wrong conclusions. A driving style that is statistically dangerous may perhaps not be perceived as such by the individual driver. If drivers exceed the speed limit, the most likely result is that they will not be stopped by the police, no crash will occur, they might have more fun, and they will get to their destinations faster. This feedback helps reinforce conclusions that this is a "safe" driving style, even though it really counteracts safety from a statistical viewpoint (Näätänen and Summala, 1976).

One can see clear examples of such reasoning, for example when examining the debate on speed limits. Statistically, there is no doubt that higher speed results in more crashes. Despite this, many people feel that speed limits should be raised. Most counter-arguments against the imposition of speed limits are put forward by people who cite the individual's ability to choose the "right" or "safe" speed. Since increased or decreased likelihood of involvement in a crash cannot be identified by the individual until he or she is actually involved in one, the individual lives secure in the "knowledge" of being skilled at modifying driving behaviour to ensure that it does not lead to road crashes. From society's perspective on traffic safety, these individual arguments are of little relevance.

The conclusion is that a driver who feels that the safety motive is sufficiently catered for will choose a driving style which, without jeopardising his or her individually assessed personal safety, will provide immediate reward for as many other motives as possible. He or she will accordingly modify driving style with regard to considerations such as the need to get to a destination, competition, self-assertiveness, the search for adventure, testing one's own and others' limits, etc. Most of these motives run counter to safety, although others, such as driving as comfortably as possible, driving economically or driving with minimum environmental impact, provide increased safety as a secondary effect (Wahlquist, 1996).

This type of compensation phenomenon, where the assessed level of safety is balanced with other motives, has been studied and discussed by many researchers. Näätänen and Summala (1976) have emphasised the significance of motivation for driving behaviour. They state in their "zero-risk theory" that drivers do not normally perceive any risks when they drive, and thus that the safety motive can be regarded as satisfied. Other motives, such as time gain, competition, searching for adventure, etc. – the so-called "extra motives" – will prompt the driver to drive faster. Safety measures, such as improved cars, better roads or better-trained drivers, may fail to improve safety, as the driver may try to exploit those extra margins to satisfy motives other than increased safety, often leading to higher speed.

In a study from New South Wales, Australia, (Catchpole, 2004) it was found that unexpected conflict crashes actually increased with initial experience and reached their peak after about two years of experience. Similar results were found when traffic offences were analysed. There was a difference between male and female drivers where, in general, females had fewer unexpected conflict crashes and fewer offences, but the pattern of development related to experience was the same for both sexes. The author concludes that higher levels of experience are associated with greater risk-taking and that this may be caused by the more experienced driver having learned that risky driving behaviour is rarely followed by unpleasant consequences. Alternatively, the higher risk may be explained by an increasing level of drivers' confidence that they can negotiate hazards if they arise.

These behavioural adaptation mechanisms are often used to explain why various types of safety measures do not, in fact, provide the expected effects. Some examples of measures that did not provide the expected effects are driver improvement programmes (Struckman-Johnson *et al*., 1989), driver training programmes (Siegrist, 1999), training for motorcyclists (Simpson and Mayhew, 1990), courses on defensive driving (Lund and Williams, 1985), skid training (Glad, 1988; Keskinen *et al*., 1992), advanced driver training (William and O'Neill, 1974), anti-locking brakes (Biehl *et al*., 1991) and voluntary traffic safety clubs for children (Gregersen and Nolén, 1994). A general discussion on these aspects and a review of the theoretical literature in this area was published in an OECD report on "Behavioural Adaptations" (OECD, 1990).

As some people are seemingly not inherently motivated to drive safely, other means are sought to encourage such motivation. These are discussed in Section 3.7, and involve such instruments as enforcement, fines, education, demerit points possibly leading to loss-of-licence, and economic incentives via insurance premiums.

2.5.2. Overconfidence and risk assessment

Through the initial training period, the learner driver acquires a range of knowledge and a number of skills, and achieves a certain individual level of actual driving ability. An assumption that has gained support in a large number of studies is that young, novice drivers have a rather poor perception of their actual ability. Subjectively they overestimate their ability behind the wheel.

Overestimation partially results from the process of socialisation whereby young people are distancing themselves from older authority figures. It is also related to the processes discussed above in section 2.5.2, regarding feed-back and behavioural adaptation. Overestimation is thus a typical example of how both age-related and experience-related aspects have an influence on decisions and behaviour in terms of risk assessment and driving behaviour in specific traffic situations.

The most common way of measuring self-assessment in research is through questionnaires. Drivers are usually asked to assess their own ability compared with that of other drivers. This type of survey traditionally reveals that young novice drivers regard themselves as better than other drivers. This pattern also appears to be most typical among young men (*e.g.* Svenson, 1981; Moe, 1984; Spolander, 1983; Finn and Bragg, 1986; McGormick *et al*., 1986; Matthews and Moran, 1986; Gregersen and Berg, 1994)

The conclusion to be drawn from these studies is that young drivers are often bad at accurately estimating their own ability and that they are therefore not very good at assessing potential and real risks in different traffic situations. They underestimate the demands of the driving task they encounter and they overestimate their own ability behind the wheel.

It is obvious that there is a link between subjective risk and subjective ability. If a driver believes that he or she is skilled and can handle hazardous situations, then these situations are no longer regarded with the same degree of caution. From the training viewpoint, this condition is difficult to rectify, since such drivers are not motivated to drive more carefully than they feel is necessary. This attitude also complicates matters as it makes it more difficult to communicate theoretical information about risks. Overconfident drivers lightly dismiss advice with responses like: "That's only a problem for others, it doesn't apply to me since I'm such a good driver."

The difference between the subjective evaluation of oneself and of others may be a result of two different estimations: "positive self" and "negative other". In order to understand the consequences of overestimation on behaviour, it is important to appreciate the relative significance of these explanations. The development of countermeasures depends on whether they should focus on self-assessment or on the assessment of others. This was done in a study by McKenna *et al*. (1991), in which drivers were asked to assess themselves and the average driver on separate scales. Since the average driver received a rating above average on the scale, the conclusion was that he or she was not regarded as being a poor driver. The personal assessments of own abilities were even higher, however, and supported the view that the prevailing attitude was more likely to be explained by "I am good" rather than "the others are bad". In another survey (1993), McKenna experimented with individuals' perceptions of whether the underestimation of the likelihood of being involved in negative events was a result of imagined control (*i.e*. belief in one's ability to handle the vehicle in various situations) or unreasonably high optimism (*i.e*. luck, random chance, etc.). He drew the conclusion that there is "clear support for the illusion of control and little support for unrealistic optimism".

The level of risk-taking behaviour may also be described as the degree of experienced risk that the driver accepts. A relationship has been shown between youth, excessive speeding, short following distance and driving through the amber light, from which the conclusion has been drawn that young drivers could be expected to accept a more risky driving style than older drivers (Elander *et al.*, 1993). According to Deery (1999), this may also indicate that they have greater difficulties in fully detecting risks.

Young, novice drivers are not the only ones who often overestimate their own skills – experienced drivers also tend to rate themselves better than the average experienced driver (Waylen *et al.*, 2004). The difference is possibly that, among experienced drivers, the gap between self-assessment and actual skills is less, and this misconception less often leads to risk-taking behaviour than it does among young drivers.

2.6. Risk-Enhancing Circumstances

Many young, novice drivers augment their risk levels by driving under circumstances that would be more demanding for any driver, and are even more so for novices.

2.6.1. Task demands/exposure

Not only the competencies and capability of the driver are relevant to road safety risk, but also the conditions under which the driving task is executed. Young people have often been shown to augment their exposure to risk by the way in which they drive, including driving style, times at which they tend to drive, and their use of safety devices. These elements of exposure have a strong influence, as young, novice drivers' abilities are still limited while driving in a relatively complex traffic environment.

In some instances, young drivers increase their risk levels simply by virtue of their lifestyles. For example, as discussed in Section 2.2.4, young people are often highly social and very active during the night hours, when crash risk is at its highest. Their socialising also often involves alcohol and, sometimes, drugs. The results of this are partly reflected in data presented in Chapter 1, which showed that young people are greatly over-represented in crashes at night, with passengers of the same age, and involving alcohol and/or drugs.

Furthermore, we have also seen that young drivers often increase their risk by their driving style. For instance, their greater tendency to drive at high speeds substantially increases their crash risk by making the driving task more difficult and reducing safety margins. Furthermore, their exposure to hazards can also be higher compared to that of more experienced drivers because of the non-use and absence of active injury prevention systems in the vehicle. The proper use of, for instance, safety belts, is sometimes lower among young drivers than among older drivers.

2.6.2. Vehicle choice

It is also often suggested that young drivers increase their exposure to risk by driving older vehicles with less modern safety features, such as airbags, headrests, etc., which means that crash injuries can be more severe. Two key issues have to be considered with regard to vehicle choice – the safety of the vehicles themselves and drivers' behaviour.

VicRoads (2005) of the state of Victoria, Australia, concludes that: "As young drivers are likely to drive smaller, older cars which are less crashworthy and have fewer safety features, they and their passengers are at greater risk of serious injury or dying in a crash." This stands to reason. Swedish analysis in 1999 found that young drivers were over-represented in crashes involving older vehicles (Engström *et al.*, 2003).

However, even where the choice of vehicles by younger drivers can be generalised, the impact of this choice is not always clear. The Association of British Insurers (2005) notes that 68% of cars owned by 17-18 year-old drivers are 6 years-old or older, compared to 58% for 30-59 year-olds, implying less protection for passengers in the event of a crash. However, they also note that, due to cost considerations, the most popular cars among the younger age group have less powerful engines (1.1-1.5 litres) than those of the older group (1.6-2.0 litres). This, in itself, could increase risk; for example, the most recent Australian used car vehicle crash worthiness study (Newstead *et al.*, 2004) indicated that "light cars" and "smaller cars" provide less protection in the event of a crash. At the same time, young people are also often named on their parents' car insurance policies, meaning that many young drivers are using the newer, safer vehicles more likely purchased by their parents. The implications of these combined factors would be difficult to assess.

The full complexity of this issue was brought out in a study by Keskinen *et al.* (1994), which focused on a random group of 18-20 year-old male drivers, representing a variety of social backgrounds, in Finland. The study considered the attitudes and behaviour of drivers of rear-wheel drive vehicles (which, in the Finnish context, were considered more "sporty" and generally had larger engines) versus those of front-wheel drive vehicles. The results revealed that the former group were more likely to place high importance on driving and cars, be more influenced by "sportiness" in choosing their vehicle, have strong confidence in their own abilities, commit traffic violations, be less concerned about safety, have lower levels of education, forget to use their seat belts, and drive with a hangover. The same group also drove more and more often just for the sake of driving. Of the 1 777 young men surveyed, 766 drove rear-wheel drive vehicle, and 1 011 front-wheel drive vehicles, indicating that young men are not a homogenous group. Also, their vehicle choices were closely related to their backgrounds, lifestyles and attitudes – in other words, who they are and what they

believe. This is in keeping with the findings of a study by Clarke *et al*. (2002), showing that young drivers of high-powered cars took more deliberate risks, such as speeding and reckless driving; that drivers interested in driving fast chose fast cars; and that young drivers who like sporty cars have the highest number of traffic violations. Senserrick and Whelan (2003) also concluded that, despite the over-representation of high-powered cars in young drivers' crashes, motivational factors could not be excluded as being responsible for the increased crash risk. Put differently, it is the individual and not the vehicle that is to blame, and the type of vehicle chosen is often a reflection of the individual.

This does not negate the point made above, that young people might more often use older and less safe vehicles as a result of their financial situations. Indeed, this is an important concern. Furthermore, the risk associated with these older vehicles will be exacerbated when they are driven by drivers who are inclined towards risk-taking, such as those of the "rear-wheel" category described above. However, the same individuals who might be inclined towards unsafe driving would presumably drive similarly in any vehicle, including their parents' newer and "un-sporty" front-wheel drive vehicles.

2.7. Conclusions

This chapter addresses the question of why young drivers have the very high risk levels outlined in Chapter 1. This information forms the basis of the countermeasures proposed in Chapters 3 and 4.

The reasons are complex, based on a myriad of interacting factors. Beyond the broad headings of experience, age and gender seen in Chapter 1, we have seen a number of key sub-issues, such as biological development, personality, social norms and circumstances, the role of youth in society, lifestyle, impairments to capabilities, and the type of driving engaged in, all of which will combine differently in each individual. This means that there is no "magic potion" for this problem, and that countermeasures to address it must also be multi-faceted.

Importantly, most young drivers do not intentionally engage in high-risk behaviour. Rather, they genuinely want to drive safely but are hampered by their lack of experience and poor self-assessment.

Furthermore, our knowledge of the causes of young driver risk does not allow us to single out problem individuals. Individual factors, such as lifestyle and personality, have a significant impact on the type of driver one is and the likelihood of being involved in a crash, and these combine with other elements, such as gender, socio–economic situation and personality. However, in most studies where crash involvement is related to individual or social factors, the correlations or overrepresentation in crashes are rather weak (Begg *et al*., 1999*)*. No studies have yet been able to use this approach to clearly predict which drivers are going to be involved in crashes.

Also, while young drivers' crash involvement is a major social and public health problem, only a small percentage of young people will be involved in serious crashes. In Sweden, for example, in a given year, approximately 1–2% of 18–19 year-old drivers are involved in police reported injury crashes, and 98-99% are not (Berg, 2000). Many studies have been able to find high risk groups that are significantly over-represented in crashes, but even persons in these groups have relatively few serious crashes. For example, while 2-4% of persons in a high risk group might have crashes, and this represents up to four times more than in other groups, the majority still do not. Again, this makes it difficult to target specific individuals in these groups.

Where crashes are concerned, it is often not possible to isolate single causes. A crash may result from poor skid control; which may be a result of a low level of attention or long reaction time; which, in turn, may be a reflection of high mental workload due to limited experience, alcohol use and/or

tiredness; which could be exacerbated by peer pressure or other social or individual factors. Alcohol use becomes more dangerous together with peer pressure, and high speed becomes more dangerous if seat belts are not used, etc. All these aspects are interrelated in a complex pattern, the ultimate result of which is high levels of crashes and fatalities.

Among the complex mix seen throughout this chapter, it is essential to note that certain factors augment risk more than others and should be subject to special attention in any programme of countermeasures. Chapter 1 already showed us the important role played by speed, alcohol, seat belt use and drugs in young driver risk, meaning that these are key elements to be addressed in any programme of countermeasures. But again, even these are a reflection of other aspects of life, resulting from individual preferences and motives that have their origins in individual, social and cultural influences. Also, their impact will be exacerbated by other circumstances, such as lifestyle, gender, immaturity and inexperience.

Our lesson from this, to be applied in the following chapters, is that an integrated approach is required to deal with many aspects together, as opposed to responding to symptoms alone.

Conclusions and Recommendations:

While our understanding of the underlying causes of the high levels of young, novice driver risk is extensive, and allows us to reach key conclusions regarding effective countermeasures, there are still some important gaps regarding causal effects between inter-correlated factors.

Work should continue to research the causes of young, novice driver risk with a view to designing more effective countermeasures. Areas of particular focus should include:

- The psychological competencies needed to drive safely (*e.g.* impulse control, self-assessment, etc.).
- Brain development in the prefrontal cortex.
- Gender, including the role of testosterone, and whether young women's risk patterns are increasingly resembling those of young men.
- Emotions.
- Drugs.
- Fatigue.

NOTES

1. "Impaired Motorists, Methods of Roadside Testing and Assessment for Licensing"

2 Information provided by Victorian officials.

3 "Roadside Testing Assessment" (www.rosita.org)

4 Much of this section is based directly on Assailly, J.-P. (2001), "Sur la route, les conduites à risque", in *Revue Toxibase*, September.

5 Cognitive dissonance may be defined as tension that arises when one is simultaneously aware of two inconsistent thoughts.

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CHAPTER 3.

COUNTERMEASURES

Abstract

This chapter provides an overview of the countermeasures in place around the world that can have an important impact in reducing young, novice driver risk. In doing so, it seeks to provide evaluations of the effectiveness of these, based on international experience. These countermeasures are largely based on elements of the licensing system, such as formal training, accompanied practice, testing, and restrictive measures following licensing; and on factors that influence the motivation to drive safely, including education, enforcement, demerit points, economic incentives, persuasive communication, informal social controls and popular media. The importance of high overall road safety standards is also noted. Particular emphasis is placed on measures that allow young, novice drivers to progressively gain experience before full, unrestricted solo driving, and those that limit exposure to risk following licensing.

3.1 Introduction

The previous chapters described the magnitude of the problem of young driver risk and analysed the factors contributing to it. This chapter focuses on the effectiveness of applied countermeasures that have been shown to decrease young, novice drivers' crash risk or exposure to dangerous conditions.

We have already seen that experience, age and gender are key factors behind the high levels of young driver risk, and that this risk manifests itself particularly when driving at night, with passengers, at high speeds, and under the influence of alcohol and/or drugs. There is no single solution to the problem; its multi-faceted nature will necessarily require a package of countermeasures. Furthermore, as OECD and ECMT countries differ widely in their legal systems, history, levels of motorisation and overall traffic safety levels, the strategies employed will have to vary for each set of circumstances.

This discussion of countermeasures begins with consideration of those that are not directly linked to licensing, and then follows the order in which one typically becomes a driver: pre-driving education, formal and informal training, testing, post-licence training and experience, and means of influencing behaviour after licensing. Chapter 5 re-examines these countermeasures, with a view to assessing their levels of priority based on effectiveness, costs and timelines for implementation.

3.2. Issues Regarding Group Selection, Outcome Criteria and the Value of Evaluation Studies

As background to this discussion, it is important that consideration be given to the following issues:

1. Young drivers as a target group, and subgroups within the young, novice driver population.

2. Assessment of the effectiveness of given countermeasures.

3.2.1. Target groups and subgroups

One question that might be asked is whether countermeasures should target *young* drivers in particular, or all *novice* drivers.

As noted in Chapters 1 and 2, young drivers in themselves are a clearly identifiable high-risk sub-group of all drivers, although, in general, most young drivers do not consciously engage in high-risk behaviour. Inexperience is the universal problem of young, novice drivers and, as most people learn to drive while they are young, this explains much of the high levels of young driver risk. Beyond this, a minority of young drivers fails to manage a complex range of additional risk factors and is thus involved in a further disproportionate number of fatal crashes. In particular, youth itself is a factor that aggravates risk, in terms of young people's emotional and physiological development, socialisation processes, role in societies and lifestyles. It is this combination of experience and age-related factors, aggravated by gender-related factors, that makes young drivers a clearly identifiable high-risk sub-group. Thus, there is a definite argument for focussing attention specifically on drivers who are both young and novices. At the same time, it should be noted that many of the countermeasures in the following sections are equally applicable to all novice drivers.

Another question is whether countermeasures should target sub-groups among young drivers that are clearly more prone to risk. Chapter 2 showed us that high-risk groups exist, based on gender, personality, social and/or socio-economic profiles. However, it was also noted that, within these groups, serious crashes are still rare, and, based on existing knowledge, it is not possible to identify

those individuals who are most prone to risk. For example, while young men experience higher crash risk, it cannot be assumed that most young men are dangerous drivers. For this reason, it is also not possible to target countermeasures towards high-risk sub-groups and individuals, and it is therefore necessary to look at young, novice drivers as a whole. At the same time, special attention is paid to young male drivers in the final section of the chapter, because of their particularly high risk profile.

3.2.2. Assessment of the effectiveness of given countermeasures

This chapter focuses heavily on the effectiveness of countermeasures, which raises three relevant questions related to the assessment of the evidence presented:

1. What are the success criteria for safety – is it the absolute number of crashes and fatalities (an "absolute number" criterion), crashes per kilometre driven (a "relative risk" criterion), or safe behaviour (an "intermediate" criterion)?

2. What are the essential characteristics of "good" evaluation studies?

3. To what extent can particular results in one country be generalised to other countries?

The "absolute number" criterion aims solely to decrease overall fatalities and may entail measures that reduce travel or restrict access to the traffic system, such as delaying the licensing of young drivers. In contrast, the "relative risk" approach states that safety should be expressed as a decrease in fatalities per kilometre driven. In the latter perspective, an increase in the absolute numbers of fatalities as a result of a higher mileage could still lead to a positive evaluation of the outcome, whereas the decrease in fatalities due to lower mileage may not be considered success.

The two perspectives result in different assessments of the outcome of measures, as well as in preferred measures. They also show that individual measures are effective in two distinct ways: either by reducing exposure to risky travel by reducing mobility under risky conditions, or by improving the general safety level of the traffic system, including novice driver performance. In this chapter we will use both perspectives for judging the effectiveness of measures.

Aside from the discussion of absolute frequencies versus fatality rates, the choice of fatality levels as a success criterion also needs elucidation. Given the enormous numbers of drivers on roads at any given time, fatalities are "rare" outcomes of a complex system, and are usually the result of a unique combination of circumstances. This implies that, although fatality reduction is the ultimate goal of countermeasures, this criterion is not a reliable variable in evaluation studies. The fatality criterion can only be employed in situations in which data on large numbers of observations over a longer period of time can be collected. In all other cases, the use of intermediate variables is advised. Intermediate variables should be chosen on the basis of an identified logical or evidence-based relationship with crash risk. For example, because of the known relationship between alcohol use and crash risk, any measure that changes the level and frequency of the intermediate variable "alcohol use in traffic" can be assumed to have an effect on crash risk as well.

In assessing the quality of evaluation studies, there are three broad approaches:

1. Comparisons between groups to which the countermeasure was either applied or not applied (a control group). In this approach, subjects should be randomly assigned to one of the groups, just to rule out that the groups differ because of the personal characteristics of the individuals chosen for a particular treatment. This is of major importance for measures that are voluntary. For instance, safety-training courses may attract individuals who are more safety-oriented. This effect is called "volunteer bias" or "self-selection".

2. Time series: Comparing the situation before the introduction of a countermeasure with the situation after. This is the best approach in assessing the effects of compulsory measures. The strength of this approach is that a large number of observations is available, and subsequently the "fatality criterion" can be used. The weakness of this approach is in the control for effects that are caused by simultaneous developments other than those that are the subject of the study.

3. Cross-country comparisons: Comparing countries in which countermeasures were applied with countries in which the measures were not applied. In the past, attempts were made to estimate the effectiveness of different licensing systems by comparing the safety levels of young drivers in different countries (*e.g.* Leutzbach *et al.*, 1988; Lynam and Twisk, 1995; Lynam *et al.*, 2005). However, as yet, these studies have not been fully successful, mainly due to the great number of other factors involved that might explain the differences, such as infrastructure, traffic intensity, and the level of separation between travel modes.

This chapter provides an overview of a broad range of interventions, examining what is known about their effectiveness. However, proven interventions in one setting may not easily be transferable elsewhere, because of differences in traffic characteristics, legal traditions and established practices. In the field of young driver safety, differences between countries can have a major impact on the outcome of similar strategies, as we will see in the discussion of the effects of accompanied driving (section 3.6.2). This implies that measures require careful evaluation, adaptation where necessary, and subsequent monitoring when applied in other settings.

3.3. The Impact of General Road Safety Measures on Young Driver Risk

Figure 1.7 in Chapter 1 showed us that countries with the highest overall levels of road safety are also typically those where young driver fatalities are the lowest. Moreover, within countries, the progressive reduction of young driver risk has followed that of experienced drivers. Assuming that the development over time of experienced driver risk is caused by general improvements in the traffic system as a whole, the parallel development of young driver risk suggests that young drivers also benefit from these general improvements. On the basis of the continuous and steady decline of risk, it can be argued that important reductions in young driver risk will result from general measures, like safe roads, obstacle-free zones, passive safety features in cars, effective enforcement and moderate driving speeds.

Chapters 1 and 2 also showed us that young drivers, especially men, are over-represented in certain dangerous driving behaviour that greatly increases their risk, notably driving under the influence of alcohol and drugs, at high speeds and without seat belts. However, as Section 3.7.3 notes, it is not easy to target enforcement of related laws specifically at young drivers, particularly because it is difficult –and sometimes illegal – for police to single out young drivers. Thus, addressing such behaviour will necessarily involve more general enforcement, although this may be focused on areas where, and at times when, young people are most likely to be active.

Table 3.1. **Overview of Generic Measures Beneficial to Specific Road Safety Issues**

The strategic approach

Road safety issues	Classes of initiatives						
	Improved enforcement	Public education	Lower speeds	Safer roads	Occupant protection	Safer modes of travel	Planning a safer system
Drink-driving	●	●		●	●	●	
Speeding	●	●		●	●	❍	
No seat belt	●	●		❍	●	❍	
Driver fatigue		●		●	●		
Young drivers	●	●	●	●	●	❍	●
Older drivers	❍		●	●	●	❍	●
Motorcycles	●	❍	●	●	●	❍	
Bicycles	❍	❍	●	●	●	❍	
Pedestrians	❍	❍	●	●	●	??	●
Heavy vehicles				●	●		
Drugs				●	●	●	

Source: Government of Western Australia and Road Safety Council, 2002

Note: Unfilled circles = indirect effect
Filled circles = direct effect

With this in mind, in addressing young driver safety, a strategic and systematic approach is called for to improve the general safety level in a country, which will also generate benefits for all drivers. Table 3.1 outlines Western Australia's strategic approach to road safety (Government of Western Australia and Road Safety Council, 2002). The first column lists the issues identified as accounting for a high number of road fatalities, including behavioural and other factors that cause road crashes, and the road user groups and vehicle types involved. It then cross references these with the initiatives known to have an important impact in reducing crashes and the impact of crashes, noting where these have a direct or indirect impact. Notably, all of these initiatives, while not targeted solely at young drivers, are seen to have an important impact on young driver risk.

This shows us that measures focussing on improving the safety of all road users under all conditions will also be beneficial for young drivers, who frequently exhibit the dangerous behaviours that are targeted. For instance, enforcement will have a proportionately higher impact on young people, as they violate traffic rules more often than experienced drivers do. Young drivers crash more frequently than expert drivers, and therefore protective devices, crashworthy cars, and safer road infrastructure will particularly reduce young drivers' injury risk. Predictable traffic situations, low complexity and reduced speeds resulting from an improved road infrastructure are beneficial for young drivers, as they lower task demands and reduce the chance of driving errors that might result in serious crashes. High predictability of the traffic situation will improve young driver performance. The World Health Organization's *World Report on Road Traffic Injury Prevention* (Peden *et al.*, 2004) noted that "[a] safe traffic system is one that accommodates and compensates for human vulnerability and fallibility". Furthermore, improving general road safety will be especially important in those countries where road safety levels are relatively low.

Evidence of the effectiveness of such general campaigns may be seen in France, where a road safety campaign mandated by the President has led to important improvements in recent years, including among young drivers. For example, from 2001 to 2004, there was a 35.9% drop in the number of killed drivers per million population, and a 34.5% drop in the number of killed 18-24 year-old drivers per million in that age group.[1]

However, the French data highlights another key issue – in 2004 the number of killed 18-24 year-old drivers per million in France remained almost three times greater than that for the population in general (117.3 versus 40.8). Figure 1.5 in Chapter 1 showed us that, while young driver risk has diminished in various OECD countries along with that of other drivers, it has also remained significantly higher than older drivers' risk. Indeed, the decline in overall young driver risk noted above may hide less positive trends. For example, Figure 1.13 shows us that young males' risk relative to that of the overall population has actually been increasing in the Netherlands, the UK and Sweden, which may indicate that young men are less susceptible to the positive impact of general road safety measures. Also, Table 1.3 showed us that, although overall young driver risk may be reducing in the UK, it is increasing in terms of fatality per young licence holder.

All of this underscores the key conclusion that initiatives aimed at the general population are not enough, in themselves, to deal with the enormous problem of young driver risk, and that more targeted actions are also required.

An additional point is worth making. Noting the high proportion of crashes and fatalities accounted for by young drivers, and particularly men, any general road safety campaign should place emphasis on these segments of the population. While this should involve the targeted countermeasures described in this report, it should also mean that general road safety measures, such as enforcement, should be applied in a way that will specifically focus on young driver risk factors, like alcohol, drugs, speed, and night-time driving. This point is discussed in greater detail in Section 3.7.3.

Conclusions and Recommendations:

Important road safety benefits for young, novice drivers will likely result from measures aimed at improving the overall safety of a country's road transport system.

- Work to ensure that high standards of road safety are in place, noting, in particular, the important reductions of traffic fatalities that result from effective legislation and enforcement, particularly regarding speed, alcohol, drugs, and seat belts; appropriate driving speeds; state-of-the art injury protection in vehicles; and good standard road infrastructure.

- Ensure that general road safety campaigns focus on the young driver problem by incorporating countermeasures targeting young drivers, and by specifically addressing the circumstances that augment young driver risk by way of enforcement at times when, and in areas where, young drivers are most active.

3.4. Classification of Licensing Systems in Use and Current Trends

The general aim of licensing systems is to exclude individuals with insufficient driving ability and competence. Licensing systems are based on laws and regulations referring to the requirements for being licensed (*e.g.* age, driving aptitude and driving qualifications), the quality of licences (*e.g.* licence categories, restrictions), the administrative procedures for licensing (*e.g.* licensing process, withdrawal, re-licensing), and fitness to drive.

Systems are generally differentiated regarding the items that are controlled, formal procedures, licensing ages and other elements. Regulations concerning the classification of licences, the theoretical and practical driving test, the withdrawal of a licence, and the approval of foreign licences can probably be found in any licensing system. More developed licensing systems possess special elements and regulations like a penalty point system, a central registry for traffic offences and special regulations for novice drivers, such as the probationary licence.

A system setting up requirements for a driving licence is, by its nature, closely connected with the processes of learning to drive. In most jurisdictions, regulations are made concerning the ways of qualifying for driving and the driving test. Learning to drive therefore can be seen as a central element of a licensing system.

Licensing systems of today differ in many aspects. In this report the licensing systems in different countries are described on a general basis. Only licensing systems related to passenger vehicles are included. A distinction will be made between the following general categories of licensing systems:

1. Traditional and probationary licensing systems; and

2. Graduated licensing (GDL) systems.

These categories are described in more detail in Sections 3.4.2 and 3.4.3 below. Annex A provides an overview of the details of different countries' licensing systems.

3.4.1. Current trends in licensing systems

Traditionally, important differences have existed between countries in the structure and content of licensing processes, allowing countries to be grouped in the separate categories of licensing systems noted below.

However, our growing understanding of the factors behind young and novice driver risk is leading to common underlying objectives that are reducing the differences between systems. Many countries' licensing systems now have elements that seek to:

- Address "higher-order" skills, like hazard perception (as discussed in Section 3.5.2 and 3.5.3).

- Ensure that experience is gained before solo driving.

- Impose protective measures during the first period of solo driving, when risk is highest.

- Ensure compliance during these first years.

Although a systematic survey of new developments across countries has not been carried out, in recent years, many countries have implemented measures to deal with these questions, as seen in Annex A. The result is increasing similarities between countries' licensing systems. For example, increases in the learning period prior to solo driving have effectively raised the age for solo driving in some GDL systems. At the same time, some probationary systems, such as those of France, Norway and Sweden, have lowered the age at which learning can begin, making the age for first (accompanied) driving closer to that seen in GDL systems. In both instances, the goal of these changes is to increase the degree of experience before solo driving.

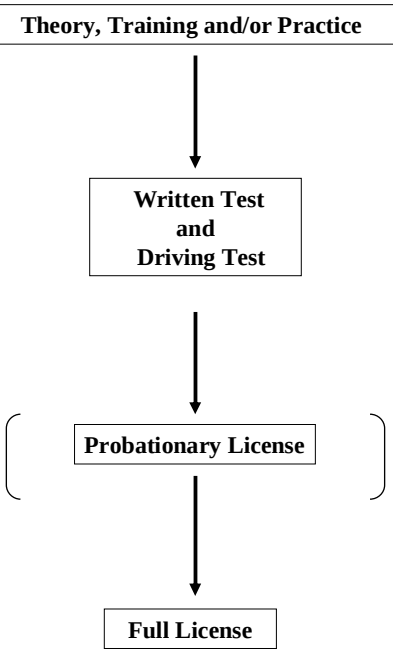
3.4.2. Traditional and probationary licensing systems

The traditional licensing system was widely used in most countries in the last century, and continues to be used in much of the world. In this system, the novice driver is fully licensed after passing the driving test, and no special conditions apply (Heinrich *et al.*, 1994, Lynam and Twisk, 1995). Thus, the traditional licensing system is often called the "single-phase licensing system."

Often, pre-conditions are applied prior to taking the test, such as mandatory training, practice or knowledge of theory. Furthermore, today most countries using a traditional licensing system have introduced a probationary licence. Consequently the novice driver does not become fully licensed until he or she has completed a probationary period, which could include higher demerit points, lower allowed BAC levels, and other restrictions.

The traditional (single-phase) licensing system is described in Figure 3.1.

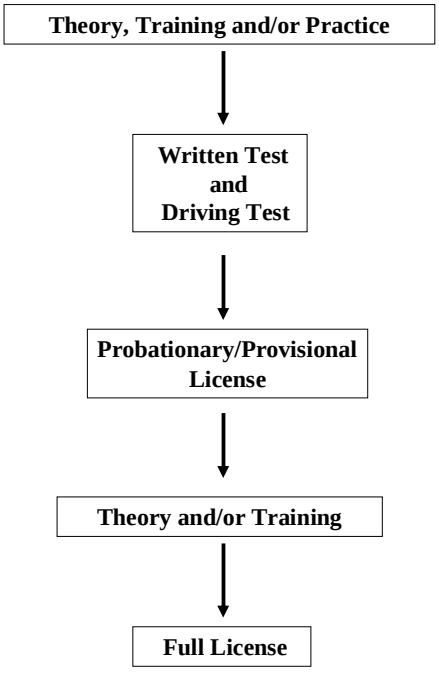
Figure 3.1. **The Traditional Licensing System**



Source: Adapted from Engström, *et al.*, 2003.

A variation on the probationary licensing system is the "two-phased" system. The major difference in the two-phase system is that, in this case, candidates must go through two phases of driving theory and training before becoming a fully licensed driver. After completing the first phase of the licensing process, candidates get a provisional or probationary licence, allowing them to drive solo under given conditions. The full licence is issued after completion of the second phase of theory and training, but without further testing. This is shown graphically in Figure 3.2. For example, Austria, Finland and Luxembourg are using a two-phase licensing system.

Figure 3.2. **Two-Phase Licensing System**



Source: Adapted from Engström, *et al.*, 2003.

3.4.3. Graduated licensing (GDL) systems

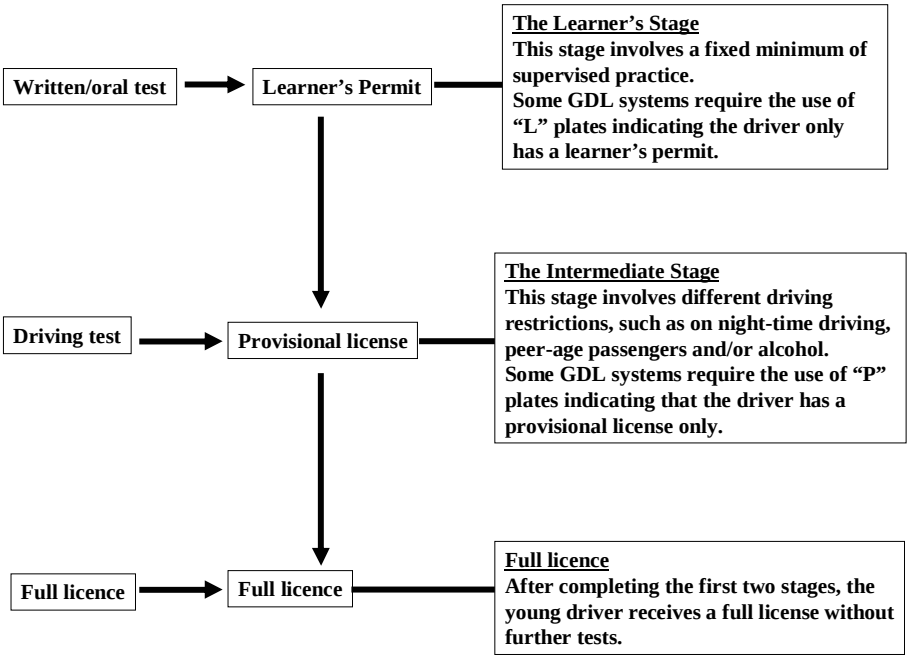
In graduated licensing (GDL) systems, selected driving privileges are progressively phased in and selected driving restrictions progressively phased out, thereby allowing the novice driver to gain driving experience under low-risk conditions. The specific restrictions and privileges used vary between countries and states.

GDL is primarily designed to address the inexperience component of young and novice drivers' crash risk, and secondarily to mitigate deliberate risk-taking, which could partially result from age-related factors (Simpson, 2003). The basic principle is to let new drivers acquire driving experience under low risk conditions.

GDL systems are typically divided in three stages: "learner", "provisional", and "fully licensed". Support and protective restrictions for the novice driver are reduced from stage to stage. In this way, experience is gained in stages of progressively increased difficulty during a longer learning process with protective learning conditions.

GDL can generally be described as consisting of the three stages described in Figure 3.3, below. [2]

Figure 3.3. **Different Stages of a Graduated Licensing (GDL) System**



However, a number of variations in GDL exist. For example, some have two learner stages and some have two intermediate stages. Also, as seen in Annex A, a wide variety of different combinations of protective restrictions are employed during the provisional phase. For example, four different versions of graduated licensing are currently in use in separate Australian jurisdictions (Senserrick and Whelan, 2003).

GDL is widely used in the Australia, Canada, New Zealand and the US, notably where licensing for solo driving typically begins before 18 years of age. Although no European country has, as yet, implemented a "complete" GDL system, selected elements (protective measures or sanctions) of GDL have been implemented in the licensing system in a number of countries.

Most evaluations of GDL conducted to date have reported significant reductions in crashes and fatalities, albeit with great variation (for an overview see Hedlund *et al.*, 2003; Senserrick and Whelan, 2003; Hedlund and Compton, 2004; Hedlund and Compton, 2005; and Hartling *et al.*, 2005). Some studies have reported a reduction in crash rates of 4%, whereas others have reported reductions as large as 60%. Simpson (2003) notes that these variations partly reflect the evaluation methods used and differences among the drivers studied, such as age differences. Other factors that could impact on the safety benefits of GDL are the previous licensing system, and the number of GDL elements implemented. Results from New Zealand show that the safety benefits of GDL last beyond the GDL period and into the period of full licensure (Begg and Stephenson, 2003).

The US Insurance Institute for Highway Safety (IIHS) has categorised systems from the US and Canada as "poor", "marginal", "fair" and "good" based on their relative strengths and weaknesses (Williams and Mayhew, 2004). This categorisation is based on the number and potential safety effects of the elements included. Thus, the systems categorised as poor have close to no GDL elements included, whereas those considered good include several and different kinds of driver restrictions, like 3 phases, and protective measures, such as a ban on night-time driving and the presence of passengers. The actual IIHS classifications of current systems in use are presented in Annex A. The classification shows that only a few programmes can be regarded as "best practice" where GDL systems are concerned.

The IIHS overview is based on experts' views and not on empirical evidence. In order to optimise the systems, more knowledge is needed about the effect of the specific GDL elements, including the learner phase, the provisional licence phase and the role of the supervisors of accompanied drivers, as well as about the longer term impacts after licensing.

3.5. Effectiveness of Individual Elements in the Licensing Process

The licensing process regulates access to driving, minimum driving ability standards and the conditions under which driving is allowed. Consequently, it has high potential as a countermeasure. Four components of the licensing process can be distinguished as potential countermeasures:

1. The licensing age for solo driving;
2. Content and method of training, practice and gaining experience;
3. Test content; and
4. 4. Protective measures for solo driving.

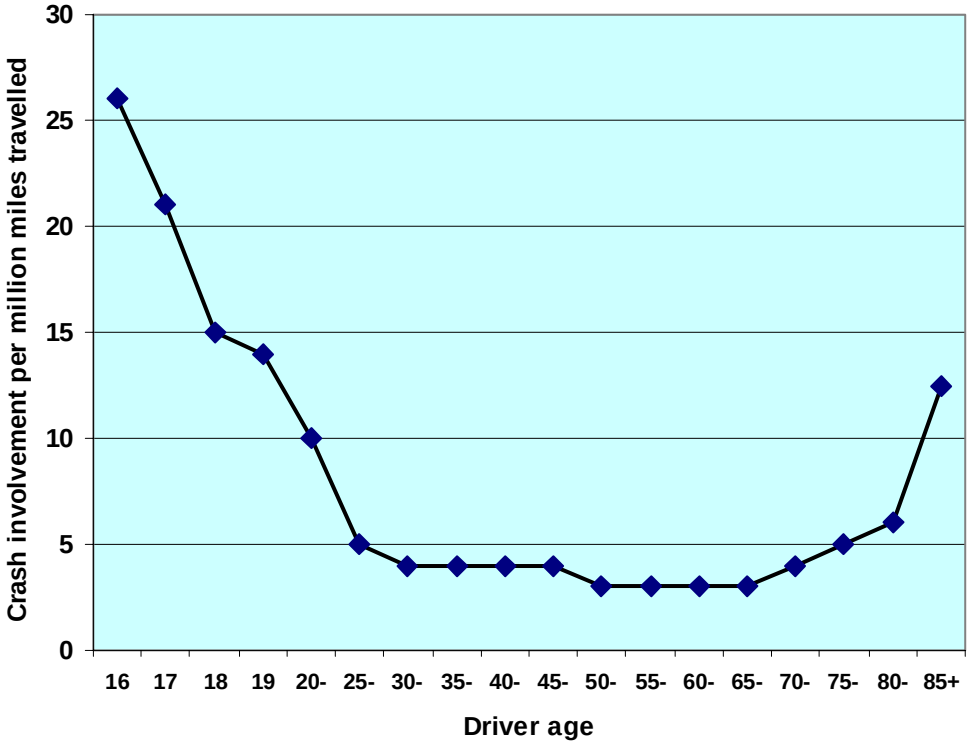
3.5.1. Licensing age for solo driving

"If young people have so many more crashes, why do we let them drive?" The question is reasonable enough, particularly in jurisdictions where people begin driving in their mid-teens. After all, young people are selectively restricted in other activities, such as drinking alcohol, voting and serving in the military.

Ultimately, the decisions taken regarding the minimum driving age will be conditioned by local circumstances, including geography, the degree of urbanisation, and the availability of alternative sources of transport, as well as by road safety considerations. Social norms also play a role; in jurisdictions where licensing for solo driving occurs at 16 years-old, raising the licensing age may be difficult to imagine simply because the driving age has always been 16, even though traffic conditions have changed radically in recent decades.

Figure 3.4. **Driver Crash Involvement per Million Miles Travelled, by Driver Age**

US, 2001-2002



Source Insurance Institute for Highway Safety, US.

Chapter 1 showed us analysis that clearly indicates the role of age in driver fatality risk, inasmuch as first year fatalities rise as the age of first time solo driving decreases. Figure 3.4 shows the extent to which crashes are more prevalent among younger drivers in the US. Importantly, the rate of driver crash involvement per million miles travelled is around 75% higher at 16 years-old than at 18 years-old, where risks are already about three times higher than for drivers aged 25 and above. In the US in 2004, 284 16 year-old drivers, and 434 17 year-old drivers died in crashes (data from IRTAD). Furthermore, as many as 1.37 other people likely died in the same crashes, for each killed driver. While we cannot assume that none of these people would have died during their first year of driving had the minimum age been 18 years-old, *fewer* first year drivers would likely die if the driving age were higher.[3] Indeed, Figure 1.10 showed us a situation in which, cumulatively, crashes among 16 and 17 year-olds were lower in a US jurisdiction where licensing began at 17 than in a contiguous jurisdiction where it began at 16. Section 2.2.1 noted recent research on human brain development indicating that adolescents may be inherently less prepared for the responsibilities of solo driving than older people.

In short, raising, or not lowering, the driving age, will save lives, by virtue of the fact that it prevents young and inexperienced drivers from solo driving until they are older. Of course, such measures could also limit young people's access to work, social and educational opportunities.

The key point is that young driving is not without its risks, and decisions taken with regard to driving ages should factor in this risk. In other words, the need for mobility at a given age should be balanced with the cost of that mobility, in terms of human life and health, as well as economic impact, based on data that is as complete and reliable as possible. Put differently, how much personal mobility should be exchanged for how many deaths and injuries related to young driver risk? At what point does the risk of preventable deaths and injury become excessive? Decision-makers and societies must arrive at their conclusions with their eyes open, although social norms are likely to guide the ultimate decision.

At very least it should be noted that, for governments seeking to achieve major gains in reducing young-driver-related deaths, the option of a higher licensing age should not be rejected without consideration, particularly in cases where people are currently allowed to drive while still in their mid-teens. The above considerations should also enter into play where there is pressure to reduce driving ages. Furthermore, as noted below, accompanied learning periods prior to solo driving and protective measures following licensing for solo driving can do much to mitigate the age-related aspects of risk.

Although this report focuses only on the young car driver, the age discussion for solo driving needs to take into account that the licensing age may motivate young people to choose even less safe modes of transport, such as motorcycles. Licensing systems should not make it possible to ride a motorcycle or moped when one is younger than the minimum age for solo passenger vehicle driving.

Conclusions and Recommendations:

Particularly before the age of 18, crash risk is inversely correlated with the age at which a driver starts solo driving – the lower the age of solo driving, the higher the crash risk.

- Seriously consider the risk implications of any pressure to lower licensing ages, as well as the implications of unrestricted solo driving before the age of 18.
- Seriously consider raising licensing ages, especially in jurisdictions where solo driving ages are particularly young.
- Encourage young people to contemplate whether they need to obtain licences as soon as they are legally able to, and promote other forms of affordable transport wherever possible.
- Ensure that licensing conditions for motorised two-wheeled vehicles are as strict as for passenger vehicles, in order to avoid migration to less safe modes of transport.

3.5.2. Objectives and methods of training, practice and gaining experience

Training objectives to create safe drivers (GDE matrix):

The goal of the licensing process, including training, should be to create drivers that are safe, and not just technically competent. Essential to this is a training process that engages novice drivers personally and emotionally, increasing their awareness of their own limitations and of the dangers inherent to driving. From this perspective, driver training should address all aspects that were identified in the previous chapter as contributing to the high crash risk of novice drivers. This would be a new development compared to the current situation, in which most driver training basically concentrates on vehicle control and the application of traffic rules.

In order to provide an overview of what the licensing process should cover, the Goals for Driver Education (GDE) Matrix was developed in the context of the EU's GADGET (Guarding Automobile Drivers through Guidance, Education and Technology) project (Siegrist, 1999). The GDE Matrix provides a hierarchical schematisation of the driver's task, outlining the personal situation within which all drivers undertake driving, including preconditions, attitudes, abilities, demands, decisions and behaviour. These have been categorised into the following four levels, which were initially described by Keskinen (1996) and later applied in GADGET (Hatakka *et al.* 2003):

Level 4, Goals for life and skills for living: The highest level refers to personal motives and tendencies in a broader perspective. This level is based on the presumption that lifestyles, social background, gender, age and other individual preconditions will influence attitudes, decision-making and behaviour in driving and, consequently, crash involvement.

Level 3, Goals for, and context of driving: The focus at the third level is on the goals behind driving and the context in which driving is performed. This includes the travel situation in terms of why, where, when and with whom driving occurs, all in relation to the purpose of the trip. Examples include the choice of mode of transport, route, time-of-day, etc., as well as the decision to drive under the influence of alcohol, drugs, fatigue or stress, or to engage in activities that will distract from the driving task, such as using a mobile telephone. It is easy to see how fourth-level elements might affect decisions at the third level.

Level 2, Driving in traffic situations: The choices made on the third level have an influence on the situations that will occur in real traffic, the level of risk, and how well the driver will be able to handle specific traffic situations. The second level is about mastering driving in specific traffic situations. A driver must be able to adjust his or her driving in accordance with the constant changes in traffic, such as at intersections, when overtaking or when encountering more vulnerable road users, like pedestrians and cyclists. The ability to identify potential hazards in traffic and to act correctly to avoid them also exists at this level.

Level 1, Vehicle control: The lowest level focuses on the vehicle and how it is operated. The ability to manage the vehicle (*i.e.* steer, brake, shift gears, etc.) belongs at this level, as well as more complex evasive manoeuvres, reducing skids on low friction and understanding the laws of nature. The proper use of injury preventive systems, such as seat belts, child restraints and airbags, also belongs here, as these are subsystems of the vehicle.

These four levels are considered hierarchical because the higher elements affect the lower ones. Clearly, the bottom two levels focus most on technical driving ability. Driver training traditionally focuses on these bottom levels, particularly with regard to teaching traffic rules, practising driving in traffic and identifying hazards. However, the proponents of the GDE Matrix propose that, in order to create safer drivers, it is essential to focus on the higher levels as well, as these have the greatest influence on the sort of driving situations that the driver will most likely find him- or herself in.

Figure 3.5. **The GDE Matrix**

	Knowledge and Skill	**Risk Increasing Aspects**	**Self-Assessment**
Goals for Life and Skills for Living	Understanding the importance of lifestyle, age group, culture, social circumstances, etc.	Understanding the importance of sensation-seeking, risk acceptance, group norms, peer pressure, etc.	Understanding the importance of introspection, competence, personal preconditions for safe driving, impulse control, etc.
Goals for, and Context of Driving	Understanding the importance of modal choice, time-of-day, motives for driving, route planning, etc.	Understanding the impact of alcohol, fatigue, low friction, rush hour traffic, peer-age passengers, etc.	Understanding the importance of personal motives, self-critical thinking, etc.
Driving in Traffic	Mastering traffic rules, hazard perception, etc. Automating elements of the driving process. Co-operating with other drivers. Etc.	Understanding the risks associated with disobeying rules, close-following, low friction, vulnerable road users, etc.	Calibration of driving skills, developing a personal driving style, etc.
Vehicle Control	Mastering vehicle functioning, protective systems, vehicle control, etc. Understanding the impact of physical laws.	Understanding risks associated with non-use of seat belts, breakdown of vehicle systems, worn-out tires, etc.	Calibration of car control skills

Source: Adapted from Hatakka *et al*., 2003

These four levels become the GDE Matrix seen in Figure 3.5, which defines appropriate goals for driver education, when combined with *three key training areas*: knowledge and skills, risk-increasing factors and self-assessment.

The first column describes the *knowledge and skills* that a driver needs for driving under normal circumstances, including the rules that must be followed. At the higher levels, the column relates to how trips should be planned to be as safe as possible and how a number of different personal preconditions may influence behaviour and safety.

The second column is about *awareness of risk-increasing factors in driving*. At the lowest level it may be worn-out tires, poor brakes, lack of routine in performing basic manoeuvring, etc. On the second and third levels of the hierarchy this column refers to excessive speeding; animals on the road; visual search deficits; mental overload; and the risks of driving in darkness, on low friction or among unprotected road users. At the highest level it includes dangerous motives for driving, peer pressure and risk-increasing aspects of lifestyle and personality.

The third column is about how well the driver *assesses his or her own situation* on the four levels. This includes, on the lower two levels, skills in vehicle control and in handling different traffic situations. At the higher levels it could include awareness of personal preconditions and tendencies, as well as decision-making about specific trips and lifestyle choices in general.

The cells of the GDE Matrix thus form a framework for the definition of the competencies needed in order to become a safe driver. The GDE Matrix provides a useful descriptive tool for ensuring that training covers all necessary goals by categorising different aspects of the training process and different competencies that are sought. Skill sets from Levels 1 and 2 are referred to as "higher-order", while those of Levels 3 and 4 are "lower-order". The matrix could be used for defining

educational goals and content in driver education and training. The matrix's creators suggest that driver training should strive to cover as much as possible of the whole matrix, although traditional driver training typically covers only the lower leftmost cells.

The GDE Matrix was developed in the European context, although its applicability is potentially wider. From a North American perspective, Mayhew *et al.* (2006) note that driver education should focus more on the skill deficiencies that contribute to young drivers' crashes, such as hazard perception, over-reaction and slow response; driving errors; and high risk behaviour such as speed, distraction and driving under the influence of alcohol and drugs. This also suggests greater focus on self-awareness and consideration of the context in which driving occurs.

At present, the GDE Matrix exists in the realm of theory, and has not been fully tested as a tool for the development of training objectives or systems, although there are initiatives attempting to refocus formal training in the direction of self-assessment skills and problem awareness. Norway is the first country to introduce a national curriculum that is based on the GDE Matrix, and foresees and evaluation of this experience (Norwegian Public Roads Administration, 2005).

As noted in Section 2.4, research is lacking with regard to the psychological competences required to drive safely, such as impulse control and self-assessment, which correspond to the highest levels of the GDE Matrix. Greater understanding in this field would assist in facilitating the direct application of the matrix to training schemes.

Conclusions and Recommendations:

The fundamental goal of pre-licence training and the licensing process should be to create drivers who are safe, and not just technically competent, by the time they are permitted to drive unsupervised. This will involve instilling novices with an appropriate cognitive skill level and safety-oriented motives. The primary goal of training should *not* be to help novices pass their driving tests.

- Increase focus in pre-licence training on risk-increasing factors and self-evaluation, including on personal motives and the context in which driving is performed.
- Research the benefits of using the GDE Matrix as a basis for developing driver training objectives and testing.

Formal pre-licence training:

In this report, we discuss both *formal* and *informal* pre-licence training. *Formal* pre-licence training is defined here as training in which a candidate driver practices under the supervision of a qualified driving instructor, while simultaneously receiving instruction regarding how to drive, and as part of a structured training process.

In the literature, the terms "driver training" and "driver education" are often used synonymously. Different reviews and meta-analyses have studied the effectiveness of pre-licence driver training and have reached the conclusion that formal pre-licence driver training is not consistently effective as a safety measure, as it does not reduce novice drivers' crash rates (Elvik *et al.*, 1997; Christie, 2001; Engström *et al.*, 2003; Elvik and Vaa, 2004). One meta-analysis (Elvik and Vaa, 2004) shows that, in experimental studies in a one-to-two-year period, drivers with formal pre-licence driver training have 11% more crashes per kilometre than drivers without formal training. Mayhew *et al.* (2006) noted that adolescent drivers having completed formal driver training in Oregon, US, had proportionally more

crashes, although this was not the case in British Columbia, Canada. At the same time, formal training adds to the cost burden faced by the learner.

The US National Transportation Safety Board (NTSB) (2005), which is responsible for crash investigation, has noted that "[w]hile driver education has been available since the 1930s and, intuitively, should improve driving safety, in fact little consensus exists on the benefits of driver education and training, what it should entail, and how it should be delivered." The lack of evidence regarding the effectiveness of formal pre-licence training indicates that it cannot be a substitute for driver experience. Similar conclusions have been reached in recent literature reviews on the matter, which point out a lack of substantial benefits from current training practices, and the positive effects of protective restrictions and driving experience (Engström *et al.*, 2003; Vlakveld, 2004).

This is not to imply that formal training is without potential as a countermeasure, but rather that more work needs to be done to understand its possible benefits. Indeed, Section 2.4.1 noted that, from the perspective of transfer and retention of skills, a combination of formal and informal training might be ideal. However, the need to quantify the benefits of formal driver training and optimise its delivery has been widely recognised. The US NTSB has recommended to the National Highway Traffic Safety Administration (NHTSA) and Department of Education (DOE) that they review national and international driver education and training programmes and determine which instructional tools, training methods and curricula are consistent with best training methodologies and will lead to reducing crashes, with a view to incorporating these into a model driver education and training curriculum (US NTSB, 2005).

As discussed in Section 3.5.2, recent overviews on the content of formal pre-licensed training (BASIC[4]; GADGET; Siegrist, 1999) have shown that current training systems primarily focus on the "lower order" car driving skills, such as vehicle control and the execution of manoeuvres like overtaking and crossing intersections, while there is a lack of training on more strategic issues, like route finding and self-assessment of driving skills. It has been hypothesised that including the higher levels in driver training will improve its effectiveness. The US NTSB (2005) concludes that, in general, "education programmes are not designed to integrate skill development, teenagers' learning styles, and the task sequencing which would ensure that young drivers have the knowledge and skills to drive safely when they receive a licence with full driving privileges."

In keeping with this view, the results of a Danish study show that formal pre-licence training can, in fact, be used as a countermeasure (Carstensen, 2002). The Danish driver training curriculum was changed in 1986, leading to more focus on defensive driving and hazard perception during training and in the theoretical and practical tests. An evaluation study showed a decrease in multiple-vehicle and manoeuvring crashes among new drivers after the change, both in terms of crashes per person and per kilometre driven, although there was no reduction in single-vehicle crashes.

The competencies of the driver trainer are also central to the effectiveness of training. These competencies are related to didactic skills, but also personal beliefs and opinions. A driver trainer who is not fully convinced about the necessity of the training will also not convince the novice driver (Craen *et al.*, 2004). European projects like MERIT[5] (2005) aim to improve driver trainers' competencies.

An additional important point to note is that, given the state of the art in behavioural sciences and neurobiology, it also makes sense to be sensitive in instruction and coaching to differences between men and women. The same treatment may sometimes result in different outcomes, and suitable treatment may help both sexes to reduce their risks in traffic.

Conclusions and Recommendations:

At present, there is little evidence of clear safety benefits resulting from formal pre-licence training.

- Conduct science-based research and cost-benefit analysis to better understand the benefits of formal training and to devise means to improve the impact of such training.
- Expand the traditional method of skills-based instruction, whereby the instructor tells the candidate about right and wrong, with methods that engage the candidate personally and emotionally to a larger extent. This is particularly relevant in relation to increasing the "self awareness" of the candidate about his/her difficulties, reactions, etc., with regard to the driving task.
- Ensure that professional driving instructors have the knowledge and pedagogical skills necessary to guide and assist the candidate towards becoming a safe driver – driver trainers should be able to coach and not simply instruct.

Informal pre-licence training (accompanied driving):

Informal (private) pre-licence training (also known as "accompanied driving" or "accompanied practice") implies that a candidate driver is allowed to practice under given conditions, including the presence of an experienced driver, without requiring the presence of a qualified driving instructor, in order to increase driving experience prior to solo driving. The use of the term "informal" does not denote that it should not be mandatory – informal driver training is currently voluntary in many licensing systems, and obligatory in others, although some systems do not permit it.

Young drivers often have significantly less than 25-40 hours of driving experience when they are licensed for solo driving, although the level is higher in some jurisdictions. In the Netherlands, for example, novice drivers begin with an average of only 35-45 hours of behind-the-wheel previous practice.

Evidence discussed below indicates that post-licensing driving risks would be greatly reduced if all learner drivers were to acquire much higher levels of pre-licensing driving experience, making informal training one of the most potentially effective countermeasures.

This could be achieved by way of targets for minimum hours or kilometres of accompanied practice, as well as minimum periods during which this practice should take place. Sagberg (2002b) "tentatively" concluded that about 5 000 and 7 000 kilometres of pre-licence practice are sufficient for a significant reduction in serious crashes after licensing. He also noted that a lower level of pre-licence practice may actually be counterproductive, as it might raise crash risk as a result of an increase of "perceived" driving skills without a proportional increase of "actual" driving skills, and that, beyond about 10 000 kilometres, further practice will likely only lead to slight increases in safety. Pre-licence practice in itself is relatively safe, with a low number of crashes, primarily resulting in material damage only.

In Sweden, in 1993, the minimum age for accompanied learning was lowered from 17½ to 16, while the minimum solo driving age remained 18. Gregersen *et al.* (2000) found that 45-50% of 16 year-olds obtained their learner's licence during the first 2½ years of the new programme, and that 95% actually practised during the learning period. This resulted in an increase to a mean of 117.6 hours of accompanied learning before licensing, compared to a mean of 47.6 hours before the change, although the hours of accompanied learning among those who did not get their learner's permits at 16

remained at a mean of 41.4. In the two-year follow-up period, the crash risk of young, novice drivers who had begun accompanied driving at 16 was reduced by 40%, adjusting for confounding factors, and the overall young, novice driver crash risk was reduced by 15% (see also Gregersen, 1997, 2000a, 2000b). While this increased reduction occurred among both men and women, it was greater for the latter. A Swedish follow-up study (Gregersen and Nyberg, 2002) showed that the level of practising remained approximately the same in 2000 as it was in the initial evaluation study covering the period 1991-1997.

Where the Swedish experience is concerned, a comparison was made between novice drivers' crashes while participating in accompanied driving, and the reduction in crashes following licensing based on accompanied driving. The results showed that injury crash risk (per 1 000 learner drivers) during practice was 0.275. Injury crash risk for novice drivers before the reform was 19.55, and was 10.13 after the reform among those who started practicing at 16. The reduction was thus 9.42 accidents per 1 000 drivers, which is 48.2%, but became 40% after adjusting for confounding factors. Therefore, if 0.275 (the cost) is compared to 9.42 (the benefit), Sweden's conclusion was that the benefits were 34.3 times higher than the costs. However, the analysis is not perfect, as the results are not adjusted for types of accidents and injuries.[6]

In 1994, Norway also reduced its minimum age for driver training from 17 to 16, in order to increase accompanied practice. However, an evaluation study of the Norwegian experience (Sagberg, 2000) revealed no general crash reduction as a result of the reform, partly due to low utilisation, meaning that the general practising time did not increase significantly. The Norwegian experience only led to an increase of 106 kilometres in driving during training before passing the driving test, compared to 1 926 in Sweden. However, the study did note that those who practised more had lower crash involvement after licensing (see also Sagberg 2002a and 2002b). Thus, while Norway's experience is different, their results are not inconsistent with our overall conclusions on pre-licensing driving experience.

In France, 16 year-olds may participate in an optional programme whereby they receive a twenty-hour training programme, followed by a 1 to 3-year period during which at least 3 000 kilometres[7] must be driven accompanied by an experienced driver. Alternatively, they may opt for the traditional training system, which begins at 18. In either case, full licensing cannot occur before 18. Page *et al*. (2004) used insurance data about injury crashes in the two years after licensing to compare French novice drivers who were traditionally trained with those who had been trained in the accompanied driving scheme. Contrary to expectations, the accompanied driving group did not have better crash records than the traditionally trained drivers. The authors suggest that the accompanied driving group did not gain sufficient experience during the training phase, and/or gain experience that favours autonomy. Also, the trips undertaken during accompanied practice were more "standard" (shopping and holiday), and more demanding tasks were taken over by the supervisor, resulting in insufficient practice of more complicated driving tasks.

These results are also partially due to weak diffusion of the measure in France, with only 25% of young drivers choosing this option, as well as uneven implementation (Page *et al*. 2004). The low uptake of accompanied practice may partly be because many people's family situations do not favour it. Moreover, a key reason for the overall failure to reduce crashes could be the quality of driving skills of those adults who are accompanying the younger drivers. Mayhew *et al*. (2006), in studying situations in Canada and the US, noted that the parents of adolescent drivers involved in crashes were more likely to have a poor driving record themselves. The fact that the number of hours of practice in France was much less than in Sweden also likely influenced results.

The French experience does not negate the potential positive impact of accompanied driving. However, it reinforces that the quality of the implementation is important and that countermeasures may not be equally effective in all countries. Moreover negative side effects need to be taken into account and further research is needed to understand the exact nature of effective versus non-effective accompanied driving. Sagberg's conclusion that accompanied driving is particularly effective if a threshold of 5 000 to 7 000 kilometres of practice is reached should also be noted.

In its recent consultative discussion paper, the State of Victoria, Australia, proposes a minimum of 120 hours of supervised practice for learners over a period lasting a minimum of one year.[8] This period would also include other conditions, such as no mobile telephone use[9], and a trial volunteer programme to ensure that underprivileged learners have access to supervised driving. It would also involve support programmes, such as "parent-learner sessions" and facilitated peer group discussion workshops (VicRoads, 2005). Western Australia has also proposed a minimum of 120 hours of accompanied practice, and two six-month learner periods (Western Australia, 2005).[10] The Australian Transport Safety Bureau recommends up to 200 hours of accompanied practice prior to licensing, including a minimum of 120 hours.

One concern is that novices will not comply with practice requirements. Mayhew *et al.* (1996) thus recommend that supervisors be asked to officially certify the number of hours of accompanied practice undertaken by novices. This is currently the practice in the US state of Oregon.

As with licensing for solo driving, the age at which accompanied practice may begin raises issues related both to safety and to individuals' access to the opportunities associated with driving. However, programmes of accompanied practice need not involve beginning solo driving at a later age. As seen above, in countries where licensing occurs in the late teens, such as Sweden, Norway and France, periods of accompanied pre-licence training have been introduced by lowering the age at which such training can occur, while retaining the same age for full licensing.

Section 4.2.1 notes that accompanied practice cannot be replaced by simulators, as only real situations can teach a novice how to apply learned skills.

Also, high levels of informal training cannot be replaced by fewer hours of formal training (Mayhew *et al.*, 2006). For example, when reduced requirements for informal training were granted to novices participating in formal training in Ontario, Canada, the result was that novices with certificates from approved driving schools had crash rates that were 44% higher than those without (Simpson, 2003). Mayhew *et al.* suggest that such "time discounts" may feed a selection bias, whereby parents who "lack time, skill or inclination" to train their children opt for enrolling them in formal driver education instead. Mayhew *et al.* also suggest that parents may be overconfident of the driving skills of their children who have participated in formal training, and therefore subject them to less supervision and monitoring.

A potential improvement to accompanied driving might be to support parents and others in the role of supervisor and to deepen their understanding of effective supervision. Those accompanying the learner must be prepared to provide appropriate direction and influences. As noted in Section 4.2.1, Internet-based tools can be very useful in this regard. In the UK, the Driving Standards Agency's *Official Guide to Accompanying L-drivers* book aims to ensure that private practice sessions, usually with parents, build on the professional instruction most learners receive, and the *Helping L Drivers* website (www.helpingldrivers.com/) provides free resources and guidance for those supervising learner drivers. Victoria, Australia, also noted the need for a comprehensive, practical and accessible resource for parents as supervisors of novice drivers (VicRoads, 2005).

This is one area where the situation for young drivers might be quite different from that of older novice drivers, making such a countermeasure more difficult to implement among the latter group. In particular, it would be important to take into consideration particular circumstances, such as older immigrants who are either novices or are requalifying to drive in their adoptive countries, in that they may not have the appropriate support networks available to allow them to undertake many hours of accompanied practice.

Conclusions and Recommendations:

Training should be conducted in such a manner as to allow young, novice drivers to attain high levels of experience before solo driving.

- Augment formal training by requiring young drivers to attain as much experience as possible before solo driving. While at least 50 hours of pre-licensing practice are recommendable, experience in one country showed that increasing this to about 120 hours reduced crashes in the two years following licensing by approximately 40%.

- Provide accompanying drivers, including parents, with information and advice about how to fulfil their role effectively, and encourage them to provide extensive opportunities for practice. While setting minimum standards for accompanying drivers may be desirable, it should not exclude or discourage people from taking on this role.

Advanced training:

Initial training and practice will likely not provide novices with extensive experience of the full range of situations regularly faced by drivers. For this reason, an advanced training module is often seen as potentially beneficial for dealing with specific situations, such as emergency braking, or for brushing up on knowledge about safety behaviour, such as the safety benefits of using seat belts.

Depending on the system, advanced training might be applied as part of a second phase in the licensing process, or after licensing for solo driving. In Austria, Finland and Luxembourg, post licence training is a compulsory part of a two-phase licensing system. Post licence training is also offered as a voluntary option in a number of countries, such as Denmark, the Netherlands, Germany and Sweden.

Evaluations, based on risk-perception and self-reported driving behaviour, have shown post-licence training to have positive and negative effects on safety competencies. The negative effect is found when post-licence training focuses on driving skills rather than on attitude and behaviour (NovEv, 2004). On the basis of a literature overview, it was also concluded that courses concentrating on advanced vehicle control skills like skidding should not be included in driver training for novices. This conclusion is supported by, among others, the Norwegian experience with a second phase practical training course, in which novice drivers were taught how to control a skid (Glad, 1988). After this course was introduced, young drivers had more crashes on slippery roads than before. A possible explanation is that, as a result of the course, young drivers were more confident about their abilities to handle a car in such dangerous conditions, which they previously would have avoided.

On the basis of this and similar studies (*e.g.* Keskinen *et al.* 1992; Gregersen, 1996), Engström *et al.* (2003) concluded that risk awareness training should not focus on vehicle control and manoeuvring, as this leads to overconfidence, and instead should improve knowledge, experience and recognition of dangers. Guidelines established for post-licence training in the EU's ADVANCED

(2002) project emphasised that it should avoid vehicle skill training (*e.g.* skid training), and focus on self-assessment (the upper right corner of the GDE Matrix).

It should be borne in mind that most evaluation studies of post-licence training programmes focus on drivers with poor driving records. In the recent meta-analyses on post-licence training, 19 out of 21 studies were found to be aimed at offenders, and thus their conclusions cannot be generalised to the entire young driver population (Ker *et al*., 2005).

Conclusions and Recommendations:

Training focusing on advanced vehicle skills can have undesirable consequences when applied before the novice has gained sufficient experience.

- Avoid advanced, skill-oriented driver training (*e.g.* skid control, etc.) before the young, novice driver has gained experience as a solo driver.

3.5.3. The driving test as a selection instrument

In many countries, the driving licence test consists of a theory test and a practical test. Tests are used to decide whether the test-taker has fulfilled stated training objectives. Test performance can be seen as a sample of behaviour from the domain being tested. Since the driving licence test is an important instrument for assessing whether these objectives are met, the test needs to be of high quality, which implies that it is *valid* in the sense that it measures achievement of clear aims and objectives (Braak *et al*., 1998; Henriksson *et al*., 2004).

Comparisons of the practical tests in different countries reveal two different ways of regulating the content of the test so that it reflects training objectives. In some countries (*e.g.* Great Britain and Norway) standardised test routes are used in order to guarantee that the test includes certain elements. In other countries (*e.g.* Sweden), the practical test is carried out in the actual traffic environment and the examiner decides on the test route, but ensures that all relevant traffic situations are present in the route (Johnson *et al.*, 2003). The European project TEST[11] (2005) showed that test procedures differed significantly within countries and between countries, and that not all elements called for by the European driving licence directive are tested. Because of such differences one cannot speak about "the" driving test, and this section will primarily focus on the question of what constitutes a good test.

When a test is administered, assurance is needed that it is reliable. *Reliability* refers to the degree to which test scores are free from errors of measurement (Crocker and Algina, 1986). For example, it is essential that different versions of the theory test be comparable and that there be agreement between different examiners' judgments on a test-taker's performance in the practical test (Johnson *et. al.*, 2003). The TEST (2005) study concluded that low reliability is undesirable because it is likely to be seen as unfair, in that it randomly penalises some candidates and passes others. It also noted that an unreliable test is inefficient and costly, since it will result in unnecessary failures and subsequent retests, and is likely to be held in general disrepute.

If the test is reliable, then the same candidate, when tested twice, should have about the same score both times. Baughan and Simpson (1999, cited in the TEST report, 2005) looked at test-retest reliability in Great Britain, in which tests were taken under the same circumstances but neither the examiners nor the candidates knew the scores on the first test. Only 64% of the candidates received the same score on both tests (pass or fail). The researchers also concluded that a rather high proportion of candidates were coming forward for the test with only a moderate chance of passing it, and that standards were not consistent enough.

After reliability, the second characteristic of a good test is its *validity*. In general, the validity of a test is the extent to which it measures what it purports to measure, which for driving tests might be defined in terms of competence and propensity for being a safe driver. In other words, how effectively does the test discriminate between those drivers that will be safe and unsafe in future? In principle, a test can make two types of errors – accepting those drivers who are in fact unsafe (false positives), and rejecting those who are potentially safe (false negatives). Not much is known about the discriminative powers of the different forms of driving tests. In particular, with respect to the false negatives, information is lacking, as the crash history cannot be known for candidate drivers who do not get a licence. However, studies on the rates of false positives are also missing, partly because such a study would require comparisons between testing regimes, which frequently can only be done by cross-country comparisons, or by time-series analyses. Some doubts about the discriminative powers of the test come from the findings that, compared to females, male drivers more easily pass the test, while their crash records after licensing are worse.

In light of the difficulties in predictive validity, the TEST report concludes that any assessment of driving tests needs to place heavy reliance on content validity, which concerns the coverage of the test and the training it induces. Thus, a test could be judged to have good content validity if it (a) covers all aspects of driving known or judged to be relevant to its objective, or (b) induces adequate training and practice in all of these aspects even if they did not feature in the test itself. To assess content validity it is desirable to have a clear theoretical view on the driving task and the goals of driver training. In the TEST report, the above-mentioned GDE Matrix was recommended as the most suitable model for this purpose. The relationship between training and testing is discussed in more detail in 3.5.4.

The TEST report also contains recommendations for improvements to driver testing, particularly with regard to ensuring increased focus on higher order skills. Specifically, it suggested:

- Making the test period long enough for drivers to display typical behaviour.
- Asking candidates to choose where and when to start given manoeuvres, such as overtaking.
- Testing hazard perception (see below).
- Encouraging self reflection.

However, in all these proposals, further analysis is required to evaluate their possible effectiveness in improving current testing regimes.

Aside from these more methodological issues, an additional point to be made here relates to the importance of the legitimacy of the licensing process in the eyes of the public. Changes to the system should be convincingly related to safety and mobility, in order to counter public concerns that resulting new costs only aim to generate financial benefits for the licensing authority or governments. Furthermore, the licensing process must be free of all possible corruption, which requires a rigorous protocol and continuous assessment of the integrity of the process. As the process of acquiring a licence is time-consuming and expensive, permission to drive is a much-sought-after commodity, and thus corruption is a threat to be reckoned with in all licensing procedures in any country.

Hazard perception test:

As was described in Chapter 2, it has long been recognised that young, novice drivers are poor at detecting and assessing hazards, and consequently several countries have introduced *hazard perception tests* (HPTs) as a compulsory element of driver testing, in order to test candidate drivers on their ability to foresee and react to hazards.

The value of HPTs has been studied extensively in laboratory conditions, but, according to Senserrick and Whelan (2003), only one evaluation study has assessed their validity in field conditions. This study (Congdon, 1999), of the HPT in Victoria, Australia, found that novices with very low scores had higher crash rates than novices with average and higher scores.

Palamara and Adams (2005) reviewed the effects of hazard perception testing in Australia. They concluded that there is no evidence to support the notion that the introduction of hazard perception skill testing anywhere in Australia has had a direct impact on the crash and injury rates of young drivers. Moreover, they question the "face validity" of a computer-based test of hazard perception skill, as the consequences of a wrong decision are vastly different to those of a wrong decision on the road. In a review of the literature on hazard perception tests, Vlakveld (2005) also expresses doubts about and the extent to which hazard perception as measured in tests reflects the reality of hazard perception in real traffic. He refers to Groeger (2000), who states that physical arousal, as a result of confronting a "hazard" in real traffic, is essential for recognising and avoiding potential hazards, while training and testing of hazards does not result in a fear response.

Sagberg and Bjørnskau (2006) did not find that a hazard perception test resulted in important safety improvements in the first nine months after licensing. They concluded that hazard perception is probably only a minor factor in explaining the rapid decrease in crash rates over this period. However, Fisher *et al.* (2006) found substantial improvements in scanning behaviour on the open road after young drivers had attended a computer-based training programme focusing on recognising potential risks. Hazard perception tests and training programmes are still under development, and further work is required to understand their full potential.

Conclusions and Recommendations:

Based on existing knowledge, driving tests are currently unable to accurately discriminate between those drivers who will be safe and unsafe once they start solo driving, although they remain essential as a means of ensuring that novice drivers have essential, basic competencies.

- Conduct science-based research focussed on increasing the ability of driver tests to identify unsafe drivers, as well as on the effectiveness of hazard perception tests.

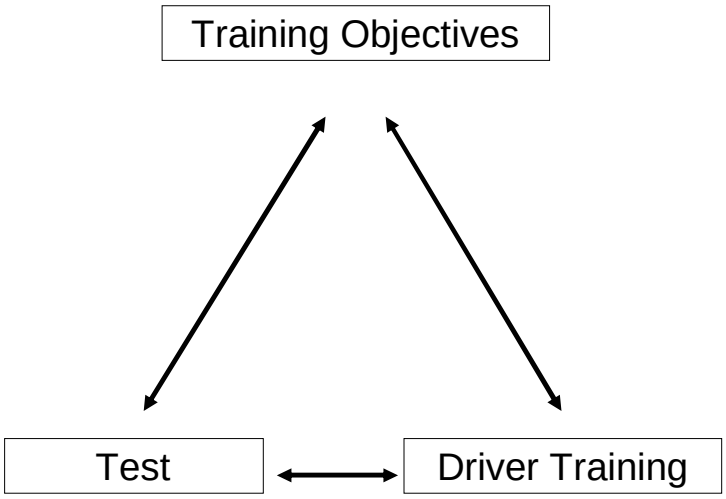
- Ensure that driving tests are free of all corruption.

3.5.4. The relationship between training objectives, training and tests

In the previous sections, we discussed tests, training and training objectives as being separate components. However, to be effective these components need to be closely related.

Training objectives, which are often reflected in official curricula, refer to goals that are to be fulfilled in order to produce a safe driver, and these should be reflected in, and constitute the basis of both *driver training* and the driving-licence *test* (Jonsson *et al.*, 2003). The essence of each part should be reflected in the other parts (see Figure 3.6). In cases of disharmony between the parts, the test may negatively affect the content of the education (Messick, 1989); for example, when certain areas are not tested they may receive less attention from both instructors and students during training.

Figure 3.6. **Triangle of Driver Education**



Source: Adapted from Henriksson *et al*., 2004

One of the vital components of a well-functioning system is well-educated instructors who possess the necessary knowledge and teaching skills concerning all aspects that should be covered. Another component of utmost importance in the education process is the availability of teaching resources, such as theory books, computer-based learning aids, professional and accompanied education and training, etc. The third important part is the test itself. The design and content of the test should enable a check of the extent to which stated training objectives have been fulfilled. If certain goals are not covered in the education process or in the test, this may limit the effectiveness of the whole system.

As noted in Section 3.5.2, the recently introduced Norwegian testing system, which implements the principles behind the GDE Matrix, is a good demonstration of how a national curriculum and test can be interrelated and mutually reinforcing. In the Norwegian case, subjects for learning are spread across the various steps in the licensing process and given greater emphasis at certain points. The amount of instruction on given subjects at different levels is defined partly through certain competence objectives, and partly through mandatory lessons. Elements that are difficult to verify through evaluation in a test are covered in mandatory lessons to ensure that they are not missed (Norwegian Public Roads Administration, 2005). Norway is currently assessing the success of this model against previous practice. The results of this assessment should be closely watched by other jurisdictions, with a view to considering whether this integrated training and testing model represents a model best practice.

Conclusions and Recommendations:

The content and form of the licensing system should be consistent at all levels and based on knowledge of, and insight into factors influencing driving behaviour and crash risk.

- Ensure that the three key elements of licensing (training objectives, training and tests) reinforce one another, and that the essence of each is reflected in the other parts. Test content should be varied and cover all possible aspects of the training objectives. Aspects of the training objectives that cannot be tested should be obligatory elements within training.

3.6. Protective Measures for Solo Driving

Young drivers should not be exposed to levels of risk that they are not yet ready to manage. Figures 1.3 and 1.4 in Chapter 1 showed us that risk is highest precisely at the ages immediately following licensing for solo driving. Various explanations exist for this. For example, young people may be allowed to drive prematurely, without proper training or based on a test that is not sufficiently rigorous. However, no licensing system produces drivers whose risk levels are as low at the time of licensing as they are after years of driving experience. In other words, the period immediately following full licensing is especially risk-intensive, as drivers experience solo driving for the first time, even in situations where they have had considerable experience prior to licensing. Thus, it is important that risk be reduced precisely in the period immediately after licensing.

Risk reductions can be achieved by way of *protective restrictions* that reduce the degree of risk that a solo driver would otherwise be exposed to. These typically take the form of legal limitations on certain activities that are removed progressively over time, as the young or novice driver gains increasing experience. Post licence protective measures limit the complexity of the driving task, and protect the novice driver from dangers resulting from poor self-regulation and self-control in the period in which higher order skills are still "under construction". Many such measures directly address circumstances where young, novice driver risk is especially high, as outlined in Chapter 1, such as driving at night, with passengers and/or under the influence of alcohol.[12] The high levels of risk following initial licensing give protective restrictions the potential to be among the most important countermeasures.

The following is a description of various existing protective measures. Different combinations of these measures are implemented in licensing systems throughout the world, and usually form the backbone of graduated licensing (GDL) systems. Annex A provides descriptions of how these countermeasures are applied by different countries.

3.6.1. Zero alcohol limits

Figure 1.7 (in Chapter 1) clearly shows that alcohol consumption, even in small amounts, increases driver fatality risk, and significantly more so among younger drivers. Lower BAC limits for novice drivers have been effective in lowering alcohol-impaired driving and crashes (Maisey, 1984; Haque and Cameron 1989; Wagenaar *et al*. 2001; Shults *et al*. 2001).

US laws allowing for the confiscation of licences of persons under 21 showing a minimum amount of alcohol (maximum 0.2 g/l) in their blood led to a 21% decline in single-vehicle, night-time fatal crashes among drivers under 21, compared to states that did not have such laws (Hingson *et al*., 2004). Boase and Tasca (1998) studied the impact of the reduction of novice drivers' alcohol restrictions from 0.8 to zero g/l in the province of Ontario, Canada. This resulted in an overall reduction of alcohol-related crashes by 27% among novice drivers, and 19% among those aged 16-19 years-old. In a literature review of young drivers' BAC restrictions in Australian and US states, Zwerling and Jones (1999, cited in Senserrick and Whelan, 2003) noted, on average, a 22% reduction in night-time, single-vehicle crash fatalities following the introduction of zero g/l BAC limitations for drivers under 22 years-old. The average reduction was 17% with 0.2 g/l restrictions, and 7% with a 0.4-0.6 g/l restriction. However, it should be noted that other elements of licensing (*e.g.* protective restrictions) were different across the jurisdictions, and may have impacted on the results. Hingson *et al*. (2004) showed that, starting from a BAC level of 0.8 g/l, lowering to zero or 0.2 g/l was effective, but that lowering BAC levels to 0.4 or 0.6 g/l did not produce significant reductions in alcohol-related fatalities.

The potential effectiveness of restricting alcohol use by young drivers is shown in the results of US legislation from the mid-1980s that led to the adoption of age 21 as the legal drinking age throughout the country, raising it from 18 or 19 years-old in many states. A review of more than 49 studies of changes in the legal drinking age revealed that, after states raised the drinking age, alcohol-related traffic crashes decreased by 10% (Shults *et al.*, 2001). The National Highway Traffic Safety Administration estimates that having a legal drinking age of 21 years-old saves 700-1 000 lives annually in the US (Toomey and Wagenaar, 2002; Wagenaar *et al.*, 2001; Shults *et al.*, 2001). The key conclusion to be drawn from this is that substantial reductions in crashes and fatalities may be achieved by limiting young people's access to alcohol, which may be carried out in a number of ways, including lower BAC levels.

There is an ongoing debate about the preferred level for young, novice drivers: 0.2 g/l or zero alcohol. US federal law penalises states that do not set a maximum limit for drivers under 21 years-old at 0.2 g/l or less. While most US states use 0.2 g/l as the limit, twelve use zero and 2 use 0.1 g/l. Most Australian states and many Canadian provinces have a zero alcohol limit (Palamara *et al.*, 2004), while in Europe the tendency is to adopt 0.2 g/l. The choice of 0.2 g/l as the alcohol limit is based on the relatively low risk below 0.2 g/l, the high chance of false positive results in tests, and concern regarding the withdrawal of enforcement capacity from higher risk categories (*i.e.* above 0.2 g/l) (*e.g.* Matthijsen 1999, Pentillä *et al.*, 2004) leading to a potential increase in alcohol related crashes. However, some maintain that a zero g/l limit sends the message that any amount of alcohol will increase risk where young drivers are concerned.

In a similar same vein, some have raised the concern that a lower limit for young drivers could send the message that it is acceptable for older drivers to drive under the influence of alcohol. Thus, it would be important for governments to dispel any such notions by way of clear communications and enforcement.

Evidence indicates that, for young, novice drivers, a maximum BAC level of zero or 0.2 g/l would contribute much towards lowering risk. However, to be effective, this would have to be associated with effective enforcement and convincing repercussions for non-compliance.

An additional point is that young people's higher susceptibility to the road safety risks posed by alcohol, likely continues beyond the period when they are novices. Thus, there is a strong argument for lower overall BAC levels. The ECMT Ministers (ECMT 1993) have recommended that maximum BAC levels should be no more than 0.5 g/l.

3.6.2. Night-time driving curfews

Figures 1.15 to 1.18 show that that young drivers have much higher risk levels at night than during the daytime, especially on weekends. Senserrick and Whelan (2003) suggest various reasons for this, which concur with points made in Chapter 2:

- Visibility is poorer at night.
- Fatigue and sleep deprivation are likely greatest at night.
- Many young people have limited experience driving at night.
- Young people drive more at night than other groups.

- Their night-time driving also tends to be more recreational and with peers than that of other groups, meaning that they are more easily distracted or encouraged to take risks.

- Driver aggressiveness and recklessness is greater during darkness, especially among men.

- Drink-driving is more common at night.

With this in mind, restrictions on night-time driving are often applied in GDL systems. These are considered to be one of the most beneficial elements of GDL in lowering crash involvement and severe crashes during solo driving (Senserrick and Whelan, 2003). However, the exact hours covered tend to be different, as noted in Annex A.

Senserrick and Whelan (2003) cite a number of studies identifying substantial benefits to night-time driving restrictions. For example, official US estimates state that night-time driving restrictions, combined with peer passenger restrictions, are linked to crash reductions of up to 60% during the hours of restriction. The introduction of GDL in North Carolina, including a night-time restriction beginning at 21:00, resulted in a 43% crash reduction during the night-time restriction period, which did not include passenger restrictions, compared to a 20% reduction during the day, meaning that 23% was due to night-time restrictions alone (Foss *et al*., 2001). In Florida, where the GDL system included night-time restrictions beginning at 23:00, there was a 17% reduction in night crashes, compared to a 7% reduction in day-time crashes. Michigan, with a midnight to 05:00 restriction, experienced a 53% night-time crash reduction, compared to 25% reduction in crashes overall (McKnight and Peck, 2002). Begg *et al*. (2001) found significant crash reductions related to restrictions in New Zealand. Mayhew *et al.* (2006) compared a jurisdiction with night-time restrictions (Oregon, US) with one without (Ontario, Canada), and found that young drivers in the former had relatively fewer night-time crashes. The data in Chapter 1 regarding young drivers' higher night-time crash and fatality rates also provide evidence for the potential of night-time restrictions. No evidence has been found to indicate that reductions in young drivers' night-time crash rates might be partially offset by increased daytime crashes, or increased night-time crashes by older drivers.

Research also indicates that, to be most effective, night-time restrictions should begin by 21:00 or 22:00 (Williams and Ferguson, 2002, cited in Senserrick and Whelan, 2003; Foss and Goodwin, 2003; Mayhew *at al.*, 2006).

The benefits of this countermeasure need to be weighed against the social equity issues of young people's mobility and access to the benefits of driving. Thus, on the introduction of this measure, Senserrick and Whelan (2003) advised that these restrictions "should allow for exemptions for work, education and other purposeful, non-recreational driving, in order to alleviate community concern that the restriction will prove to be a barrier to activities such as employment and schooling, or discriminate against remote or disadvantaged youth." Furthermore, there is a legitimate concern that this restriction unfairly targets all young drivers, when it is, in fact, possibly a high-risk minority that is particularly active at night that produces the high levels of night-time young driver crashes noted in Chapter 1. For reasons such as these, the decision to implement such countermeasures should be based on each jurisdiction's rigorous analysis of its own young driver risk situation, as well as the nature of its licensing system, including the minimum driving age. It is also important that novice drivers gain experience driving at night, which could be hampered by such restrictions, although Annex A shows us various cases where exceptions are made for accompanied practice.

3.6.3. Driving without peer-age passengers

As noted in Chapter 1, young drivers' crash risk generally increases along with the number of similarly aged passengers. Chapter 2 provides various explanations for this, including increased distraction at a time when skills are not fully developed, and the fact that young passengers may have a negative influence on their peers' driving, especially where males are concerned. Having more people in a vehicle also increases the possible number that can be killed or injured. Thus, limits on driving with similarly aged passengers are widely used in the intermediate stage of GDL. As seen in Annex A, this can include limits on all young passengers, or on more than one young passenger.

The benefits of such restrictions could be substantial if effectively imposed (Chen *et al.*, 2000; Harrison, 2003; Rice *et al.*, 2003; Lam *et al.*, 2003; Lin and Fearn, 2003). They are in place in 27 US states, where they have generally resulted in road safety benefits. In New Zealand, passenger restrictions were followed by a 9% reduction in crashes for the target group (Begg *et al.*, 2001). San Diego witnessed a 23% reduction in passenger injuries per licensed driver in the first to second years following restrictions on peer age passengers (McKnight and Peck, 2002).

One concern raised with this countermeasure is that it might lead to more young drivers on the road, as those who previously would have been passengers will end up driving to a given destination. Chen *et al.* (2000) studied this, and concluded that, even taking increased numbers of young drivers into consideration, restricting 16 and 17 year-old drivers from carrying passengers under 20 years-old could lead to 31-42% fewer road user deaths among the 16-17 year-old age group, based on 90% compliance. The reductions would be 23-29% based on 70% compliance; 15-22% based on 50% compliance, and 7% based on 20% compliance (see also IIHS and TIRF 1999, IIHS 1999).

Again, social equity and access to the benefits associated with mobility are important considerations, as well as the need to gain experience by practicing driving. With this in mind, in many systems where this restriction is used it does not apply to family members, or to supervising adults. Most GDL systems in the US allow the young, novice driver to drive with young family members, such as their own children and younger siblings, during the intermediate stage with a restricted licence. For similar reasons, the applicability of such measures to older novices may not be appropriate. As with the case of night-time restrictions, each jurisdiction needs to consider such countermeasures based on analysis of its own young driver risk problem and legal and licensing systems, assessing whether the potential benefits justify the restrictions.

3.6.4. Power/weight ratio of vehicles

Some jurisdictions with GDL systems have considered imposing restrictions on the use of high-power passenger vehicles by young drivers. However, as yet, only the Australian states of Victoria and New South Wales restrict young drivers' access to high power or "high performance" vehicles.

There is considerable doubt about the effectiveness of this measure. As noted in Section 2.6.2, self-selection is likely an important explanatory factor regarding why young people with powerful vehicles appear to have more accidents, meaning that the "riskiest" driver may be attracted to the "riskiest" vehicle. Thus, a ban is not likely to have positive safety benefits, as such drivers would likely take risks in any vehicle (Palamara and Gavin, 2005). Also, lighter vehicles might have fewer safety features. Furthermore, in cases where a young driver's parents own a powerful vehicle, such restrictions would limit possibilities for gaining experience.

3.6.5. Lower speed limits

Evidence provided in the context of the OECD and ECMT's (2006) current project on *Speed Management* indicates that speed-related crashes typically account for around 30% of all road fatalities. Levels of fatalities can be reduced dramatically by reducing vehicle speeds; for example, decreasing mean speeds by 5% can be expected to reduce injury crashes by around 10% and to prevent 20% of fatal collisions, starting almost immediately. Several studies that show that a reduction of average speeds by 1 km/h reduces crashes by 2-4% and fatalities by 5% (ECMT, 2006a, 2006b).

Inappropriate speed is one of the greatest specific safety problems of young drivers in traffic. Motivational factors are behind this problem, as well as lack of experience and related deficiencies in cognitive skills.

Special speed limits for beginner drivers have been proposed and used to reduce the risk in early stages of driving, although this measure is not unanimously supported among experts. Low compliance among the target group and the introduction of speed differences in traffic, which is a risk factor itself, are pointed out as critical issues (Hernetkowski and Keskinen, 2003). Considering these objections, the authors of the EU project DAN (Description and Analysis of Measures for Novice Drivers) did not include the proposal of special speed limits for novice drivers in their recommendations (Bartl, 2000). Furthermore, as discussed in Section 3.7.3, identifying young drivers on the road could pose a problem in enforcing such a measures.

The province of Ontario, Canada, deals with this issue by limiting young drivers' access to certain highways where speed limits are particularly high, and where driving conditions might be especially complex. This was found to result in a 61% decline in learners' collisions on these highways (Boase and Tasca, 1998, cited in Simpson, 2003).

3.6.6. Mobile telephone use

Section 2.3.4 outlines the dangers resulting from distraction as a result of using mobile telephones while driving. These findings indicate that measures banning mobile telephone use while driving need to be considered for all drivers, not just young novices. Some US states include a ban on mobile telephones as part of their GDL systems, and many jurisdictions have an outright ban on all use while driving. This often targets hand-held units, although Section 2.3.4 notes that hands-free phones are equally dangerous while driving. It is important to note that banning mobile telephones only for young or novice drivers would pose enforcement problems, as police may not be able to identify such drivers without first stopping them and asking for identification.

Conclusions and Recommendations:

The greatest risk faced by young, novice drivers is in the period immediately following licensing for solo driving.

- In the period immediately following licensing, impose protective restrictions that limit the level of risk to which young, novice drivers are exposed, and lift these progressively as the drivers obtain skills and experience. Such protective measures are central to reducing young driver risks and can be introduced in GDL and probationary licensing systems. Under any system, subject young, novice drivers to a specific BAC limit of a maximum of 0.2 g/l. Limits on driving with peer passengers and/or at night have also shown themselves to be beneficial.

3.7. Influencing Safety Motivation in Solo Driving

Chapter 2 discussed the various factors that induce the young novice to drive carelessly or recklessly, whether intentionally or otherwise. The existence of these makes it all the more important to promote means of motivating young people to drive safely. Instruments for influencing safety motivation could take the form of the threat of punishment, economic incentives and disincentives, and education, as well as removing negative influences from public media.

3.7.1. Driver safety education in schools

A driver's safety-related attitudes are formed well before the age at which one legally begins driving, under the influence of role models, and based on personal traffic experiences (Waylen and McKenna, 2002). Therefore, countermeasures should also focus on children at a much younger age than 16-18. Examples of such countermeasures are educational programmes and communications campaigns in schools (see OECD, 2004).

Because of the absence of evaluation studies, the effectiveness of such programmes in influencing young driver risk is not fully understood. Based on the Mann *et al*. (1986) review of school-based programmes targeting drink-driving, Engström *et al.* (2003) concluded that those based on an accurate provision of information, on non–threatening attempts to change attitudes and on behavioural peer interventions demonstrated knowledge gains and, in some cases, changes in attitudes and self-reported behaviour. Section 3.7.6 also describes programmes in the US whereby parents have been successfully engaged in school and community-based initiatives aimed at changing young people's attitudes toward alcohol before they reach the driving age.

In the Australian Capital Territory (ACT), obligatory pre-learners' licence training was introduced, and offered free through schools to students aged approximately 15-16. Schools were given the option of volunteering to offer this course, and many of them did. Also, many teachers volunteered to provide the courses. The ACT government provided training to the teachers and also funded substitute teachers while this training took place. Unfortunately, full evaluation of this programme is not available, as it was implemented simultaneously along with other measures that combined to significantly reduce fatalities, such as speed cameras. Those who were not in school at that age would be obliged to pay for this course.[13]

The State of Western Australia has established a comprehensive school-based pre-driver road safety education programme called *Road Aware*, with funding provided from the government's third party personal injury insurer, the Insurance Commission of Western Australia, and managed by the state's Office of Road Safety. *Road Aware* curriculum materials for 16 year-old students examine risk-taking behaviour, attitudes and values, and encourage students and their parents to undertake 120 hours of supervised practice as a learner driver. Parent education seminars with a set curriculum are conducted by Road Aware in partnership with the Royal Automobile Club of Western Australia (see (www.roadaware.wa.edu.au/default.asp)

Conclusions and Recommendations:

Fundamental attitudes regarding road safety are established in early adolescence, and can be difficult to alter at a later stage.

- Pursue educational programmes and campaigns at an early stage, well before young people actually start driving, to actively encourage children to adopt safe attitudes towards driving.

3.7.2. Enforcement

In order for protective measures to achieve their goals, compliance is vital, which requires effective enforcement.

However, it is difficult for police to specifically identify young drivers on the road. Obviously, it is not self-evident when looking at a vehicle what the driver's age is. This makes the enforcement of young-driver-specific countermeasures difficult, as the driver's age likely will not be known to the police unless she or he is stopped for committing an infraction or is involved in a crash. Furthermore, targeting a given segment of the population, such as young people, can lead to questions of discrimination, and may be legally impossible in some countries, even though young drivers impose a higher risk to themselves, their passengers and other road users. In the UK, there is no requirement for drivers to carry a licence, making immediate identification of young drivers impossible.

For this reason, as noted in Section 3.3, it is important that overall enforcement be effective. Furthermore, given the high proportion of young drivers in crashes and fatalities, it only makes sense that enforcement efforts should focus on issues where young drivers are particularly vulnerable, including speed, alcohol, seat-belt use and drugs. Furthermore, without targeting young people *per se*, enforcement can also focus on locations and times when young drivers are particularly at risk, such as at night and near locations where alcohol is prevalent.

In some jurisdictions, special plates are employed for identifying novice drivers. These include "L (learner) Plates" and "P (probationary) Plates", among others. Special plates help older drivers take greater precautions in circumstances involving young drivers and also make it easier for the enforcement of protective measures imposed as part of licensing for solo driving, such as night driving or passenger restrictions. Little analysis is available regarding the effectiveness of these, although it stands to reason that they would be useful. Not surprisingly, recent analysis in the UK indicates that such plates are of limited value when their use is voluntary, as there is considerable resistance to them. Thus, to be effective, they need to be mandatory. In future, new technological developments, like smart cards or interlocks, may assist in focusing enforcement on given high-risk groups. This issue is explored further in Chapter 4.

Special attention should also be paid to unlicensed driving. The more regulated and demanding the licensing process becomes, the more tempted novices will be to drop out of the licensing process and drive without a licence. Knox *et al.* (2003) concluded that the longer novices have to wait for the practical test and the more problems they have in passing it, the greater the temptation to drive unlicensed will be.

The following are examples of areas where effective enforcement is particularly relevant to young drivers.

Speed:

Police speed enforcement is essential for ensuring young driver safety. However, while it may be possible to focus on specific problems, such as places where illegal races among youth groups are known to occur, this does not address the mass phenomenon of inappropriate speed choices by young, novice drivers. Thus, effective overall efforts to reduce the negative effects of speed, such as those considered in the OECD and ECMT's report on *Speed Management* (2006), will have a particularly important impact where young people are concerned.

It is also important to note that many of the protective restrictions discussed in Section 3.6 will have an important impact on mitigating the impact of speed on young, novice drivers. Strict measures regarding drink-driving may reduce the severity and number of speed-related crashes, which are often associated with alcohol. Speed crashes often occur at night, and the presence of young passengers may encourage a driver to speed and make the impact of a crash more severe. Thus, restrictions regarding alcohol, night driving and passengers could complement enforcement action on speeding, helping to reduce the consequences of any avoidance of speed restrictions. Furthermore, as discussed in Section 3.7.4, more stringent demerit point systems could act to discourage those inclined to speed, and will also assist in preventing some dangerous drivers from driving, if they are caught and lose their licences.

Drink-driving:

Clearly, effective enforcement plays a key role in preventing drink-driving, including in ensuring that the low maximum BAC levels allowed under GDL and probationary systems are strictly adhered to. This is an area were specific targeting of young drivers is likely impossible, and, thus, good general enforcement will be important. BAC limits are irrelevant if drivers are never checked, and experiences vary widely across countries – a recent survey across the 25 EU countries, in the context of the SARTRE (Social Attitudes to Road Traffic Risk in Europe) study, showed a variance between those where 64.3% of a country's respondents had been checked for drink-driving within the previous 3 years, and those where only 12.5% had been checked.

One policing technique that has been found to be particularly effective is random breath testing (RBT). RBT means that individual drivers are not selected for testing because of a suspicion of alcohol use, but purely on the basis of chance, although testing can occur during periods when, and at locations where high alcohol use is expected. This countermeasure is particularly interesting in that its implementation has been found to result in a change of normative beliefs. It is generally agreed that RBT increases potential offenders' perceived probability of being arrested, which deters their drinking and/or driving behaviour. It has also been found to strengthen young drivers' belief that peers would disapprove of drinking and driving (Loxley *et al.*, 1992), and positive long-term effects have been noted (Regler *et al.*, 2004).

This deterrence effect is greatest when RBT is widely publicised. A 10-year study in Sydney, Australia, beginning with the introduction of RBT in 1982, showed that the perceived probability of being detected remained at an adequate level over time and that social disapproval of the offence increased (Job *et al.*, 1997). The authors noted a drop in the bias towards optimism (thinking that the effect of drinking and risk of a crash are lower for oneself than for the average driver) over the period of the study. Their general interpretation was that the law generated a fear of punishment and that social tolerance of driving after drinking diminished over time. However, the effectiveness of RBT requires intense enforcement activity on the road, and accompanying media coverage (Mercer, 1985; Homel, 1990). In Germany, a 71% decrease in drink-driving offences and a 28% decrease in the number of crashes resulted from a drink-driving campaign that was extended over three local regions and in which enforcement was combined with different information measures. A cost-benefit analysis showed that economic benefits from the decrease in the number of crashes had been greater than the expenses incurred for the operation (Regler *et al.*, 2004).

In many countries, public support for anti drink-driving measures is high, indicating that the implementation of anti-drink-driving campaigns would not meet with significant public resistance. In Europe for instance, 88% of would like to have more severe penalties for drink drivers in their country (SARTRE, 2004).

Drug-driving:

One central problem in dealing with drug-related traffic safety risk is that, in roadside testing, drugs are less easily detected than alcohol. The technology for detecting the presence of drugs and levels of impairment is not yet as precise for drugs as it is for alcohol. For example, traces of the psychoactive agent (THC) in cannabis may be present for several days in urine, which makes it more complicated to link a positive test result to impairment. Perceived complications with regard to testing for drugs, as well as the heavier emphasis sometimes put on alcohol in enforcement, could induce some drivers to use drugs instead of alcohol. For this reason, both types of intoxicants should be the subject of similar severity.

In some instances, legal frameworks regarding controlled drugs are not clear. For example, by taking illicit drugs, a person is inherently engaged in an illegal activity, although the law may not be specific about driving under the influence of drugs (Assailly and Biecheler, 2002). It becomes even more complicated in situations in which, despite the drug being illegal, its use is unofficially tolerated.[14]

However, legal or illicit drug impairment can be detected, and these drugs can be treated in much the same way as alcohol is. In the UK, for example, drug-driving is considered as serious an offence as drunk driving. Detection abilities were enhanced by the introduction of new powers in the Road Traffic Act in September 2003, such as the ability of police to administer three preliminary tests, including a drug screening test (Department for Transport, 2005). In 2004, a new Code of Practice was introduced, detailing drug tests and outlining training for police officers to detect drugs. At the same time, it became illegal in the UK for drivers to refuse to take part in a drug impairment test (British Medical Association, 2005). Recent legislation in Victoria (Australia) created an 18-month trial for the testing of THC and methamphetamine, including some targeting (*e.g.* after dance parties or on major truck routes). New legislation was also introduced to allow continuation of the trial after July 2006.[15]

Clearly, enforcement of drug-driving would be enhanced by way of improved roadside testing technology, as well as appropriate legislation.

Conclusions and Recommendations:

Effective legislation and enforcement are fundamental to ensuring the effectiveness and legitimacy of the licensing process, and to reduce young driver risks.

- Strictly enforce safety laws and regulations, including those regarding speed, seat belt use, alcohol, drugs and vehicle safety, focusing particularly on those areas where young drivers are over-represented.
- Ensure strict compliance with the protective measures imposed by the licensing system, such as alcohol, passenger and night-time restrictions.
- Focus police enforcement of drink-driving laws on random breath-testing, targeting times and locations where and when high proportions of impaired drivers might be expected (*e.g.* near bars, discos and leisure areas), and ensure the application of tough penalties for breaking drink-driving rules.
- Conduct research to enhance technologies for the detection of drugs and for measuring the impact of both legal and illicit drug use on driving ability.
- Ensure the existence of an appropriate legal framework for dealing with drug-driving.

3.7.3. (Dis)Incentives

(Dis-)Incentive schemes aim to make safe behaviour more attractive and unsafe behaviour less attractive by way of rewards or penalties. For example, meta-analysis on the effects of material incentives on safety belt use revealed that, under certain circumstances, well-designed programmes had as large an effect as police enforcement (Hagenzieker *et al*., 1997). In the study, different incentive strategies were compared, such as group versus individual rewards, and lotteries with big rewards versus small unconditional rewards.

Special demerit point systems:

One disincentive for risky driving is the threat of losing one's licence or having to pay more to renew it. This is often enforced through demerit points assigned to drivers caught breaking rules. These can be specifically targeted to novice drivers, who would either receive more points per infraction, or be subject to a lower point threshold for losing their licences than more experienced drivers. Point systems can be employed under GDL or probationary systems, meaning that traffic violations during an intermediate stage of licensing could delay the novice in attaining a full licence. An additional benefit is that lower demerit point thresholds may result in some dangerous young drivers being temporarily barred from driving. In some Australian states, demerit point systems include higher points during high-risk periods.

The result of demerit point loss by a young driver could be of a penal or rehabilitative nature, or both. Penal results could involve eventual loss of licence. The rehabilitative treatment could be a mandatory driver improvement course, which has to be followed and paid for by the offender. Subsequent treatments for re-offending or not following the course could be participation in psychological counselling and withdrawal of the driving licence. Warning letters sent to young drivers may reinforce the risks of dangerous driving, as well as the consequences of the loss of demerit points.

It stands to reason that systems with probationary periods will only be effective if there is a tangible repercussion associated with breaking rules. In one early assessment, Tannahill and Smith (1990, cited in Senserrick and Whelan, 2003) found that Ontario's requirement of two years free of licence suspension to achieve full licensing, combined with a threshold for suspension for probationary drivers that was 50% that of fully licensed drivers, resulted in a 14% reduction in traffic offences for intermediate drivers, and an 11% reduction for male drivers under 20. In Germany, a general preventative effect was shown in the first year after implementation of a special demerit point system, with decreases in the crash involvement of the target group or parts of it of about 5% (Meewes and Weissbrodt, 1992).[16] A 19% crash reduction in Austria (Bartl and Stummvoll, 2000) resulted from the combined introduction of a point system and a lower alcohol limit for novice drivers (from 0.8 g/l BAC to 0.1 g/l BAC). Elvik and Vaa (2004) concluded, on the basis of a meta-analysis of 11 studies, that the combination of demerit points, warning letters and potential loss-of-licence led to a 17% reduction in fatal and injury crashes. Individually, warning letters accounted for a 15% reduction in overall crashes, the demerit system for 5%, and the licence suspension for 17%.

In contrast, the results of a new penalty points system for novice drivers introduced in Great Britain in 1997 did not lead to a significant decrease in crashes in the first year of driving, and only to a slight change in the second year (Simpson *et al*, 2002). Having said that, from June 1997 through January 2006, 107 000 drivers were disqualified under the British New Drivers Act, representing a significant number of "under performing" drivers removed from the system. In the period from 1 June 2005 to mid-March 2006, 11 659 drivers were disqualified, of which 58% were males 21 or less and 47% were females of the same age group.[17] In Finland, the introduction of such a system in 1996 resulted only in a decrease in the number of repeat offences among young drivers (Hatakka *et al.*, 2000). Experiences with general demerit systems for all drivers have demonstrated that, after an initial

positive effect, in conditions where police enforcement is low, the impact decreases to zero over time (Vlakveld, 2004). In addition, licence revocation as part of the point system may lead to an increase in unlicensed driving, and this needs to be counteracted in order for demerit systems not to lose credibility (Knox *et al.*, 2003).

In conclusion, evaluation studies show that demerit point systems have significant potential, and may be an important supporting element for other systems, such as probationary licensing or GDL. Obviously, in order to be effective, demerit point systems require effective enforcement.

Insurance-based schemes:

One means by which incentives could be offered is by way of insurance premiums. The OECD (1990) noted that the question of insurance pricing for young drivers poses a special problem for companies in the sector, which prevents them from fully applying commercial logic where this age group is concerned.

The tension is between the concepts of "true pricing", where insurance rates reflect the level of risk posed by a given group, and "inter-generational solidarity", where risk differences are not taken into account and costs are spread evenly over different age groups. The OECD noted that, in reality, most pricing policies fell somewhere in between. This is because "true pricing" would likely exclude many young people, especially men, from driving, and thus not be viewed as acceptable by society. It could also result in more uninsured driving. Thus, most prices are based on a compromise that includes both economic and social considerations, reflecting that young drivers pose more risk but not preventing them from having insurance. However, this balance is awkward, as insurance companies are generally profit-oriented organisations and not instruments of social policy.[18] These factors explain why there are great differences in the insurance prices applied to young drivers across different countries.

Unfortunately, very little information is available regarding the impact of differential insurance pricing. In one study, a special "reverse bonus system" was offered to 18-22 year-old car insurance holders. When no claims were made in the course of a 5-year period, the accrued bonuses, which amounted to about 2.5 times the annual premium, were paid out to the insurance-holder. This system led to a reduction in crashes of about 20 percent (Vaaje, 1991, 1992; Elvik and Vaa, 2004). However, these results may have been in part due to self-selection, in that young people who expected to benefit from such insurance schemes (*i.e.* those who expect to drive safely) would enrol in them, while the high risk group would not consider these to be attractive conditions and thus not take up the offer to join.

There are fundamental differences in the context of young driving since the publication of the 1990 OECD report, and these could serve to make insurance-based incentives more effective. To begin with, protective measures are applied in licensing in many countries, reducing the risk imposed by young, novice drivers.

Furthermore, as discussed in Chapter 4, new technologies are available to support young, novice drivers. In some cases, differentiated insurance premium rates are being used to induce the use of risk-reducing technologies. For example, a three-year study is currently being conducted in Denmark, examining insurance-based economic incentives linked to the use of intelligent speed adaptation (ISA) systems (Schmidt Nielsen and Lahrmann, 2005). Also, one insurance company has advertised a technology-based incentive scheme especially targeting young, male drivers, whereby clients are offered the option of putting a GPS-based black box in their vehicle in exchange for a discount on

their premium. The black box then lets the company identify and financially penalise young male drivers who speed. Notably, this programme was only available to 17 and 18 year-old males insuring cars up to 1400 cc's, and 19-25 year-old males with cars up to 1600 cc's.[19]

Arguably, if high risk groups are offered an option whereby they can enjoy lower premiums if they undertake risk-reducing measures, such as using black boxes, the higher premiums paid by those who do not choose this option cannot be seen as discriminatory. Furthermore, based on a combination of protective measures and technology, the overall level of risk could be reduced, making premiums closer to "true pricing" less prohibitive.

There is also much room for co-operation between public authorities and the insurance industry, as both stand to gain from reductions in young driver risk. Chapter 5 provides examples of situations in Australia, Great Britain and Iceland where the insurance industry and government have co-operated in the development and promotion of practices aimed at reducing this risk, including, for example, GDL or specialised training.

Conclusions and Recommendations:

Incentives and disincentives can have an important impact on young, novice drivers' behaviour.

- Support other countermeasures with specialised demerit point systems for young, novice drivers that provide a concrete disincentive to inappropriate driving behaviour and non-compliance with driving laws and licensing regulations.
- Working with the insurance industry, conduct more research into the potential benefits of economic incentives by way of automobile insurance.

3.7.4. Persuasive communication

"Persuasive communication" refers to efforts to persuade young people to drive safely by way of information, including advertising campaigns. Persuasive communication comes in many forms, from simply giving factual information to emotional and confronting visual messages. This section will first deal with the effectiveness of general publicity campaigns for car drivers, followed by publicity campaigns primarily directed at young drivers.

General publicity campaigns:

In the late 1990s, a meta-analysis on the effects of publicity campaigns was carried out within the framework of the European GADGET project (Siegrist, 1999). In that study, no differentiation was made regarding the effects of the campaigns on young and older drivers. The overall effect of safety campaigns was estimated to reduce the number of crashes by 8.5% during the campaign period (based on 31 studies and 52 results). For the period following the campaigns, the overall effect nearly doubled, to 14.8% (based on 12 studies and 20 results). Both estimates are statistically significant (Delhomme *et al*. 1999).

These results must be attributed to all components of the campaign, including concurrent factors like enforcement, reward, legislation, educational programmes, etc., and not only to the media campaign itself. The effects were greater for campaigns carried out on a local or city scale, combined with enforcement and legislation, or with a reward. The effects were also greater for campaigns on speeding, and for other campaigns whose development was based on background information

regarding the knowledge, beliefs and values of the target group. Thus, at a general level, road safety campaigns were found to help significantly to reduce the frequency of crashes, especially when combined with other actions.

Campaigns targeting young drivers and their parents:

An overview of current campaigns by Lockhart (2005), commissioned for this report by the Canadian Department of Transport, concluded that there has been a trend in recent years away from campaigns that emphasise rules-based messages ("don't") and towards campaigns that use more positive, critical thinking messages like "think" and "learn." These latter campaigns combine solid information and the use of emotions. Many involve elements of personal assessment or reflection. Some have found explicit graphics to be very effective in getting the message across, while others have hard-hitting messages with less "shocking" graphics. Many have a web-based component that is often interactive. Many programmes are taking place at the community level on an on-going or time-limited basis, while others that occur at the state or national level are multi-pronged, with educational, enforcement and multi-media components. Those in the latter group tend to have substantial budgets and are coupled with comprehensive tracking and evaluation plans.

Lockhart concluded that persuasive messaging campaigns can play an important role in pursuing the ultimate goal of reducing young drivers' crashes and resulting injuries and deaths. She recommended that:

- Persuasive messaging campaigns be used as part of road safety strategies for young drivers and the development of such campaigns should be done in consultation and collaboration with youth from the onset.

- Evaluation of persuasive messaging campaigns be encouraged and funding sources urged to include monies for longer term tracking and evaluation as part of funding criteria.

- Focus be placed on increasing the range and number of persuasive messaging programmes specifically targeted at young male drivers, and that they incorporate relevant research on male risk factors. It would be important to compare the results of these campaigns to the more general approach being applied at present.

- Governments work in partnership with non-governmental organisations, as well as other agencies, to maximise their range of delivery approaches when implementing campaigns, so that programmes taking place in community and school settings can reinforce or enhance those being delivered on a regional or national scale through various media and other outlets.

Engström *et al*. (2003) reviewed the literature on the effectiveness of publicity campaigns for young drivers in the field of drink-driving, safety belts and speed, and concluded that the combination of different measures (*e.g.* media campaigns, interpersonal communication, enforcement, and education) has more impact than each of them alone. They also emphasised the need for a thorough analysis of target groups and messages. Those programmes that demand participation in an educational situation, and thus personal effort, are more promising in influencing attitudes and behaviour. Methods demanding the use of emotions, personal self-reflection and evaluation are also promising.

There are different views about the effectiveness of fear-arousing campaigns. Whether they lead to behaviour change is, among other factors, dependent on individuals' coping strategies, meaning their behaviour in response to the threat presented. Where people have poor coping strategies, it is

believed that these "fear" appeals lead them to reject or ignore the message. An evaluation of an Irish campaign, in which young drivers were confronted with the immediate horror of a traffic crash, showed that the campaign did not affect driver behaviour, but that it changed the susceptibility of the target group to safety communication, in the sense that, over time, young people lost their positive attitudes about the problem, although they picked them up more readily when exposed to similar messages one year later (O'Brien *et al*., 2002). Delaney *et al.*'s (2004) review of mass media campaigns in road safety, which looked at the type of appeal used (*e.g.* rational, emotional, fear, etc.), concluded that persuasive or emotional campaigns were more effective than rational ones. Assailly (2001) gave the following overview on the factors influencing the dynamics between fear and persuasion:

- Young people are more reactant to fear arousal.
- Persuasion decreases with anxiety and depression.
- Persuasion decreases with sensation-seeking personalities.
- Persuasion increases with willingness to participate in a program.
- Persuasion increases with the "negativity" of the message — negative messages (stressing the inconvenience of rejecting preventive recommendations) are more efficient than positive ones (stressing the advantages of adopting preventive recommendations).

An approach that has been shown to be successful in changing young peoples' behaviour with respect to seat belt use and drink-driving is the "social norm campaign". This strategy is based on the observation that young people tend to overestimate the frequency with which their peer group engages in dangerous behaviour. Thus, safe behaviour is encouraged by communicating to young people that dangerous behaviour, in fact, is not the "the norm" among their age group (*e.g.* Hellstrom, 2003).

Chapters 1 and 2 noted the role of passengers in increasing risk. With that in mind, communications efforts could focus on passengers, as well as drivers.

Conclusions and Recommendations:

Persuasive communications campaigns should be employed in combination with other countermeasures, as a means of positively changing attitudes towards safe driving.

- Develop targeted road safety campaigns, combining the resources, efforts and expertise of government and non-governmental agencies, and in consultation with young people themselves;
- Apply these campaigns in conjunction with other initiatives, such as enforcement and legislations.
- Ensure ongoing evaluation and improvement of these campaigns.

3.7.5. The role of parents and other adult role models

Any consideration of the role of parents in young driver risk must take into account the fact that the relationships between parents and children are deeply conditioned by society, and subject to different cultural norms. Where driving is concerned, the ages at which one begins learning and solo driving are also essential considerations – it is not same for a parent to oversee the driving of a 16 year-old compared to that of an 18 year-old, especially given that the former is not legally considered an adult in many countries.

Simons-Morton and Hartos (2003) reviewed the literature on the role and efficacy of parenting in influencing driving behaviour and crash risk in solo driving and noted that "[t]he existing research indicated that parental management practices are important influences on teen driving practices and safety when imposed; but unfortunately, parents do not perceive teen driving as highly risky and establish few restrictions on teens after licensure. While a great deal remains to be learned, we have demonstrated in several small randomised trials the efficacy of brief motivational interventions for increasing parental restrictions on teen driving during the first month of licensing." However, Mayhew *et al.* (2006) found that parents of teenage drivers recognised that the greatest crash risk faced by their children was in the first six months of driving.

Research on young people's risk-taking and compliance with rules show that parenting style and the type of control exercised by parents over their children's behaviour can be very influential. Baumrind (1995) suggests that, between the two extremes of "authoritarian" and "permissive" approaches to parenting, a "middle way", referred to as the "authoritative" approach, is the most protective strategy, including with regards to traffic safety. This approach involves behavioural control through negotiation, dialogue and knowledge about one's children's activities (Baumrind, 1985). However, again, cultural norms will clearly play a role in this debate. Mayhew *et al.* (2006) recently cited analysis whereby the parents of adolescent drivers involved in crashes were less likely to report having "excellent" or "very good" communications with their children, in comparison with parents of drivers not involved in crashes.

Mulvihill *et al.* (2005) emphasise the need for an active role for parents to moderate high risk among young, novice solo drivers. They conclude that many programmes and instructional materials have been developed to help parents teach adolescents to drive, but few educational materials have been developed to encourage and teach parents how to manage young driver risks. Clear guidelines for parents on why and how to manage novice driving risks are generally not available. Mayhew *et al.* (2006) suggest the development of education and awareness initiatives to help parents of young, novice drivers, including with a focus on communication.

In a more recent literature review, Simons-Morton and Ouimet (2006) conclude that programmes intended to stimulate parents to take on and increase supervised practice driving have not resulted in greater parental involvement. This could indicate that initiatives such as accompanied driving should be obligatory and not voluntary. However instruments that help parents to impose restrictions on car use during the intermediate phase of GDL (*e.g.* no driving with passengers of the same age, no driving at night) seem to work. They mention, in particular, a programme in which teenage drivers and their parents reach an agreement on driving restrictions. An evaluation study showed that this led to significantly higher use of restrictions during the solo driving phase.

In addition, Section 3.7.1 already noted that drivers' attitudes towards safety are established long before they begin driving, and that the examples set by role models – such as parents – play a key role. This indicates that parents can take a proactive role in reducing their children's driving risk levels long before their children actually start driving. Section 3.7.6 provides examples where organised programmes have engaged parents in informing their pre-driving-age children about the risks associated with drinking alcohol.

A final caveat is important. Many young people, due to a variety of circumstances, are not able to turn to their parents for support with regard to such issues as learning to drive safely. Society should thus consider means of supporting such people, and providing other appropriate role model examples, instruction and oversight. Section 6.3.7 notes examples in Australia whereby the state, education administrations, community organisations and employers might co-operate in offering underprivileged youth opportunities to undertake accompanied driving.

Conclusions and Recommendations:

Parents and other adult role models have an important role to play in reducing young driver risk, including in guiding initial driving experience.

- Proactively inform parents about the degree of risk associated with their children's first driving experience, and provide them with information and guidelines that can help them to participate in reducing that risk.

- Explore and evaluate initiatives aimed at changing adults' attitudes regarding road safety, including by means of education, publicity and enforcement, reinforcing the message that their behaviour will have an important impact on their children's future driving and safety.

3.7.6. Informal social controls for drink and drug-driving

Assailly (2004) notes two strategies that can be employed to prevent drink-driving:

1. *Formal social control* of behaviour, influenced by professionals involved in crash prevention (*e.g.* police, justice, educators, researchers, etc.) and formalised by laws, rules, norms and procedures.

2. *Informal social control* of behaviour, influenced by the proximal environment of the subject (*e.g.* parents, friends, girl/boyfriends, spouses, servers, DJ's, colleagues, etc.), which is not formalised, but mediated by social stigma, social support and groups' subjective norms.

These two strategies can also be applied to the prevention of drug-driving, although the different legal context needs to be considered, especially with regard to educational activities and materials.

Traditionally, most emphasis has been placed on formal social controls. Such formal social controls are extremely important, and include the enforcement of drink and drug-driving laws discussed in Section 3.7.2, as well as rules regarding the maximum BAC allowed for young drivers discussed in 3.6. Other such controls could include laws and regulations regarding the legality of drugs; minimum legal drinking age; alcohol taxation and pricing; location and density of outlets; bans or restrictions on alcohol advertising; curfews; labels and warning notices on bottles; and laws placing some responsibility on bar and restaurant owners for damages caused by patrons who drive intoxicated. In general, all countries should strictly enforce existing laws limiting young people's access to alcohol, and consider the positive road safety impacts of strengthening such laws.

At the same time, formal social controls may be more effective when combined with informal social controls. For example, the decision to drink and to associate leisure activities with drinking can be influenced at early stages of development, before the driving age, by educating parents and peers, as studies have indicated that the likelihood of serious crashes is also related to parental and/or peer disapproval of alcohol misuse (Shope *et al.*, 2001).

Several school and community-based initiatives in the US have been successful in reducing drinking and/or related alcohol problems among young people.[20] These programmes focus on adolescents of different ages, including well before the driving age, and typically coordinate the efforts of government officials from multiple areas, such as education, health, police, alcoholic beverage control, etc., along with concerned students, teachers, parents, merchants and others. Often, multiple intervention strategies are incorporated into the programmes, including school-based programmes, media advocacy, community mobilisation, changes to alcohol sales policy, and heightened enforcement of related laws (See Larimer and Cronce, 2002).

Where the management of alcohol consumption during the evening is concerned, informal social controls can take the form of server intervention training, which has been shown to effectively reduce consumption in places serving alcohol (Saltz, 1989). This is particularly effective when combined with a change in establishments' sales policies, such as the elimination of initiatives to increase alcohol consumption, like "happy hours" at off-peak business times. Effectiveness also depends on the integration of such programmes into a more general set of actions directed at establishments, their extension to a significant proportion of the profession, and the targeting of establishments where they are most likely to have an impact. Holder and Wagenaar (1994) found a significant reduction in alcohol-related crashes and in night-time, single-vehicle crashes in Oregon, US, following legislation requiring server intervention training. Adjustments were made for confounding factors, such as national trends, exposure, economic conditions, and the effects of other concomitant road safety programmes.[21]

Many countries encourage the promotion of designated drivers (*i.e.* persons who plan not to drink so that they may safely drive their colleagues) by way of media campaigns. One that is particularly well known involves attaching a moniker to the designated driver, such as Belgium's "Bob" campaign, the UK's "Des", France's "SAM", and various others. These campaigns have included publicity aimed at young people, volunteers promoting the concept in bars, and participation by bar owners, for example by way of free soft drinks for designated drivers. An additional objective of Bob-like campaigns is to communicate the risks inherent to mixing alcohol and driving, with a view to changing attitudes regarding the issue.

In reality, little evaluation is available regarding the effectiveness of designated driver programmes. Ditter *et al*. (2005) carried out a systematic review of studies available on the subject and only found one evaluation, on Western Australia's "Pick-a-Skipper" campaign. Telephone surveys indicated a 13% increase in people always selecting a designated driver and these people were also more likely to report awareness of the "Skipper" concept. However, there was no significant change in self-reported drinking and driving or riding with an alcohol-impaired drivers. Ditter *et al*. also examined evaluations of small-scale designated driver programmes (*e.g.* a particular disco that has a designated driver program) and, while some positive effects were found, the overall the effects were quite modest. Belgium's Bob campaign did not initially yield positive results, especially in the period 1999-2002, when the number of drivers tested for alcohol during the campaign period fell steadily, and the number of impaired drivers increased. However, this was likely due to other factors related to the degree of enforcement at that time. Researchers thus concluded that programmes promoting designated drivers are not enough by themselves, and that strict enforcement is also necessary – when there is little risk of getting caught (objective and subjective risk), a prevention campaign, no matter how good it may be, will not be efficient (Scheers and Drevet, 2002). Moreover, as Foss and Beirness (1996) point out, being "Bob" for the evening can imply driving drunk peers home, which adds to the already complicated task of driving.

Distribution of breathalyzer units could have preventive benefits by filling the gap between subjective perceptions and objective states of intoxication. Informing patrons of BAC levels could prevent them from committing an unintentional offence (Assailly, 2004). France is experimenting with a breathalyser unit aimed at young people, which functions in conjunction with a mobile telephone. A major concern with this initiative is that it allows young people to drink up to the maximum legal limit, which, as discussed in Section 1.4.5, is particularly dangerous for young people, especially if this limit is above 0.2 g/l BAC. Thus, breathalyzer units should only be employed when BAC limits for young drivers are no more than 0.2 g/l, as recommended in Section 3.6.1. In addition, breathalyzer units will also only provide a measure of the immediate level of alcohol in the system, whereas potential drivers need to know if they are in the "absorption" phase of alcohol effects, which would mean that BAC levels will be higher later, when they are actually on the road.

Peers, such as passengers, friends or party hosts, could exert important influence over the decision to drive while under the influence of alcohol. However, this requires a social environment where drink-driving is poorly viewed, and where peers are encouraged to express their views on the subject. In addition, legislation in some jurisdictions ascribes partial legal responsibility to hosts of events where persons drink too much before driving, as well as to bars and restaurants whose patrons might drive intoxicated.

Conclusions and Recommendations:

Governments and civil society should co-operate in taking a holistic approach to preventing drink-driving and drug-driving by young drivers, focusing on both formal and informal social controls.

- Strictly enforce existing laws limiting young people's access to alcohol, and consider the positive road safety impacts of strengthening such laws.
- Stringently enforce drink and drug-driving laws, including by way of random breath testing.
- Accompany such enforcement campaigns with information or publicity aimed at modifying the beliefs and values associated with drink and drug-driving.
- Publicise the dangers of drink and drug-driving in places where young people are likely to see it (*e.g.* schools, discos, the Internet, etc.), and in a manner that they are likely to relate to. Ensure that media campaigns accompany and explain law enforcement initiatives, and target parents, peers and social hosts, as well as drivers.
- Train persons serving and selling alcohol to intervene to prevent underage and excessive drinking.
- Encourage co-operation between different areas of government and members of the community to establish programmes aimed at discouraging alcohol and drug abuse by young people.
- Ensure the availability of alternative transport for young people, where they are likely to be drinking.

3.7.7. Automobile advertising

It is widely accepted in many OECD countries that advertising should not sell motor vehicles through the portrayal of dangerous or illegal driving, or otherwise contravene the safe driving messages put forward by public authorities. This principle may be particularly important where young people are concerned – Chapter 2 notes that young people, in particular males, may be especially motivated by speed and risk-taking, and apt to over-estimate their abilities. We have also seen that young people's attitudes regarding driving and safety may be formed well before they begin driving.

Many countries opt for voluntary codes of practice established and enforced by the automotive and/or advertising industries. In some cases they are specifically targeted to motor vehicles, while in others basic principles are established that apply to all advertising. Codes that focus specifically on automobiles tend to demand that advertisers not depict unsafe or illegal behaviour, arguments based on speed or acceleration, situations where alcohol is combined with driving, and/or disrespect for the environment (see New Zealand Advertising Standards Authority, European Advertising Standards Alliance, and Federal Chamber of Automotive Industries). This is also in keeping with the ECMT Ministers' recommendations regarding vehicle advertising (ECMT, 1989).

In 1999, the European Advertising Standards Alliance (EASA) reported that seven of the then 15 European Union members had automobile-specific codes, while eight applied general codes based on the International Chamber of Commerce's International Code of advertising practice and/or its basic principles, which include that advertising should be legal, decent and show a due sense of social responsibility, among other elements. Australia has a Voluntary Code of Practice for Motor Vehicle Advertising established by its Federal Chamber of Automotive Industries (FCAI). New Zealand's Advertising Standards Authority Inc. (ASA) has developed the Code for Advertising Vehicles (see FCAI and ASA web sites). In contrast, the Canadian Code of Advertising Standards is general in nature, and prohibits advertisements that "without reason, justifiable on educational or social grounds, display a disregard for safety by depicting situations that might reasonably be interpreted as encouraging unsafe or dangerous practices, or acts" (Advertising Standards Canada).

A recent official evaluation examined the effectiveness of the Australian code in regulating the content of motor vehicle advertising. It noted that the occurrence of the primary themes of "performance" and "exciting/fun to drive", which could be interpreted as encouraging unsafe driving, had diminished significantly since the code was introduced. The "acceleration", "speed" and "traction" sub-themes of performance had not increased in occurrence over the period reviewed, although the "power performance" sub-theme did increase. While themes relating to general driving safety were represented in a very low proportion of advertisements, a gradual increase had occurred regarding such specific safety features as airbags and ABS since the code's introduction. The "personal experience" and "performance experience" themes, related to the thrill or pleasure of driving, had also decreased (ATSB, 2006).

The effectiveness of advertising codes may be enhanced by the actions of public or private organisations. For example, in the state of Western Australia, a community road safety group produced a self-addressed postcard to assist citizens in making complaints. The card names elements of the code, and invites citizens to identify if a given advertisement does not comply with them.

Lessons for making automobile advertising codes more effective may also be taken from other fields. For example, Australia's voluntary code system for alcohol advertising includes the "Alcohol Advertising Pre-Vetting System (AAPS)", set up by the Distilled Spirits Council of Australia and the Australian Associated Brewers. During the period 1999-2001, as many as 10% of pre-vetted advertisements were rejected, thus preventing them from being shown to the public before being declared incompliant, and avoiding the complaint process (National Committee for the Review of Alcohol Advertising, 2003).

3.7.8. Entertainment media and video games

Interestingly, codes do not typically extend to other aspects of media to which young people are regularly exposed. For example, the US and Canadian TV Parental Guidelines warn parents about scenes of violence, sexual activity and coarse language on television, but not dangerous behaviour (see Motion Picture Association of America or Canadian Media Awareness Network web sites). The British Office of Communications Broadcasting Code includes consideration of "dangerous behaviour" in programming, although the focus is on protecting persons under the age of 15 (see Ofcom website: www.ofcom.org.uk/).

It also unclear what the potential impact of video games is on young people's driving behaviour, especially where they involve the simulation of dangerous driving.

Conclusions and Recommendations:

Little is known about the impact of popular media on young drivers' safety-related attitudes and driving behaviour.

- Conduct research regarding the impact of popular media on young, novice driver risk, including advertising, films, television and video games, and on the impact of voluntary codes of practice for advertising.

3.8. Young Male Drivers: In Search of Effective Measures

The issue of young, male drivers deserves some special mention in this chapter, because it presents perhaps the greatest challenge where young, novice drivers are concerned. To recap what we have heard earlier, young men, collectively, have more crashes and more serious crashes, speed more regularly, are more likely to over-estimate their abilities, drink and drug-drive more often, and are less likely to wear seat belts.

The problem lends itself to no easy solutions. Young men, overall, clearly pose greater risk to themselves and other road users, which provides justification for action on these grounds. However, while risk is higher in general among young men, this does not mean that every individual young man is specifically a high-risk driver by virtue of being young and male. Furthermore, "targeted" measures could be interpreted as discriminatory, although an alternative interpretation would be that efforts should be made to seek greater equality in the risk levels between young men and women, while reducing those of both.

An obvious option is harsher measures targeting all drivers or all young drivers, but this raises the question of why segments of the population that generally do not represent a higher risk should pay the price along with those that do. The complexity of this issue is all the more reason why it needs to be given particular thought and emphasis.

As it currently stands, there are no known male-specific countermeasures, meaning that the solutions must be found in combinations of the various instruments described throughout this chapter and in Chapter 4. This does not mean that nothing can be done. In reality, Chapter 1 shows us that much of the young driver problem is, in fact, a young *male* driver problem. Thus, many of the countermeasures proposed here that focus on specific young driver problems are inherently likely to have an impact on young males. This point was also raised in Section 3.3, where it was noted that many general road safety measures, particularly enforcement, should focus on behaviour that augments young driver risk in particular, noting that young men are over-represented where this behaviour is concerned.

The following is a listing of the measures proposed in this report that might be particularly relevant to addressing young *male* driver risk:

- *Effective enforcement, particularly with regard to those risk areas where young men have shown themselves to be over-represented, namely speed, alcohol, seat belts and drugs.* Such enforcement is also essential to the effectiveness of many of the other countermeasures noted below. This may also be targeted to areas where, and times when young drivers are expected to be particularly active, such as at night.

- *Mandatory high levels of pre-licence accompanied practice.* Increased experience will reduce risk in any event. Longer practice periods will also reduce age-related risk if they result in licensing for solo driving occurring when the driver is older.

- *Restrictive conditions immediately following licensing for solo driving.* Maximum BAC levels of 0.2 g/l will reduce alcohol-related crashes. Restrictions on night-time driving will reduce exposure to risk at the times of day when risk is highest. Restrictions on similarly aged passengers will reduce peer pressure to drive dangerously, and minimise the impact of crashes when they occur.

- *More severe demerit point systems for young drivers.* In order for probationary or GDL licensing systems to be effective, they must be combined with concrete disincentives to unsafe behaviour. Such systems may also have the benefit of temporarily removing unsafe drivers from the road, provided they do not turn to unlicensed driving.

- *Communications campaigns specifically targeting young males, their passengers, and their parents.* Effective communications are a pre-requisite for gaining increased understanding and acceptance of other countermeasures. Combined with other measures, such as enforcement of drink-driving laws, they may ultimately assist in changing attitudes towards safety.

- *Insurance-based economic incentives.* Insurance companies in many jurisdictions set prices for different age and gender groups based on collective performance records. More concrete evidence is required to understand the potential contributions of such incentives.

- *Technology-based solutions.* Subject to further assessment, technology that detects excessive speeds could play a role in reducing young, male driver risk. Technologies that monitor behaviour could also support punishment or incentive-based solutions, such as those described above, and assist in targeting those specific drivers, male or otherwise, who drive dangerously. These are given greater consideration in Chapter 4.

Conclusions and Recommendations:

The particular over-representation of young males in crash statistics – both in absolute terms and based on adjustments for exposure – needs to be recognised as a serious public health problem, and dealt with in a proactive manner.

- Conduct more research aimed at finding effective approaches to target high-risk groups, particularly young male drivers.

- Place particular emphasis on implementing countermeasures that have been shown to be successful in reducing young, male driver risk.

3.9. A Survey of Experts' Views on the Potential Effectiveness of Countermeasures

Table 3.2 provides a synopsis of experts' views regarding the potential effectiveness of the many countermeasures presented in this report, focussing on specific problem areas. This table is based on a survey conducted in the context of this report. The purpose of this table is to provide a qualitative notion, and not a quantitative assessment of the specific effectiveness of each measure. In other words, it is interesting to note experts' views, although we do not necessarily recommend that this be strictly employed in the design of a programme of countermeasures.

The table reflects key problem areas as rows. Notably, age was broken down between maturity and lifestyle. Experience is reflected in a number of factors, such as skill acquisition, mental workload, self-assessment, etc. There was no effort to prioritise the problem areas.

This table was sent blank to a number of international experts in the field of young, novice driver risk, including members of the working group responsible for developing this report. Twenty responses were received. Some respondents left certain cells blank, and the occasional answer was not used.[22] Thus, the number in each cell reflects an average of at least 17 responses, and, in the vast majority of cases, 19. Where respondents filled in a cell with a range (*e.g.* 3-4), we took the upper number, noting that we are looking for the *potential* effectiveness of the countermeasure. Similarly, some respondents noted conditions on specific responses, such as the fact that accompanied practice could be affected by the nature of relations between the novice driver and supervisor, but again, our focus was on the *potential* positive impact.

Some caveats should be noted. Clearly, the first is that the terms "slight", "moderate" and "large" will have different meanings for each respondent. Also, each factor and countermeasure could hold a different meaning for each expert, although they had the opportunity to read a draft of this report, which presents these concepts. However, some of these concepts may have significantly different connotations for experts from a country where licensing occurs at 16 years-old, as opposed to 18.

Some respondents pointed out that these countermeasures could have different impacts depending on the quality of their implementation, enforcement being a good example. Furthermore, any measure is likely to be of limited impact if not implemented as part of a co-ordinated package along with others. There is also no room for consideration of negative consequences of a given measure, such as strict alcohol enforcement leading to an increase in drug use.

With this said, we are presenting this table as a synopsis of experts' views with regard to the effectiveness of given countermeasures in addressing specific factors behind young, novice driver risk.

It may be interesting to note a few areas where the overall finding suggested a view that a countermeasure had a relatively larger (*i.e.* above 3.0 out of a maximum of 4 – these are highlighted on the table) potential to have a positive impact on a given factor, such as:

- Maturity related factors – late licensing (3.55).
- Young males – passenger limits (3.47), late licensing (3.25), night driving limits (3.21), enforcement (3.16) and minimal BAC limits (3.11).
- Alcohol – minimal BAC limits (3.50), enforcement (3.50) and night driving limits (3.25).
- Drugs – enforcement (3.05).
- Fatigue – night driving limits (3.10).
- Distraction – passenger limits (3.37).
- Skill acquisition – informal practice (3.55) and formal training (3.25).
- Hazard perception – formal training (3.20) and informal practice (3.00).

3.10. Conclusions

Throughout this chapter, we have considered the potential effects of various known countermeasures. No countermeasure is, in itself, *the* solution. Reducing young, novice driver risk will depend on co-ordination among different areas and levels of government and with stakeholders, implementing a package of measures in a manner that is most likely to meet with the acceptance of those affected by them.

Some measures are likely to be more effective than others. The authors of this report note that high levels of road safety are a basic prerequisite, and place particular emphasis on countermeasures that allow young, novice drivers to progressively gain additional accompanied driving experience of up to 120 hours before licensing for solo driving, and limit their exposure to risk by being subject to protective conditions immediately following licensing for solo driving.

Ultimately, the implementation of these measures and their impact will depend partially on national circumstances, social and legal differences, and economic development. Most likely, not all effective countermeasures can be implemented simultaneously. Moreover, some countermeasures are preconditions for implementing the more advanced measures, and most countermeasures are less effective when introduced in isolation.

However, a key conclusion that should be derived from this chapter is that many effective countermeasures are known for the problem of young, novice risk, and are already in place around the world. Thus, where the will exists, important inroads can be made. Furthermore, constant measurement and evaluation of existing measures are required in order to more fully understand their costs and benefits, continue to improve on them, and encourage other jurisdictions to adopt them.

The next chapter examines potential new countermeasures. Chapter 5 outlines a strategy for prioritising countermeasures on the basis of their potential effectiveness, costs and timelines for implementation. Chapter 6 explores how societies might go about implementing measures.

Table 3.2. **Schematic Overview of Experts' Views Regarding Potential Impact of Countermeasures in Given Problem Areas***

(Potential positive impact on problem factors = 1 none; 2 slight; 3 moderate; and 4 large)

	Late Licensing	Formal Training	Informal Practice	Driving Test	Post Licence Training	No Passengers	No Night Driving	Minimal BAC	Enforcement	Stricter Demerit Point System	Insurance-Based Incentives	Persuasive Communication
Maturity	3.55	1.74	1.79	1.53	2.42	2.74	2.58	2.37	2.26	2.42	1.63	1.84
Young Males	3.25	1.85	2.05	1.68	2.42	3.47	3.21	3.11	3.16	2.89	2.32	1.89
Personality	1.79	1.58	1.42	1.37	1.68	1.84	1.68	1.89	2.32	2.06	1.44	1.67
Lifestyle	2.56	1.47	1.47	1.21	1.68	2.35	2.47	2.32	2.37	2.11	1.68	1.89
Alcohol	1.94	1.75	1.45	1.40	2.05	2.20	3.25	3.50	3.50	2.90	1.95	2.25
Drugs	1.67	1.75	1.45	1.16	1.89	2.17	2.74	2.22	3.05	2.45	2.32	2.05
Fatigue	1.89	1.80	1.55	1.11	1.95	1.78	3.10	2.21	1.44	1.33	1.28	1.89
Distraction	1.68	1.95	2.10	1.37	2.16	3.37	2.05	1.95	1.45	1.32	1.16	1.68
Emotions	2.10	1.47	1.35	1.10	1.63	2.32	1.74	2.05	1.21	1.32	1.11	1.84
Skill Acquisition	1.37	3.25	3.55	2.75	2.75	1.44	1.47	1.53	1.32	1.37	1.58	1.26
Mental Workload	1.53	2.21	2.75	1.58	2.00	2.58	2.21	2.11	1.11	1.05	1.11	1.37
Hazard Perception	2.21	3.20	3.00	2.40	2.70	1.95	1.84	2.16	1.26	1.21	1.26	1.68
Self-assessment	2.56	2.53	2.11	2.11	2.68	1.63	1.59	1.72	1.50	1.56	1.50	1.68
Safety Motivation	1.89	2.55	2.00	1.84	2.50	2.00	1.74	1.84	2.11	2.15	2.20	2.45
Vehicle Choice	1.89	1.58	1.17	1.11	1.58	1.32	1.21	1.16	1.26	1.00	2.06	2.05

* See Section 3.9 for a description of the rating process

NOTES

1. Data from the International Road Traffic Accident Database (IRTAD).

2. For a detailed description of the different forms of GDL see Begg and Stephenson (2003), Engström *et al*. (2003), Insurance Institute for Highway Safety (www.iihs.org/), Senserrick and Whelan (2003), and Simpson (2003).

3. See discussion in Chapter 1, Section 1.3.1.

4. Acronym for the "Basic Driver Training – New Models Evaluation" project.

5. Acronym for "Minimum European Requirements for Driver Instructor Training".

6. This information was provided directly by Swedish officials.

7. While no exact equivalent has been established between hours and kilometres of practice, this could amount to about 60 hours.

8. See www.VicRoads.vic.gov.au.

9. As noted in Section 2.3.4, mobile telephones significantly distract from the driving task, even when they are "hand's free", and ideally would not be used by anyone, of any age, while they are driving.

10. See www.officeofroadsafety.wa.gov.au/novicedriverreview/documents/NoviceDrivercompletedoc.pdf

11. Acronym for "Towards European Standards for Testing".

12. One question that could be raised is whether these circumstances of high risk noted in Chapter 1 result from questions of young drivers' competence and preparedness, or simply from the fact that young people tend to be particularly active under circumstances that would raise risk levels for any driver, such as at night. Chapter 2 provided ample reason to suggest that both sets of factors likely play a role. In any event, post-licensing protective measures are relevant in either case.

13. Information provided and verified by Robin Anderson, Churchill Fellow, NRMA-ACT Road Safety Trust.

14. More detail on the issues of risk and roadside testing is available from the EU's ROSITA (Roadside Testing Assessment – www.rosita.org) and IMMORTAL (Impaired Motorists, Methods of Roadside Testing and Assessment for Licensing – www.immortal.or.at) projects, and the literature review by Lenne *et al*. (2004).

15. Information provided directly by Australian sources.

16. However, the long-term effect could not be studied due to the changes caused by the unification of the East and West Germany.

17. Data provided directly by UK officials.

18. Although examples exist in some Australia. states and Canadian provinces where automobile insurance is provided by a state-run agency.

19. We have chosen not to identify the company in question, although this information was gathered from its web site by OECD staff.

20. Programmes include the Iowa Strengthening Families Program, Preparing for Drug Free Years, DARE and DARE Plus, the Mid-Western Prevention Project, Project Northland, Communities Mobilizing for Change, the Community Trials Program, and the Massachusetts Saving Lives Program (described in Assailly, 2004).

21. While the server intervention itself is an *informal* social control, legislation regarding such intervention could be considered a *formal* social control.

22. For example, one respondent specified that his rating in one of the cells was dependent on the use of a black box. We did not employ this as it brings to bear assumptions that other respondents would not have had.

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CHAPTER 4.

AREAS FOR NEW IMPROVEMENTS

Abstract

This chapter augments the discussion of countermeasures to young, novice driver risk found in Chapter 3, with consideration of options that, while as yet relatively unexplored, offer potential for new gains. The primary focus is on non-regulatory measures and on new technologies.

4.1. Introduction

Chapter 3 discusses a number of countermeasures that assist governments in reducing young, novice driver risk. These represent "best practices" that are currently showing concrete results in a number of countries. As noted, the implementation of those countermeasures in a co-ordinated fashion would lead to important gains in terms of reducing fatalities.

In this chapter, we discuss countermeasures that, while not yet well established, could potentially lead to important new breakthroughs. These focus on two themes: non-regulatory measures and technology.

4.2. Non-regulatory Measures

Chapter 1 showed us that age is a factor in young driver crashes. We also saw that young men are over-represented in crashes. Thus, it stands to reason that some crashes would be avoided if young people – particularly men – were to put off licensing or limit solo driving until they are older. This could occur as the result of policies or phenomena that are not directly related to driving. In some cases it could be an intentional by-product of government action, while in others it may be an unintended result.

The Association of British Insurers (2005) reports that the proportion of the population aged 1720 with a full driving licence dropped from 48% in 1991 to 32% in 2002. The decline was particularly important among young men. They relate this to a drop in the pass rate for the driving test from 50% in 1992 to 43% in 2002, to increased participation in higher education, and to an overall increase in the costs of maintaining and insuring a motor vehicle. Notably, as shown in Chapter 1, Table 1.3, this did not result in a substantial decrease in young driver fatalities, due to an increase in fatalities per young licence holder.

Research by Twisk (1999) revealed that the involvement in serious crashes of 20-24 year-old male drivers in the Netherlands decreased by 10.5% from 1985 to 1997, far beyond that of any other segment of the population. This accompanied an almost 40% drop in kilometres driven per year by 20-24 year-old males, while mileage remained relatively stable for the rest of the population. During the same period, young men's licence holding dropped by more than 20% and their car ownership by almost 50%. While a system of free bus passes for students was introduced at the time and likely played some role, public transport use by young males actually increased more among non-students than among students. The only factor left to explain the phenomenon was an economic recession experienced during that period. Indeed, a general decrease in young, male traffic crash deaths was experienced throughout the EU, where similar economic conditions to those of the Netherlands largely prevailed.

These figures present a complicated picture from a public policy perspective. Clearly, decision-makers cannot pursue a policy of economic recession in order to reduce traffic crashes. It also shows that traffic crashes are partially the result of individuals' mobility related to and as a result of their economic activity.

Ideally, young males and others could be induced to use more public transport without this having to result from an economic downturn. The question is which policy options might be available to governments to reduce young people's driving during the period when they are most susceptible to age-related, risk-enhancing factors, without this impacting on their economic, educational and family activities. Additional caution is also advised to ensure that the decrease in young people's car use and

ownership is not accompanied by an increased use of less safe forms of transport, such as motorcycles and scooters.

The availability and cost of public transit is an obvious consideration, and, in this, there is a clear link to policies aimed at reducing congestion and the environmental impacts of transport use. This includes transportation to and from schools, particularly in countries where school-age youth may also be licensed to drive a passenger vehicle. The US Transportation Research Board (TRB, 2002) has also emphasised that making parking available and low-cost for school students will increase young driving, and therefore also increase the risk of fatalities and injuries. Furthermore, allowing students to leave school premises throughout the school day as they wish also increases risk. Even such local-level decisions as the licensing of centres of social activity could be considered in this context – a discotheque serving alcohol and located in a remote location requiring access by car is an obvious risk-enhancing factor. Higher parking charges may also induce more use of public transit and taxis, including by young people.

The legal drinking age, and enforcement of this age, has a great impact on young driver crashes. Elvik and Vaa (2004) concluded, on the basis of a meta-analysis, that increasing the legal drinking age from 18 to 21 years-old leads to a decrease of 24% in fatal crashes involving drivers 18-21 years of age, and a 31% decrease in injury crashes in this age group. Chapter 3 also noted the important impact on young driver crashes and fatalities of US laws restricting the sale of alcohol to persons under 21 years-old. Access to alcohol by young people needs to be carefully considered, and related legislation strictly enforced.

In general, it is important to consider the road safety implications, especially for young people, of policy and regulatory decisions in areas not initially related to road safety. In some instances, the road safety benefits of a given policy decision, such as investment in public transport, could serve as an additional justification beyond its initial objectives.

Conclusions and Recommendations:

Non-road safety policies, such as the existence of an effective public transit system or reduced fares for young users, can have an important impact in changing young, novice drivers' travel patterns, mileage and risks.

- Factor the road safety implications, including the impact on young road users, into consideration of non-road safety legislative, policy and regulatory initiatives.

4.3. Technology-Based Solutions

Many of the countermeasures discussed in this chapter are technology-based, and play the role of facilitating the implementation of other measures, or of allowing more detailed focus on specific elements of the problem. Many new technologies currently entering the market have potential for reducing young, novice drivers' crash risk, including in the various areas identified in Chapter 1. In some instances there may also be potential for creating new risks. Much research remains to be done to understand the full implications of these technologies.

In some cases, consideration should be given to the impact on individual freedoms of the use of new technologies, as well as to the legal implications of reducing the driver's control over aspects of the vehicle's functioning. For example, the 1968 Convention on Road Traffic (the "Vienna

Convention"), which standardises traffic rules among contracting parties, states that "[e]very driver shall at all times be able to control his vehicle …" (UNECE, 1968)

In other cases, it may be easier to employ some of this technology in situations where drivers are very young, in that they may be less independent from their parents, who, in turn, could play a greater role in imposing the technology, particularly when the young driver is using the "family car". New drivers will also have to learn to properly manage these technologies, as well as develop skills for situations in which the technologies do not function or are not available.[1]

To date, almost no research has focused on the benefits and problems connected with the use of technology systems specifically by young, novice drivers. Since young drivers are among the most crash-involved road users, this research is of the utmost importance.

4.3.1. Education and training tools

Simulators:

Simulators have clearly become an integral part of the learning environment in many fields, and it is natural to imagine that they might provide a means of gaining experience without exposing new drivers to the risks of the road. Furthermore, as the costs of driving simulators have declined, they have become increasingly common in the domain of driver training.

It is often thought that simulators' success in teaching pilots can be repeated with novice drivers. However, it is difficult to draw this comparison. Flying is much more procedural and rules-based than driving, even with regard to responding to emergency situations (Vlakveld, 2005).

There are some clear advantages to driving simulators. They allow for more control over training conditions, including the simulation of specific circumstances, and provide a safe training environment. They also offer improved feedback and instruction possibilities (Vlakveld, 2005).

In reality, the effectiveness of simulators will be conditioned by the way in which they are employed to acquire skills, in combination with more traditional methods. Well-developed simulator training programmes have been shown to speed up the learning of certain skills, although there is no proof regarding whether these skills are subsequently retained for as long as if they had been learned otherwise (Vlakveld, 2005). Pardillo (2005) notes that basic skills, like vehicle operation, steering, manoeuvring and interaction with other traffic, may particularly lend themselves to simulators, which likely show a simplified version of the driving environment.

However, caution is called for when estimating the potential of driver simulators for the acquisition of many higher-order skills. Situation awareness is a product of practical experience, and it is only in the context of actual driving that one can conclude how to apply learned skills (Falkmer and Gregersen, 2003; also Groeger, 2000 and Christie and Harrison, 2003, cited in Vlakveld, 2005). Also, while tests by Falkmer and Gregersen (2003) showed that simulator training could lead to some improvements in hazard perception, this was not the case in all different scenarios tested, and "Low Cost Simulators" were less effective in this than "Mean Cost Simulators"[2] (cited in Pardillo, 2005 and Vlakveld, 2005). Falkmer and Gregersen note that the challenge is not only in the development of new simulator technology, but, to a large extent, also in defining the goals pursued in training and how scenarios should be designed to achieve these (Falkmer and Gregersen, 2003).

For these reasons, simulators should not replace high levels of real driving practice under protected circumstances. Rather, where they are employed, they should be considered an adjunct to,

and not a replacement for, other training methods. More research is encouraged to explore the full potential, as well as the limits, of this tool.

E-Learning:

The possibility of training by means of e-learning (distance learning by means of the Internet) will increase options for monitoring and guiding the learner driver. However, as yet, these approaches are still under development where learning to drive is concerned.

E-learning presents, in particular, a cost-effective manner of providing materials to educate new drivers and those assisting them regarding aspects of driving, including the rules of the road and potential dangers. Examples include the UK's *Helping L Drivers* (www.helpingldrivers.com/); *Driving Skills for Life* (www.drivingskillsforlife.com/), developed by the Ford Motor Company and the US Governors Highway Safety Association; *Road Ready Teens* (www.roadreadyteens.org/), developed by Daimler Chrysler and others; and the Insurance Corporate of British Columbia's (Canada) *Geared 2 Youth* (www.icbc.com/youth/).

4.3.2. Access systems

Smart Cards:

One of the problems in implementing protective measures for newly licensed solo drivers is in ensuring compliance. This is made difficult for police by the task of identifying when a young person is actually at the wheel. Special plates are currently used for this task in some jurisdictions (see Section 3.7.2).

A "smart card" offers a technology-based solution. It holds information regarding the driver and, used in conjunction with the ignition key, prevents the vehicle from starting if the driver is not authorised to drive it. The card could thus prevent unlicensed or unauthorised driving. It could also be used as a tool to select which drivers are allowed to drive under specific conditions, and thus could be relevant for novice drivers in specific phases of driver training, such as those with restrictions during certain times of day. An additional benefit would be the prevention of vehicle theft. As yet, there is no practical experience with the system specifically related to young drivers, although it holds great promise.

Alco-locks (Interlocks):

Alco-lock systems check the concentration of alcohol in breath in order to prevent drink-driving. If the alcohol level is higher than a pre-set level, the system will render the car impossible to start and drive. Several trial activities are on-going, primarily targeting repeat-offending drink-drivers, and evaluation studies have shown positive results, although repeat offences have tended to rise again after the interlock is removed (Frank 1997; Beck *et al*., 1999; Beirness and Marques, 2004). Despite the fact that young drivers have high crash risk as a result of alcohol use, as yet, no trials have targeted this group. Alco-locks for all young drivers as a preventive measure could be expected to have positive safety effects, although the concern that these might lead to a migration to other psychoactive substances should be taken into account.

Seat belt systems:

Given the role of non-use of seat belts in young, novice drivers' fatalities and injuries, systems that warn the driver to put on a seat belt, or prevent the engine from starting until the seat belt is put

on, also have an important role to play in reducing risk. Work is underway in various countries looking at interlocks for seat belts that would prevent the functioning of some aspect of the vehicle, such as a time delay in putting it into gear if the seat belt is not fastened.

4.3.3. Support for the driving process

The following are technologies that assist with the driving task. These have considerable potential to reduce accidents. Furthermore, as these technologies become increasingly common in vehicles, young drivers will have to learn to employ them as part of the training process. It could also be noted that, as these new technologies are more likely to be employed in new and more expensive vehicles first, their benefits may initially be felt less by young drivers, who might be more likely to drive used and cheaper cars for economic reasons.

Intelligent Speed Adaptation:

Intelligent Speed Adaptation (ISA) systems allow the vehicle to recognise the speed limit in any given location, and use this information to respond if the speed limit is exceeded. An example would be a system that uses GPS to establish the speed limit in the area where the vehicle is located, and then compares this with the speed at which the vehicle is travelling.

ISA systems can potentially be either "informative", meaning that they only provide information to the driver, or "supportive", meaning that they actually intervene to slow the vehicle down. An example of informative ISA would be a warning light for the driver ("speed threshold warning"), while an example of supportive ISA would be a system that increases the resistance of the accelerator pedal above certain speeds (Carsten and Tate, 2005; Schmidt Nielsen and Lahrmann, 2005; OECD and ECMT, 2006). In addition, similar technology can be used for monitoring purposes, by registering information for consideration after driving has occurred (see below).

Tests in Sweden, the UK and the Netherlands have shown initial positive results, although effectiveness would depend on the type of technology, and how it is implemented, for example, whether or not it would be mandatory. Carsten and Tate (2005) estimate that the voluntary use of a strictly advisory ISA system could reduce injury accidents by 2-10%, while the mandatory use of an intervening system could lead to a 50% reduction.

Various technical complications currently exist with regard to the implementation of ISA, including their ability to function across different jurisdictions. Legal concerns also arise with regard to situations where the driver would not be fully in control of the vehicle in the case of intervening ISA, or where responsibility for adherence to the speed limit seems to be ceded to a machine, as opposed to remaining with the driver.

Adaptive Cruise Control:

Adaptive Cruise Control (ACC) is a technology that actively intervenes in the vehicle's functioning to ensure a pre-selected time-lag between it and the vehicle in front of it. In some instances, ACC applies light, imperceptible break pressure when there is a vehicle ahead, thus reducing breaking distances if the driver subsequently breaks (OECD and ECMT, 2006). Initial analysis suggests that ACC could act as a potential countermeasure in 7.5% of crashes (OECD and ECMT, 2006).

The OECD and ECMT (2006) suggest a need to research the possible adaptive impacts of ACC where drivers are concerned, in terms of trust, dependence, complacency and other adaptive effects.

ACC is expected to be widely applied on many vehicles in the near future, meaning that young drivers will need to become accustomed to it.

In general, given the role of speed in overall young driver fatalities, it may be assumed that speed limitation and harmonisation systems have a high potential for decreasing risk among young people.

Electronic Stability Control (ESC):

Electronic Stability Control (ESC) systems – also called Electronic Stability Programmes (ESP) – employ sensors to detect deviations of a vehicle from the driver's intended path, and then apply breaking or power reduction to individual wheels to bring the vehicle back under control. They also assist in slowing down the vehicle in loss-of-control situations (OECD and ECMT, 2006). These systems are increasingly present in new vehicles, including in as many as 40% of those sold in Europe in 2003 (Chew, 2003).

The OECD and ECMT (2006) cite international field work showing that ESC can be effective in reducing, by more than 30%, single-vehicle, loss-of-control crashes that result in serious injuries or fatalities. Thus, this technology could be of great value to young drivers, who are involved in such crashes in disproportionately high numbers (see Chapter 1). The safety benefits of ESC could lead some governments to mandate their use in the foreseeable future (OECD and ECMT, 2006).

4.3.4. Monitoring systems

Driving Data Storage Unit:

Various types of monitoring systems exist that can be used to register information regarding the driver's performance, the vehicle and traffic situations, in order to provide feedback to the driver or others, such as employers, parents, traffic authorities or insurance companies. Examples include event data recorders (EDRs), which, like aircraft "black boxes", can provide information regarding the circumstances surrounding a crash, or tachographs, which are already used in commercial vehicles to monitor speeds and drivers' hours of service, and track cargo (OECD and ECMT, 2006). One example is the SAGA system, developed in Iceland, which allows for monitoring and reporting on vehicle localisation and use, speeds relative to local speed limits, and other elements of driving behaviour. The system is currently used in the vehicle fleets of 70 companies, leading to significant registered reductions in crashes (OECD and ECMT, 2006).

The question is how such systems might be employed to reduce young driver risk. Presumably, concerns about privacy and excessive state intrusion into one's activities would lead to pressure for these to be employed on a voluntary basis. However, economic incentives, such as lower insurance premiums, could be employed to induce their use. Also, in some cases, parents might be able to insist that certain technology be placed in vehicles used by their children.

One pilot project (Heinzmann and Schade, 2003) has examined whether the presence of a monitoring system in young drivers' vehicles has a preventative effect by leading to more lawful and careful driving. The results showed that the presence of a black box did not have a significant effect on crash and violation frequency. However, young drivers participated on a voluntary basis and were assured that the data from the black box (*e.g.* on traffic violations prior to crashes) would not lead to any negative consequences.

As noted in Chapter 3, a study is currently being conducted in Denmark on the effectiveness of ISA systems in reducing young driver risk, involving Aarlborg University, the County of North

Jutland, the insurance company Topdanmar, and the Danish Road Safety Transport Agency. This study will include the development of a new generation of ISA equipment and software, the creation of digital speed maps and related web applications, and a three-year test involving 300 young car drivers. The goal will be to gain greater understanding of the possible effects of this technology on young drivers, including behavioural change that might result from insurance discounts offered in exchange for installing and using the systems (Schmidt Nielsen and Lahrmann, 2005).

Also, as discussed in Chapter 3, one insurance company is already using economic incentives tied to black box use to specifically target young, male drivers. Furthermore, research is being conducted on the use of "black boxes" that register when a vehicle is driven, thus allowing for insurance policies that take into account the time of day when driving occurs (Association of British Insurers, 2005).

The "Belonitor" experiment sponsored by the Dutch Ministry of Transport, Public Works and Water has looked at the benefits of rewarding good driving behaviour. The project involves equipping rental cars with systems that register whether drivers are speeding or driving dangerously close to vehicles in front of them, while also providing this information to the driver. Based on the results, a rental company could provide "rewards" to customers (Infrasite, 2006). Similar projects are being considered in North America, and could presumably be extended beyond the car rental field.

Conclusions and Recommendations:

Certain technological applications have great potential to reduce young driver risk. However, greater knowledge and understanding is required in this area.

- Research the potential value of technological countermeasures in reducing young, novice driver risk, including speed limitation or harmonising systems, black boxes, alco-locks, smart cards, and intelligent protective systems.
- Consider the implications of such technologies for driver training, to ensure that novice drivers are prepared to safely use new technologies.
- Note that simulators are not a substitute for practical experience gained under protective conditions, and that they should be employed as an adjunct to, and not replacement for, other training methods. Continue research aimed at improving the usefulness of simulators as a training tool.
- Explore possibilities to better exploit the benefits of e-learning as part of driver training.

4.4. Conclusions

Chapter 3 provided a list of important known countermeasures that governments should be applying in their efforts to reduce young, novice driver risk, many of which represent best practices. However, in order to meet ambitious road safety targets and reduce the excessive rates of fatalities and injuries associated with this age group, authorities must proactively seek out new improvements. This chapter has discussed areas for potential important new gains that should continue to be explored, focussing on non-regulatory measures and technology.

NOTES

1. The Organisation for Economic Co-operation (OECD) and European Conference of Ministers of Transport (ECMT) includes extensive treatment of technology, particularly related to assisting and monitoring the driver in executing the driving task, as part of their 2006 report, *Speed Management*.

2. Pardillo (2005) defines the difference as: "A Low Cost Simulator consists of a driver chair, pedals, a gear lever, a steering wheel, a dashboard, only one monitor (40 degrees field of view) right in front of the driver, and a sound generator. It has no moving base but pedals and a steering wheel counterpoise. A [Mean Cost Simulator] has the same configuration but with 3 monitors (a field of view of about 120 degrees)."

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CHAPTER 5.

WHICH ACTIONS TO TAKE?

Abstract

The chapter concentrates on the advice needed by policy makers in deciding how best to address national road safety problems with young drivers. It reviews the understandings of young driver risks (as outlined in Chapters 1 and 2) from a policy perspective, as well as the most effective countermeasures (as identified in Chapters 3 and 4). Based on the research outlined, it gives further consideration to which actions countries should take. Policy decisions and actions will of course depend on the particular circumstances in the country concerned, such as political leadership and will, road safety legislation and administrative arrangements, road safety performance and public attitudes to road safety. The chapter discusses the issues and provides guidance on the most effective strategies and measures, taking into account the resources involved and the timelines within which the actions proposed could have real impacts on the ground.

5.1. Introduction

This chapter presents an overview of the matters decision-makers will need to take into account in their different national contexts in addressing young driver problems and deciding which actions to take. This overview builds on the analysis of young driver risks and research findings set out in the earlier chapters on the causes and possible countermeasures.

The strategies that countries adopt to deal with young driver problems can be expected to include the aims of reducing the risks that young drivers pose to themselves, as well as reducing the risks that they pose to other road users. Decision-makers will no doubt also be focussed on the significant reductions in young driver-related fatalities necessary to achieve the road safety targets that have been set nationally and internationally.

From a policy perspective, there are a number of important considerations to be addressed by any country in understanding national problems and refining and improving road safety strategies in relation to young drivers. For example:

- Detailed analysis of road safety performance and crash statistics is needed to identify the extent of the problems and the levels of young driver risk in each country. The data provided in Chapter 1 in particular should help with this task.

- Cross-country comparisons will help identify areas where local road safety performance is not fully adequate and can clearly be improved. Again, the data and analysis in Chapter 1 provide a useful start on the evidence-based approaches that are likely to be most effective.

- Consideration needs to be given to the existing and required road safety legislative framework, as this will define the scope for action.

- Consideration also needs to be given to overall responsibilities and accountabilities in relation to road safety, the importance of adequate stakeholder and public involvement in the processes of strategy development and the identification of the resources required and available to address young driver risks.

Armed with the latest data and analysis, member countries will need to consider how best to respond to their young driver problems and the policy imperatives that have been identified. Importantly, in the context of limited political, financial and administrative resources, they will need to give careful consideration to choices and priorities in deciding which actions to take, taking into account the assessments outlined in Chapters 3 and 4.

5.2. Overview of Key Risk Factors

This part provides a policy-oriented overview of the key risk factors that underlie the young driver problem in all countries. It highlights the way in which an understanding of the relative importance of these risk factors can guide broad road safety strategies. It is intended to provide policy and other non-expert readers with a quick review of the factors that together place young drivers in such high risk circumstances. This sets the scene for the policy oriented decisions that countries must make on which actions to take.

5.2.1. Experience, Age and Gender

This section focuses on key underlying risk factors related to young drivers themselves rather than the circumstances in which these factors manifest themselves. As noted in Chapters 1 and 2, there are three fundamental factors underpinning young driver risk. These are:

- Level of experience
- Age
- Gender

Experience, age and gender risk factors materialise in the crash circumstances where young drivers are over-represented, principally: speeding, impairment by alcohol and drugs, non-use of seat belts, night-time driving and driving with peer-age passengers. However, research indicates that experience, age and gender do not make equal contributions to young driver risk.

Understanding the respective contributions of these factors is fundamental to policy deliberations. Chapter 2 highlighted that young driver risk is not easily divided between experience, age and gender. In fact, they intertwine distinctly in each young driver, based on a complex mixture of individual elements, such as physiological and emotional development, personality traits, socio-economic situation, reaction to the role of youth in society, and others. However, the following provides a broad overview.

Experience:

While both experience and age are important, research indicates that experience is clearly more important than age in determining the relative risk levels of both young male and young female drivers. Risk levels for both young males and females are extremely high immediately following licensing for solo driving, but reduce significantly in the first six to 12 months (see Figures 1.8 and 1.9). Risks then reduce more gradually in line with experience over the remainder of the first two to three years of solo driving. However, it does take that long – *i.e.* two or three years at least - before risk levels for young male and female drivers approach the levels of older male and female drivers.

Age:

While age is an important factor, the reduction in risks solely due to licensing at a later age is typically much less than can be expected from increased driving experience over the same period. For example, an increase in the initial solo driving age from 18 to 21 could be expected to reduce accident risks in the first year of driving by around 25% – *i.e.* around 8% per year (see Figure 1.9).

Where age could become a more important factor is for solo driving before 18 years of age. While the data available is limited, the analysis done in the US suggests that the risks of driver crash involvement per million miles travelled at age 16 was about 75% higher than at age 18 (see Figure 3.4), although this also reflects the period when many people are first gaining experience.

Of course, age-related contributing factors include the physiological elements (such as psychological and physical maturity) as well as the lifestyle issues (including how young people socialise, and their overall role in society) outlined in Chapter 2.

Gender:

Gender is a key attribute that distinguishes young male and young female driver risk levels from each other and from those of older drivers.

Relative risk levels for young female drivers are clearly higher by comparison with older female drivers – with fatalities per million population indicatively 50% higher for 15-17 and 21-24 year olds and 100% higher for 18-20 year olds (Figure 1.11). As well, their relative risk levels are also higher by comparison with the average of older drivers (Figure 1.13).

Risk levels for young male drivers are extremely high by comparison with young female drivers – typically around three times as high (Figure 1.11). Risk levels for young male drivers are also very high by comparison with older male drivers – typically 50 to 100% higher.

The relative risk levels for young male drivers are therefore also very high by comparison with the general driving population. For example, as seen in Figure 1.13, young male drivers in the UK, the Netherlands and Sweden had an average relative risk level of around 7 times that of all drivers aged 30 to 59 in 2001 – and this had increased considerably from around 4 times in 1994. In other words, in these countries, although total fatalities have decreased over this period, young male driver risks and fatalities have not reduced at the same rate, and are increasingly out of line with general road safety improvements.

Policy Considerations:

From a policy perspective, the relatively low risks to *inexperienced drivers* during periods of accompanied practice before licensing, and the very high levels of risk during initial periods of solo driving post-licensing (particularly in the first six to 12 months) highlight two distinct areas for policy consideration and policy action. In each case, the aim should be to *provide safer driving conditions* in which young drivers can gain increased driving experience:

- The first is the scope for learner drivers to acquire more driving experience pre-licensing, to ensure they are better prepared to handle the extremely high risks that they will encounter after licensing for solo driving, particularly in the first six to 12 months.

- The second is the scope for complementary actions to protect newly licensed drivers from the high risk circumstances to which they would otherwise be exposed at the outset of solo driving, maintaining such protection until they have gained sufficient experience.

The *effects of age* on driver risk are important and also deserve careful consideration in deciding which actions to take. The principal age-related policy considerations are:

- Any reduction in the licensing age for solo driving will increase young driver risks significantly.

- On the contrary, any increase in the age of licensing for solo driving is likely to decrease fatality risks.

- From a safety viewpoint, therefore, administrations should give consideration to the safety benefits of raising licensing ages for solo driving.

- However, recognising the practical difficulties in increasing legislated licensing ages, as an alternative to increasing the minimum age specified in legislation for solo driving, consideration could be given to measures that would effectively increase the average age at which young drivers actually begin solo driving.

From a policy perspective, both *young male and young female drivers* face significantly higher risks than their older, experienced counterparts. As well, the extremely high risk levels of *young male drivers* is a centrally important concern. In this context:

- In terms of overall fatalities, young male driver fatalities are typically several times higher the young female driver fatalities.

- The road safety strategies developed to better deal with young driver problems therefore need to give due weight to how best to reduce young driver risks – and particularly young male driver risks.

- The over-riding aim should not only be to reduce the level of fatalities of young drivers themselves but also the high levels of young driver-related fatalities involving their passengers and other road users killed in crashes involving young drivers.

- In this context, there will be a need to achieve the appropriate balance in each country between the individual liberties and responsibilities of young drivers and the overall social responsibilities to ensure road safety for all road users.

In summary, there are important policy options that arise from such an overview of experience, age and gender. As well, it is the blend of experience and age, and their interaction with gender, that makes the young driver problem different from that of other novices who begin driving at later ages.

As noted earlier, despite these underlying experience, age and gender factors, young driver risks are nevertheless likely to be lower in countries with better overall levels of road safety performance. However, in most countries, reliance on overall road safety improvements alone will not be sufficient. In circumstances where young drivers comprise a significant proportion of overall fatalities and injuries, significant improvements in overall road safety may depend to a large extent on achieving significant reductions in young driver fatalities – calling for consideration of young driver-specific measures. A full analysis of the national and local road safety problems with young drivers in each country is required to develop the best strategies and actions. Such an analysis needs to take into account the full range of circumstances in which experience, age and gender factors translate to high young driver risk. More detailed insights that can assist with such analysis are provided in the earlier chapters.

5.3. Key Policy options

This section highlights options that are available to governments for addressing the general problem of young driver risk as well as the circumstances that aggravate the underlying causes.

As noted earlier, while young driver risks are high by comparison with older drivers, most young drivers do not intentionally or systematically drive dangerously. Many may not drive dangerously at all. However, despite this, there are high risks to young drivers and other road users. Dealing with young driver risk therefore requires decisions on how best to reduce these risks and fatalities. Should the problems be addressed by measures that encompass all young drivers as a group; or by measures that focus on sub-groups likely to be most at risk?

As a general position, the research in this area has shown that it is difficult if not impossible to reliably identify drivers who are "unsafe" through the licensing processes, although tests like Hazard Perception Tests may provide some insights. As well, experience has indicated that communities often tend to favour general measures applied to a wide group (such as all drivers) over specific measures that target sub-groups (such as young male drivers) on the basis of perceived risk. Sitting behind these judgements are questions of equality and equity between specific groups within society, including young people themselves and young male drivers in particular.

Obviously, individual rights must be respected and individual responsibility expected. At the same time, it is important to give due consideration to the impact of young drivers on other individuals, and on society in general, including in terms of human and economic costs. This is a delicate balance that policy makers must strike, and the approach taken will depend largely on legal and social traditions in individual countries. The policy options set out below need to be considered in this context.

5.3.1. Period prior to licensing: Increase pre-licence accompanied driving

It is important for young drivers to have adequate practice "on the road" prior to being licensed for solo driving. Research suggests that all governments should give serious consideration to increasing the levels of driving experience that learner drivers actually acquire during pre-licence learning periods *i.e.* before young drivers can present themselves for licensing for solo driving. While at least 50 hours of pre-licensing practice are recommendable, the research supports increasing this towards 120 hours, which experience in one country (Sweden) showed reduced crashes in the two years following licensing by about 40%[1] (see Section 3.6).

From a policy perspective, as outlined in Chapter 2, a combination of formal and informal "training" can help with "retention" of the lessons learned and the experience gained. It should be noted that high levels of accompanied practice "on the road" cannot be replaced by simulators or by shorter periods of formal training.

While primarily focused on the experience-related elements of risk, this countermeasure also helps to address age-related factors in countries where licensing ages are relatively low. In such circumstances, by requiring high levels of accompanied practice, authorities would also increase the average age at which solo driving occurs.

Given that many young drivers currently have only limited driving experience in many risky circumstances (*e.g.* wet weather, higher speed, with multiple passengers or at night), such additional practice should involve a wide variety of circumstances and experience, under the surveillance of a driver able to give useful advice about safe driving. The provision of appropriate materials to guide accompanying drivers will also be useful.

Such accompanied practice is likely to involve little financial burden on young drivers, their parents or the community, although it will place demands on the time of the families and other people involved. Costs to government will likely be relatively minor. Overall, research indicates that such approaches are likely to be very cost effective (see Chapter 3). Implementing increased requirements for pre-licensing practice may require legislation, and thus would need time to be implemented. As well, consideration needs to be given to how requirements for such increased levels of "on the road" experience will be enforced. Informal advice from the US American Automobile Association (AAA)[2] suggested that actual compliance with current, lower levels of "on the road" experience requirements there (typically 30 to 50 hours) may be as low as 25%.

Developing and implementing such a programme could be expected to meet with some resistance, especially from young drivers themselves. This will be more likely when it means that the young driver will effectively face a later age of licensing for solo driving – such as in systems where the base age for solo driving is 16 but is effectively raised by the requirement for high levels of practice – as opposed to systems where the age for solo driving remains 18 but accompanied practice may occur earlier. Thus, the policy deliberations should involve a strategic process of consultation, whereby the larger community is engaged, and materials are provided that clearly discuss the benefits of such action. Also, implementing measures over an extended period may be helpful, such as in the case of Victoria, Australia, where a long term target of 120 hours of accompanied practice was announced and promoted, and then steps taken to meet this in a mandatory sense some seven years later.

5.3.2. Post licensing period: Gaining increased experience in safer driving conditions

As noted earlier, the specific problems and risk factors need to be identified and addressed in each country. Based on experience across member countries, the highest risk circumstances – where experience, age and gender factors are most likely to become evident – will be associated with:

- Speeding
- Drink-driving
- No seat belt wearing
- Drugs
- Night-time driving
- Driving with peer-age passengers

Of these, speeding, drink-driving and non-wearing of seat belts are widely recognised as the highest risk circumstances and therefore fundamentally important for young drivers; addressing them adequately is of the highest priority from a young driver perspective and will make a major contribution to allowing young drivers to gain experience in safer driving conditions. Despite a lack of community awareness in many countries, drugs and driving have become an increasingly important problem in many countries. Although there has been concerted action in some countries (*e.g.* the US), night-time driving and driving with peer-aged passengers do not seem to have near the same recognition as important young driver issues.

As a general rule, some of these circumstances and issues are best addressed by *general* road safety policy and enforcement action; and others are best addressed by *young driver-specific measures*. In both cases, one of the aims is to provide safer driving conditions in which young drivers can acquire experience:

General action. The circumstances best addressed by general road safety policy and enforcement action are likely to be:

- Speeding
- Drink-driving (*i.e.* general BAC limits and enforcement)
- Seat belt wearing; and possibly
- Drugs

Young driver specific action. The circumstances best addressed by measures specifically targeted at young, novice drivers are likely to be:

- Drink-driving (*i.e.* lower BAC restrictions for young drivers up to a certain age, above which the general BAC limits apply)
- Night-time driving
- Passengers

The following sections deal with these two groups of measures in detail.

5.4. Which Actions to Take: Key General Actions/Enforcement Measures

For the reasons outlined above, it is generally not appropriate or possible to single out young people on the road. However, the propensity of young people – and especially young males – to speed, drink and drug-drive, and not use seat belts contributes to their over-representation in crashes. Consequently, they will be among the greatest beneficiaries from general policy, legislation and enforcement actions in these areas. Of course, there may be opportunities for enforcement to be targeted to points where they might have a particular impact on the young driver problem, such as in areas where young people are more likely to speed and/or drink drive, at night, and on particularly dangerous stretches of road.

5.4.1. Speeding

Speeding – *i.e.* excessive and inappropriate speed – is the number one road safety problem in many countries. Speed-related crashes typically account for around 20-30% of road fatalities. Young drivers are over-represented in speeding behaviour, crashes and fatalities in most countries.

Many countries have adopted a speed limit of 50 km/h in urban areas, and 30 km/h zones are recommended in areas where vulnerable road users are particularly at risk, although higher speed limits apply in many other countries. Experience has shown that speed limits need effective enforcement, including a visible police presence and the use of modern control technologies and methods. Penalties should be credible and accompanied by sound means of collecting them, including the streamlining of the legal and administrative frameworks associated with the sanctioning process.

Speed reductions will increase safety for all drivers including young drivers. Levels of fatalities can be reduced dramatically by reducing vehicle speeds. Decreasing mean speeds by 5% can typically be expected to reduce injury crashes by around 10% and to prevent 20% of fatal collisions, starting almost immediately. As an example, a concerted effort to reduce traffic fatalities in France in recent years, which primarily focused on speed, led to a 35.9% drop in the number of killed drivers per million population overall between 2001 and 2004, and a 34.5% drop in the number of killed 18-24 year-old drivers per million in that age group.[3] Speed cameras played an important role in this improved outcome.

As noted in Chapter 4 technological advances, such as Intelligent Speed Adaptation and “black boxes”, have considerable potential to address speeding, although more research is required particularly with regard to their application to young drivers in particular.

5.4.2. Drink-driving

A general BAC limit of 0.5 g/l is widely accepted as the norm in European countries and is recommended by the EU, and by the ECMT in Resolution No. 46 of 1993. Some countries have introduced lower general limits, such as Sweden and Norway (0.2 g/l). Furthermore, levels of enforcement vary greatly as do levels of fatalities.

Some countries have higher minimum BAC limits. In the absence of specific BAC limits for younger drivers, and at the end of their period of application, the general BAC limits apply. In jurisdictions with BAC limits at 0.8 g/l, young drivers will be exposed to risks several times higher than at the 0.5 g/l levels applicable in many countries.

Random, high-visibility breath testing at roadside checkpoints, combined with hard-hitting publicity, is well established as the most effective means of achieving reductions in alcohol-related casualties. Removing the requirement for suspicion from breath testing procedures will improve the efficiency of police operations, as would automatic licence withdrawal on refusal to undergo a test. Furthermore, breath testing should be considered admissible evidence, in order to make complex medical tests unnecessary.

In addition, intensive publicity campaigns combined with enforcement have been shown to have a positive impact on attitudes regarding drink-driving.

5.4.3 Seat belt wearing

The wearing of seat belts is one of the most effective measures in protecting car occupants when crashes do occur. There is no doubt that seat belts save lives. In many countries, research has found that young men are less likely to wear seat belts than other drivers (see Section 1.4.7) and are therefore mostly likely to benefit from effective seat belt wearing legislation and enforcement action.

All seats in new cars should be equipped with seat belts, with their use obligatory at all times for both front and rear seat occupants. Enforcement can achieve incremental increases in seat belt usage and research indicates there is generally a high benefit-cost ratio to effective enforcement programmes. Enforcement needs to be risk-targeted, highly visible and well-publicised, conducted over a sufficiently long period, and repeated frequently. As seen in Chapter 4, technological solutions, such as reminder systems or interlocks, can also contribute to increasing seat belt use.

5.4.4. Drugs

Driving under the influence of illegal and legal drugs is a growing road safety problem. Research shows that narcotics, such as cannabis can be dangerous for road safety, and particularly so when combined with alcohol and other drugs. Young drivers are likely to be over-represented among drivers who drive while impaired by drugs, either alone or in combination with alcohol.

Drugs have been more difficult to detect than alcohol and legislative frameworks for dealing with drug-driving have not always been clear. However, there have been recent improvements in legislation in a number of countries. As an example, in the UK, “drug-driving” is now considered as serious an offence as drink-driving, and a Code of Practice has been developed that details drug tests and outlines training for police officers to detect drugs. At the same time, it became illegal for drivers to refuse to take part in a drug impairment test (see Section 3.7.3).

In relation to detection, in Victoria, Australia, an 18-month legislated trial was agreed, legislation adopted by the Parliament in December 2003 and the trial started in December 2004. New legislation was introduced to allow its continuation after July 2006. Testing has been targeted to some degree but the results have been noteworthy, with higher proportions of drivers testing positive for the presence of two drugs (THC [Δ^9 tetrahydrocannabinol, the most active of the principle constituents of marijuana (cannabis sativa)] and Methamphetamine) than to impaired alcohol levels. Recent experience also has raised concerns about the use of "ecstasy".

In summary, significant reductions in young driver risk could be achieved in most jurisdictions with increased levels of accompanied practice prior to solo driving, as well as by effective policy legislation and general enforcement of the key road safety problems – speeding, drink-driving, seat belt wearing and the emerging problem of drugs. Effectively addressing these problems will help protect young drivers in particular and contribute to young drivers being able to gain experience in safer driving conditions generally. For countries with lower levels of road safety performance, these are the areas that are probably most likely to produce the biggest improvements in young driver safety.

5.5. Which Actions to Take: Young Driver-Specific Measures

Even with effective action along the lines outlined in the previous section, it is likely that young drivers will face unacceptably high levels of risk in many jurisdictions immediately following licensing for solo driving. Additional action may be required to provide greater protection for young drivers collectively while they gain experience, by limiting their exposure to specific driving circumstances that pose the highest risks to themselves, their passengers and other drivers.

As outlined earlier, it is important for the circumstances of high young driver risk to be carefully researched so that there is a solid, evidence-based understanding of the problems in each country. Any proposal for young-driver-specific measures should be made after a careful balancing of the interests and responsibilities of young drivers with the broader social responsibilities for safe transport systems. Public knowledge and understanding of the extent of the problems and public acceptance of the proposed measures are centrally important, given that there is likely be an elevated degree of sensitivity to young-driver-specific measures from those who might perceive themselves adversely affected. As noted in Section 6.3.4, it is important to actively engage stakeholders and the wider public, providing them with the facts and options, and allowing opportunities for feedback.

5.5.1. Drink-driving: More stringent Blood Alcohol Content (BAC) limits

There is good research support and there seems to be general community acceptance for young-driver-specific limits in many jurisdictions. Maximum BAC levels of no more than 0.2 g/l for young, novice drivers are particularly recommended, for a range of reasons specific to young people, as outlined in earlier chapters.

Where the BAC limits for young drivers in the country are above "best practice" levels, consideration should be given to reducing these levels as quickly as possible. Doing so can be expected to significantly reduce alcohol-related crash and risk, as seen in various examples in Section 3.6.1.

Consideration also needs to be given to the period over which such BAC levels will apply to young drivers, taking into account the age and BAC levels that will be involved afterwards. As noted above, a level of 0.5 g/l is recommended as a general maximum BAC level for all drivers. As an example, strict restrictions on drinking before the age of 21 in the US mean that, at that age, many

young people could be exposed legally for the first time to the road safety effects of driving at BAC levels of around 0.8 g/l.

5.5.2. Night-time driving curfews

The highest number of young driver-related crashes and fatalities occurs at night. As an indication, casualty risk levels of night-time driving by probationary drivers in Melbourne, Australia, are close to 4.5 times higher for probationary drivers (*i.e.* novice drivers within their first 3 years of solo driving) late at night than for more experienced drivers.

Where crash analysis in the country indicates particularly elevated crash risks for young drivers late at night, consideration needs to be given to the possible introduction of restrictions on night-time driving by young drivers. The assessments should recognise that such restrictions may be more problematic in terms of levels of public support than is the case for young-driver-specific BAC levels. In terms of priority, it is likely to be best to introduce young-driver-specific BAC limits first.

There is not the same recognition in all countries of night-time driving as a high risk activity for young drivers as there is for many other young driver risks, However, night driving restrictions are already quite widely used. For example, following the introduction of graduated driver licensing (GDL) in all US states, there has been a concerted effort to introduce night driving curfews, and these are now imposed in almost all US states. They are also applied in many Canadian provinces and in New Zealand. The times covered vary, some beginning as early as 21:00, but many not starting until 23:00 or later. Section 3.6.2 provides examples regarding the effectiveness of night-time driving restrictions.

5.5.3 Restrictions on driving with peer-age passengers

Crash analysis in many jurisdictions (see Chapter 1) has highlighted the elevated risks related to young drivers having multiple passengers. However, like night-time restrictions, there does not seem to be high level of recognition in all countries of the extent to which multiple passengers and, particularly, peer-age passengers increase young driver risks.

Nevertheless, protective restrictions in the form of limits on the total number of passengers – and especially the number of peer-age passengers – young drivers may carry have shown themselves to be effective in many locations.

The provisions in use vary considerably and, in some cases, passengers are allowed if a more experienced, adult driver is supervising. As well, exemptions from such limits for family members are quite common. Recognising the particular risks of peer-age passengers, different forms of peer-age passenger restrictions (*e.g.* no passengers under 21 or under 20) are in place in many US states and Canadian provinces, and in New Zealand.

The particular circumstances in each country need to be researched carefully in each case. The assessments should recognise that restrictions on passenger numbers may be more problematic in terms of levels of public support than is the case for young-driver-specific BAC levels or night-time restrictions.

Section 3.6.3 outlines international experiences with this countermeasure.

The American Automobile Association supports peer-age passenger restrictions as part of its overall promotion of GDL, and is promoting their implementation in the US, where all but 15 US states now have restrictions on the number and age of passengers that a young driver can carry.

5.5.4. Special demerit point systems

In many jurisdictions, demerit point systems have been found that effective in improving compliance with road safety provisions. In some jurisdictions, young and/or novice drivers are subject to special demerit point systems that apply during the period of probation. This means that probationary drivers are potentially subject to punitive (*e.g.* loss of licence) or rehabilitative (*e.g.* mandatory traffic risk awareness training) measures if they lose a certain number of points, and the threshold for such measures is lower than it would be for other drivers. In other words, the young or new driver is assigned fewer points, or loses more points for each infraction. Such young-driver specific demerit point systems help enforce the young-driver-specific protective measures, such as those in GDL systems. They can also temporarily remove dangerous drivers from the road, although unlicensed driving remains a concern.

As seen in Chapter 3, there are enough success stories to recommend that jurisdictions assess the possible use of demerit point systems.

5.5.5. Special plates for young and novice drivers

It is logical that, in order to better enforce measures targeting young drivers, some effort should be made to specifically identify them on the road. For this reason, in some jurisdictions, special plates are employed for identifying novice drivers, including "L (learner) Plates" and "P (probationary) Plates", among others. An additional benefit of such plates is that they allow other drivers to make allowances for novices on the road.

Little analysis is available regarding the effectiveness of special identification plates for young drivers. They are likely of limited value when their use is voluntary, as there is considerable resistance to them. Of course, even where they are required, there is no guarantee that they will be widely used unless they are adequately enforced. Nevertheless, as the range of young-driver-specific measures is increased, jurisdictions may find it worthwhile to give the options for young driver identification some further consideration.

5.6. Other General Application Measures

5.6.1. Increase overall safety levels, with particular emphasis on areas where young people are over-represented

It has already been shown above that, in areas like speeding, drink-driving and seat belt wearing, young driver risk is particularly high and requires effective enforcement at a general level. At the same time, it should be noted that overall improvements in road safety levels are likely to benefit young drivers.

Countries with higher overall levels of road safety tend to be those with the lowest young driver fatality rates (see Figure 1.7). Young drivers have more crashes and, thus, general initiatives aimed at reducing crashes and their severity will have a particularly important impact on the young. Indeed, given the over-representation of young people in crash fatality statistics, any concerted effort to address overall road safety should include a particular focus on young drivers. Furthermore, the impacts of increasing overall levels of safety will be particularly great in those countries that currently have relatively lower levels of road safety performance.

Improvements can be achieved by a range of measures including: a safe transport systems approach; safer vehicles; safe, more forgiving infrastructure; as well as, of course, safer drivers, driving at the speed limit.

5.6.2. Improve national licensing systems

- *Improve driver training and testing, focussing on higher order skills:*

Existing research provides little evidence of clear safety benefits resulting from current formal training practices. Also, based on current knowledge, driving tests have not shown themselves to be effective instruments in distinguishing between novice drivers who will be safe and unsafe once they start solo driving. Thus, changes to existing training and testing practices should be considered.

The three key elements of licensing (training objectives, training processes and tests) should reinforce one another. Test content should be varied and cover all possible aspects of the training objectives, and those that cannot be tested should be obligatory elements within training.

Implementing changes in the training and testing domains has immediate financial consequences for the candidate driver, the driving instruction industry, and/or for taxpayers, and will therefore meet with resistance. It will likely require legislation, and thus take time.

Some changes to tests could be implemented in the short term, and would have an impact on young, novice driver risk if they resulted in more stringent standards for becoming a solo driver. However, it would be essential to ensure that the benefits of such a practice not be offset by an increase in unlicensed driving.

- *More effective licensing practices:*

It is also important to borrow the best practices from international licensing systems, with a view to ensuring that licensing systems are as effective as possible in providing ample experience prior to licensing, and reducing risk immediately after. Such elements have been inferred in the sections above, and could include, *inter alia*:

- Mandatory accompanied practice before licensing
- Hazard Perception Testing considered for inclusion in licence testing
- Provisional licences covering an initial period of solo driving
- Protective conditions that are gradually removed from provisional licences
- Reinforcement of licensing conditions by sanctions for non-compliance (*e.g.* demerit points)
- Absence of any corruption from the process

5.6.3. Explore the use of technology to control access to, support and monitor solo driving immediately after licensing

Governments should continue to experiment with the development and testing of new technologies, such as Intelligent Speed Adaptation, Adaptive Cruise Control, Electronic Stability Control, alco-locks and black boxes, and encourage their implementation as their benefits become known. Further details are provided in Chapter 4.

The implementation of new technology applications could take many forms, including by way of regulation, voluntary application, pressure from parents, or economic incentives associated with insurance rates. In some instances, these technologies are becoming standard in many vehicles.

The costs of these technologies will be borne by drivers themselves, which could be a source of resistance. Legal problems will also arise where a technology appears to alleviate the driver of full responsibility for control of the vehicle. Furthermore, given the need to develop and apply new technologies, this is a countermeasure for the medium term.

5.6.4. Proactively employ persuasive communication

Communication campaigns have been found to be effective when combined with other countermeasures, particularly enforcement. Also, communication is a basic element in developing and implementing all of the countermeasures discussed here, including the young driver-specific measures in particular. It is essential for the public to be aware of the problem at the outset and to understand and be involved in the solutions needed to address it. This is an area where governments can take visible and immediate action, especially if they are also pursuing other road safety initiatives.

Persuasive communication campaigns are best developed in consultation with young driver groups, and based on the combined resources of different levels of government and non-governmental organisations (see Section 3.7.5).

The costs involved will depend on the nature of the communications and media employed, although they are unlikely to be controversial given the importance of the message.

5.6.5. Consider the road safety implications of other public policy decisions

Non-road safety policy decisions could have important impacts on drivers' risk levels, particularly those of young people. This includes the availability and cost of public transport and parking, and decisions regarding the location of establishments serving alcohol, among others. The possible road safety cost, in terms of crash risk, should be factored into all public policy decisions, where relevant, similar to the way in which environmental costs are currently considered.

This is something that could begin immediately, although it would become more effective if entrenched in legislation. There would be administrative costs to government, as well as public resistance in cases where this limits choices or makes them more expensive.

5.7. How Well Will These General and Young Driver-Specific Measures Deal with Young Male Driver Risks?

The predominance of young males in the young driver problem has been clearly emphasised throughout the report and this chapter. To recap what we have heard earlier, young males, collectively, have more crashes and more serious crashes, speed more regularly, are more likely to over-estimate their abilities, drink and drug drive more often, and are less likely to wear seat belts.

The problem does not lend itself to any easy solutions. While young men are clearly at greater risk than others and pose greater risk to other road users, this does not mean that every individual young man is specifically a high-risk driver. "Targeted" measures could be interpreted as discriminatory, although one could also say that efforts should be made to seek equality in the risk levels between young men and women, while reducing those of both. Furthermore, young drivers' crashes impact on other road users, who should also be allowed to expect as safe a road traffic environment as possible.

As it currently stands, the solutions will most likely be found in combinations of the various instruments highlighted here and described in detail in Chapters 3 and 4. Measures that ensure high levels of practice prior to licensing and that reduce exposure to risk after licensing will be particularly important. Furthermore, there should be considerable emphasis on general road safety measures and enforcement in the key areas of speeding, drink-driving and seat belt wearing.

5.8. Timelines for Action

As in any area of public policy, taking effective action on road safety is a complicated and, often, time-consuming process. New measures may require legislation, which necessitates an extensive process of consultation, development of policy documents and legal instruments, and parliamentary debate, as well as implementation. Other initiatives may be based on existing legislation, but will still require administrative activity in order to be effective, such as the development of regulations, communication and co-ordinated implementation. Shorter term actions may be prerequisites for longer term goals. Also, initial failures may make later action more difficult.

It is clear that no single countermeasure will provide the entire solution. Rather, important improvements will result from a co-ordinated introduction of various countermeasures, addressing all of the factors and circumstances that heighten young driver risk.

5.9. Prioritising

The countermeasures will require different degrees of effort, cost and time to put in place, and likely meet with varying degrees of resistance. It will be important for policy makers to make both immediate gains in reducing the human and economic costs of young drivers' crashes, and ensure durable, long-lasting improvements in this area. Thus, the introduction of countermeasures should involve a strategic approach, establishing priorities based on the likely effectiveness of given measures, as well as on the time and resources required to make them effective. It will be important to show short-term gains to attain support for later measures.

5.10. The Young Driver Strategy

An indicative Young Driver Strategy has been developed which is set out in Table 5.1. This provides a schematic overview of the above countermeasures and identifies their potential impact as well as timelines for implementation and costs. They are presented here in order of how quickly they could be put in place. While each of the countermeasures listed is deemed to be effective, they are also rated in terms of whether their impact would likely be moderate, quite high or very high, based on the discussion in Chapters 3 and 4.

The timelines for beginning action and seeing results and costs are not based on exhaustive analysis but deduced from considerations of the amount of effort involved in a given countermeasure, such as whether it would require new legislation, extensive enforcement, etc. With particular regard to timelines for beginning action, this will depend on the conditions in each country, including existing legislation, and the initial public perception of the problem, among other factors. For example,

"immediate" action in some countries may involve beginning development of legislation, which would first require examining international best practices, considering how this might work in national circumstances, consulting the public, and other elements. In other instances, it may involve developing regulations based on existing legislation. The degree of effort involved in the immediate stage will condition the time required before concrete results will be seen. Where we indicate that research is required, this means that not enough knowledge is currently available to begin implementation of the measure.

This figure provides an indication of how a step-wise approach could be undertaken to implementing countermeasures, with both shorter and longer term deliverables.

5.11. Conclusions

No single countermeasure holds the key to reducing young driver risk. Rather, various measures must be applied, addressing the key factors behind that risk, namely experience, age and gender. These must also focus on the circumstances under which young driver risk is highest, namely driving under the influence of alcohol or drugs, at high speed, without seat belts, at night and with passengers.

However, from a policy perspective, these countermeasures will involve different degrees of effort and resources, and require varying timelines to become effective. For this reason, governments must adopt a strategic approach, focusing on priority actions that will deliver results both immediately, and over the longer term.

Table 5.1. **Prioritisation of Administrations' Implementation of Effective Countermeasures**

Countermeasure	Timeline		Potential Impact*	Costs to Government	Costs to Young Drivers	Costs to Others
	Start	Effective				
1. Increase public awareness of the problem	Immediate	<1 year	Moderate (But this is an essential prerequisite to other actions)	High (if advertising involved)	N/A	N/A (Although NGOs may be involved)
2. Target key road safety risk factors (Note: Prerequisite for 4, below)				High (But this might be part of an overall road safety initiative)	Low (But still controversial, *e.g.* fines)	Low (But still controversial, *e.g.* fines)
●Speeding	Immediate	1+ years*	Very high			
●Alcohol	Immediate	1+ years	Very high			
●Seat belts	Immediate 2+ years	1+ years	Very high			
3. High levels of accompanied practice prior to solo driving	Immediate	2+ years	Very high	Low	Low	Low
4. Protective restrictions following licensing for solo driving				High (will require effective enforcement, changes to administrative systems, and communications)	Medium (possible higher costs associated with licensing)	Low
●Max. BAC of 0.2 g/l	Immediate	2-3+ years**	Very high			
●No night-time driving	Immediate	2-3+ years	Quite high			
●No peer-age passengers	Immediate	2-3+ years	Quite high			
●Persuasive communication (as a prerequisite to implementing protective measures)	Immediate	2-3+ years	Quite high			
5. Consider road safety implications of other policy decisions	Immediate	1+ years	Moderate (but cumulative over time)	Medium	Low	Medium
6. Improve national licensing systems				High	High (could lead to higher costs for training and new costs for testing)	Medium-high (Parents may ultimately shoulder any additional costs; Driving schools will have to update techniques)
●Overall licensing practices	Immediate	2-3+ years	Moderate			
●Formal training and testing	Research	2-3+ years	Moderate			
7. New technologies			Requires more assessment	Medium (including R&D)	Medium (more expensive vehicles)	Medium-High (*e.g.* R&D costs)
●ISA, ASC, ESC, etc.	Research	2-3+ years				
●Black boxes	Research	2-3+ years				

* All of these countermeasures are considered effective. They are rated here in terms of their degree of effectiveness (moderate, quite high, very high).

** Lower BAC restrictions could possibly be implemented earlier, based on existing drink- driving legislation.

NOTES

1. Adjusted for confounding factors.

2. June 2006

3. Data from the International Road Traffic Accident Database (IRTAD).

CHAPTER 6.

MANAGING CHANGE

Abstract

This chapter considers the means by which effective countermeasures could best be introduced with a view to reducing young, novice driver risk. In doing so, it notes that the initiatives that have brought about the greatest reductions in traffic fatalities and injuries – such as seat belts, strict drink-driving enforcement, and airbags – have all met with considerable resistance in the past. The chapter explores both the primary barriers to introducing countermeasures, and means by which these might be overcome.

6.1. Introduction

Several fundamental conclusions can be drawn from the earlier chapters. To begin with, if governments wish to meet ambitious road safety targets, they will have to address the issue of young, novice driver risk. Furthermore, the costs associated with young, novice driver risk – in both human and economic terms – are enough to justify taking specific action where this segment of the population is concerned. In addition, there is now a wide body of evidence about what can be done to reduce this risk, as well as indications of new areas where additional gains could be made.

In short, taking action to address young, novice driver risk is desirable, necessary and possible. However, this does not make it easy; as in any public policy area, there will be resistance to change.

With this as a backdrop, the focus of this chapter is on how to manage the changes required to reach an ideal situation where young, novice driver risk is concerned. This situation is one in which the age, experience and gender-related determinants of that risk are largely mitigated, thereby greatly reducing the difference in risk levels between younger and older drivers, while continuing to reduce fatalities among all age groups, and particularly among young men.

6.2. Barriers to Change

Road safety often presents a public policy dilemma. Improvements in road safety benefit all of society, in that they reduce loss of life and injury and associated costs, including those associated with police, emergency and medical services. However, individual road safety risk is usually relatively low, and individuals do not often directly perceive the full costs of road safety, while mobility is highly prized. For example, in Norway, recent risk estimates found that, on average, a driver must drive 5.5 million kilometres before he or she would be injured in a crash. On the other hand, 259 Norwegians died in traffic crashes in 2004, and the annual cost of road crashes to society is estimated at between 25 and 30 billion NOK (some 3.5 billion euros) (Bjørnskau, 2003; IRTAD).

As a result, road crashes impose a high cost on society but public opinion surveys show that people are often likely to be more concerned about other social issues, such as health care, education or the threat of crime. In other words, while improving road safety performance would generally be good for all, it does not appeal to individuals' perceived self-interest. This can lead to a vicious cycle, in which the media places more emphasis on higher profile issues, thus increasing the extent of public and political focus in those areas, to the detriment of others.

Historically, many of the measures proposed to improve road safety have met with considerable public hostility, including those which have proven essential in lowering fatality rates. This is partially because these measures are seen to interfere with personal choices and increase the likelihood of receiving a fine.

Similar resistance is likely to be associated with new countermeasures to young, novice driver risk. Obviously, much resistance will come from those with vested interests. Young people will resent any changes that make it more difficult to obtain a driving licence, or any restrictions on their ability to drive under certain circumstances once they have a licence. Parents may see new measures as putting an additional burden on their time, and will be subject to pressure from their children anxious to gain independence. The training industry may also not welcome change, particularly if it is seen as unnecessary government inference or a threat to their business.

Cost is likely to be a key issue. For example, cost considerations may inhibit investment in new licensing systems or technological advances. Furthermore, new costs may ultimately have to be met by

learner drivers or their parents, and rejection of these costs will likely include the argument that they impact unequally and unfairly on those less able to pay. The costs imposed on the driving instruction industry also need to be taken into account.

Countermeasures will likely affect all new drivers rather than a subset of "deviant drivers", and may thus be perceived as unfair. As noted in Chapter 3, it is very difficult, and sometimes illegal, to impose measures that specifically target high-risk sub-groups among a given set of the population.

It is also important to consider the possible negative consequences – real or perceived – that could result from change. For example, if obtaining a licence becomes more difficult, time-consuming and/or expensive, some people may decide to drive without a licence, or choose less safe forms of transport, such as motorcycles or scooters. In countries or areas with limited access to public transport, education or employment opportunities may be reduced for those unable to drive.

This translates into a political quandary. Despite significant potential benefits to society as a whole, politicians will be reluctant to support initiatives that are subject to limited public demand or even public hostility. Also, proposing change often calls into question practices that have existed for many years, while lack of awareness about young, novice driver risk may prevent some parents, voters and decision-makers from giving the issue the attention and support it deserves.

6.3. Managing Change

Barriers such as these are difficult, but not impossible, to surmount. Measures like seat belts, motorcycle helmets, radar cameras and airbags all experienced initial resistance, but are now standard practice around the world, saving hundreds of thousands of lives. Attitudes can also change; legislation to tackle drunk driving was initially controversial, but today such behaviour is widely considered socially irresponsible, as well as being an offence.

Ultimately, the implementation of new measures will require the participation of political decision-makers, different areas of government and affected stakeholders, facilitated by research and communication. The reason to act, and the basis for action, is perhaps best summed up by the guiding principles for reducing the impact of road safety on human health put forward by the World Health Organization (Peden *et al*., 2004) in its *World Report on Road Traffic Injury:*

ROAD INJURY PREVENTION AND CONTROL THE NEW UNDERSTANDING
Road crash injury is largely preventable and predictable: it is a human-made problem amenable to rational analysis and countermeasure.
Road safety is a multisectoral issue and a public health issue – all sectors, including health, need to be fully engaged in responsibility, activity and advocacy for road crash injury prevention.
Common driving errors and common pedestrian behaviour should not lead to death and serious injury – the traffic system should help users to cope with increasingly demanding conditions.
The vulnerability of the human body should be a limiting design parameter for the traffic system and speed management is central.
Road crash injury is a social equity issue – equal protection to all road users should be aimed for since non-motor vehicle users bear a disproportionate share of road injury and risk.
Technology transfer from high-income to low-income countries needs to fit local conditions and should address research-based local needs.
Local knowledge needs to inform the implementation of local solutions.

Source: Peden *et al*., 2004

6.3.1. Research

The challenge could be summarised as the need to convince the public to accept what is in the broader public interest. This will not be achieved based on superficial arguments. It is essential to start from the perspective that the public and decision-makers are rational, and will respond to well-documented argumentation. In other words, the full extent of the problem, its causes and costs to society as a whole must be understood to the greatest extent possible. The potential results of any proposed countermeasure should be well documented in terms of lives and costs saved. Challenges to proposed countermeasures should be foreseen and responded to based on solid analysis. To be credible, research must be independent and based on reliable data.

However, it may also be difficult to fully evaluate the effectiveness of any new countermeasures until some years after they have been implemented. Prior research may have to rely on hypothetical projections – or judgements informed by experience elsewhere – of how people would respond to a change. The actual impacts of any countermeasure need to be measured and adjustments made to reflect the results.

Governments should invest in research and, to the extent possible, build on experience in other jurisdictions, while noting that differences in traditions, laws, established driving practices and geography will require the tailoring of countermeasures for each specific set of circumstances. Stakeholders, such as the motor vehicle or insurance industries, may also play an important role in such research and analysis.

6.3.2. Political leadership

Possibly the single most important factor in managing change is political will. Governments face many pressures, and, for the reasons noted above, new road safety measures are unlikely to be driven by a groundswell of popular opinion.

As political will is strongly influenced by public opinion, political courage and leadership are required to introduce change, particularly when the benefits in terms of casualty savings may not be achieved within the short timeframes between elections. An essential first step is for politicians to publicly recognise that there is a problem, and proactively communicate it to the public, reinforcing that the problem is closely linked to national interest in terms of the health of citizens and associated costs. Often, a particularly influential political "champion" can play a key role by taking on an issue and passionately communicating its value to the public. This has been the case in France and Russia in recent years, where the Presidents have publicly acknowledged the need to take action on road safety. In France, a committee of Ministers responsible for the various aspects of road safety has also been created (ECMT, 2006).

The treatment of young, novice driver risk needs to be seen in the context of a country's overall road safety and health policies. Ideally, it will fit within a national vision for road safety and contribute to stated targets. A stated *vision*[1] represents government's formal commitment, and thus gives prominence to road safety in the policy and decision-making processes, as well as raising public interest and support (OECD, 2002). In order to be successful, a vision requires wide acceptance among stakeholders, and should be uncomplicated, easy to communicate and realistic (Rumar, 1999; OECD, 2002). A *target* is a quantified goal with an explicit time frame, and is often accompanied by comprehensive programmes outlining the allocation of resources and identification of specific actions (OECD, 1994, 2002).[2] In general, targets lead to more realistic programmes, better use of public funds and other resources, and greater credibility for those responsible for road safety policy. They can thus increase road safety performance, give direction to policy-making, motivate partners to set priorities,

and increase commitment (Elvik, 1993; OECD, 1994; Elvik, 2000). Where national visions and targets result in improved overall safety and reductions in crashes and fatalities, the benefits will also extend to young, novice drivers. Targets or related programmes can also involve a specific focus on young, novice drivers.[3]

Finally, as noted in Chapter 5, a strategic approach should be established that will show results both in the short and longer terms. This should be based on the potential effectiveness, costs and timelines required to implement given measures, as well as expected resistance.

6.3.3. Co-ordination among different areas of government

Responding to young driver risk will require action on various fronts, including in the areas of education, communication, regulation and enforcement. Clearly, this is beyond the responsibility of any single branch of government, and may require the participation of various jurisdictions. Close co-operation will be required, in order to ensure that action in one area is reinforced by action in another, and not contradicted. For example, as noted in Chapter 3, enforcement of drink-driving laws will be most successful when accompanied by communication regarding the risks of drink-driving and ramifications of getting caught.

Different areas and levels of government need to co-ordinate closely in their research, regulatory and communications efforts. Understanding the full costs of young driver risks involves close co-ordination with health and emergency response authorities. In some instances, local or regional authorities may be assisted by nation-wide standards and initiatives, which could serve to justify otherwise unpopular measures. The same dynamic may exist between national governments in Europe and the European Commission.

6.3.4. Consultation with stakeholders and the community

The role of stakeholders is complex, as there could be as many perspectives on a given issue as there are stakeholder groups, all of whom will be affected in different ways by the problem and its countermeasures. Young drivers, parents, driving instructors and the insurance industry, for example, will be more immediately affected. Road users other than young drivers; taxpayers; and the health sector, among others, will also be affected, although they will likely not feel the effects as directly. For this reason, some stakeholders will resist change, some will be ambivalent, and some will seek to drive change.

Measures that do not engage stakeholders are doomed to failure. Public consultation is a key part of the process, although it is far from easy. It will not be possible to fully meet the demands of every stakeholder, and the temptation to forge political trade-offs in an effort to assuage different groups should be resisted, as it will only result in less-than-optimal outcomes. Stakeholders need to be presented with realistic scenarios, based on scientific research. To ensure balanced input, all relevant stakeholders should be consulted, not just those directly affected by new measures. Even so, as noted above, political courage will likely be required to manage relations with those stakeholders whose demands are not representative of the wider public good.

There has been considerable experience recently in some member countries (*e.g.* in various states in Australia and the US) with consultation on the proposed introduction of young driver-specific protective measures. The recent consultation experience highlights the value in outlining proposals and the supporting evidence in a clear and transparent manner. It also highlights the possible value in identifying the overall levels of community support for improving young driver road safety outcomes and the particular measures under consideration, as well as the levels of stakeholder support and resistance.

The consultation programme undertaken by the Western Australian Road Safety Council in 2005 identified both community support and areas of resistance to young driver measures. As this could be a useful model for other jurisdictions to consider, some further advice on the approach taken is provided in the case study outlined below:

Western Australian Example: Consultation with stakeholders and the community

A good example of consultation with stakeholders and the community is found in Western Australia, where the Road Safety Council developed a package of recommendations for augmenting the state's *Graduated Driver Training and Licensing System*, based on international research and best practices. The composition of the Road Safety Council – made up of senior-level representatives from the Insurance Commission of Western Australia, police, the transport ministry, the roads agency, local government, the education and health administrations, and the Royal Automobile Club (Western Australia Road Safety Council, 2005) – indicates an inclusive process from the start. The Council developed a public discussion paper based on nine specific recommendations, then disseminated it along with a consultation kit, with 12 000 copies sent to a random sample of the community, and 9 000 sent to a variety of road safety stakeholders. This sample was large enough to provide statistically reliable sub-samples of interest, such as parents and people in remote areas.

In summary, the responses to the survey showed that:

- 85% of the community was very concerned or quite concerned about the safety of novice drivers.
- 87% felt that there was probably a need to make changes to the way that novice drivers are trained and licensed.
- More than two thirds of people agreed with the concept underlying each of the nine recommendations made in the discussion paper.
- Overall, 77% of respondents said they would support introducing the entire package of recommendations either very strongly (37%) or quite strongly (40%) (Western Australia Road Safety Council, 2005). Crucially, parental support was very high.

The responses from young driver groups showed the majority of novice and pre-drivers themselves did not support the new measures proposed. For example, only 48% of novice drivers and 38% of pre-novice drivers agreed that they were "very concerned or quite concerned about the safety of novice drivers". These responses showed that the views of young drivers were quite different from the views of the rest of the community. This pattern of responses carried through into them being less in agreement with each recommendation and with the package as a whole.

Taking the responses from stakeholders and the community into account, the WA Road Safety Council recommended that the Government:

1. *Increase the minimum number of supervised and logged driving hours required from 25 hours in one Learner phase to 120 hours over two Learner phases.*
2. *Specify a minimum of six months for the Learner Phase 2 period.*
3. *Increase the maximum time a Learner can stay on their Learner's Permit to three years with no renewal fee.*
4. *Extend the Provisional licence period from two to three years.*
5. *Tighten the requirements for supervising drivers, particularly in relation to the Blood Alcohol Concentration limit.*
6. *Introduce night-time driving restrictions for Provisional drivers for the first six months of their Provisional period.*
7. *Introduce peer passenger restrictions for Provisional drivers for the first six months of their Provisional period.*
8. *Introduce a zero Blood Alcohol Concentration limit for both Learner and Provisional drivers.*
9. *Introduce a graduated demerit point system and issue warning letters to deter unsafe driving practices.*

Considerable work based on a well-conceived communications strategy ensured that the media was kept informed and involved throughout a very transparent development process.

Following further consideration, in May 2006 the Western Australian government adopted recommendations 2, 3, 5, 6, 7, 8 and 9, including night-time and peer passenger restrictions, a zero g/l BAC limit for young novices and for those supervising learner drivers, and a graduated demerit point system. The government also endorsed the safety principles behind the recommended increase to 120 hours in supervised driving hours pre-licensing, and further consideration is being given to broadening awareness of its benefits and possible future implementation/support aspects (e.g. safety net programs for those who cannot access a supervising driver and/or vehicle).

As work continues to prepare for the implementation of these measures, further consultation is planned with young people to ensure that they are aware of how they will be impacted by the changes and to ensure a smooth implementation process.

The West Australian Office of Road Safety advised that the factors contributing to the success of the consultation exercise included:

The commitment of the Road Safety Council to genuine consultation with the community was crucial in establishing the parameters for consultation and enabled the community to decide whether these measures would be considered for implementation by the WA Government.

The collegiate attitude of the Road Safety Council agencies brought a highly collaborative tone to the project, with agencies contributing at all stages of the project and using their networks particularly well to spread awareness during the consultation period.

Considerable work based on a well-conceived communications strategy ensured that the media was kept informed and involved throughout a very transparent development process and that messages delivered to the community through mass media and other means were consistent and targeted.

The public discussion paper drew on independently researched best practice and was written in a style that was easy to read and explained the recommendations and the research supporting them in a non-threatening manner.

The design of the feedback form, the sampling approach and the analytical framework ensured that all research questions could be answered through this single mechanism and that the WA Government could be confident that the results reflected the broad views of the entire community.

As the consultation was an initiative of the Road Safety Council, the Council was able to independently consult with the community before finalising recommendations with a summary of community feedback to the Minister and Government.

The public discussion paper and the results of the community consultation process are available online at:
www.officeofroadsafety.wa.gov.au/novicedriverreview

This example from Western Australia shows us that, if a wide cross-section of the community and stakeholders is involved and provided with well-researched and clearly presented information regarding potential measures and the problems they are meant to address, a genuine demand for improved road safety may be revealed. Such an inclusive approach can make it easier for decision-makers to overcome the resistance of smaller groups of interested parties, and thus secure decisions to implement the measures proposed.[4] It is particularly important that communications documents be easy to read, and address issues as they relate to the local culture and customs.

Stakeholder groups, including private industry and non-governmental organisations, can also play an important or leading role in achieving political acceptance of measures, as well as in changing attitudes and behaviour, by communicating appropriate messages to the public. For example, since 1997, the American Automobile Association (AAA) has actively campaigned to promote graduated licensing (GDL) legislation in the US. This has included raising public awareness of young driver deaths by pursuing coverage in the press. Over the period from 1997 to 2005, the number of US states with GDL systems increased from 8 to 50. The AAA's Foundation for Traffic Safety, a non-profit research organisation, conducted studies leading to the development of training materials. The AAA is also part of a nation-wide coalition of public, private and not-for-profit actors known as "Road Ready Teens" (RRT), along with DaimlerChrysler, the Insurance Institute for Highway Safety (IIHS),

Mothers Against Drunk Driving (MADD), the National Safety Council, and the National Transportation Safety Board, among others. In this context, DaimlerChrysler has donated funds to state-level coalitions focusing on the issue, some of which are led by the AAA (Pikrallidas, 2005; see also www.roadreadyteens.org). Since the implementation of GDL throughout the US, the AAA has been actively campaigning for all states to implement, as part of their GDL processes, young-driver-specific restrictions on night-time driving and numbers of peer-age passengers.

In another example, "traffic meetings" were established by one of the biggest insurance companies in Iceland in 1994 to highlight the consequences of dangerous behaviour for young drivers and their passengers. Since then, more than 30 000 young people have attended these meetings, which include testimony by police and hospital staff. A special magazine, STANZ, is given out to those attending, who are eligible for a 30% reduction on motor liability insurance premiums and comprehensive car insurance.[5]

Of course, parents have an important role to play in communicating and preparing their children to be young, novice drivers. As well as being good role models, parents need to assist in many other ways, *e.g.* explaining the need for supervised on the road practice; and helping ensure that their children acquire enough such experience pre-licensing to prepare for solo driving. They also need to actively communicate about risky driving situations and supervise the use of their vehicles by their children, especially when they are relatively very young. The non-governmental organisation Mothers Against Drunk Driving (MADD) in the US and Canada has been very influential in communicating the dangers associated with young, novice drinking and driving, both to governments and to young drivers themselves (see www.madd.org/under21/ and www.madd.ca/). The State of Victoria's (Australia) consultation report on improvements to their GDL system proposes "parent-learner sessions", as well as informational material for parents of learner drivers (VicRoads, 2005). As noted in 3.7.1, such sessions currently exist in Western Australia as part of "Road Aware", the state's school-based pre-driver education programme, which is funded by the government third-party insurance provider, and managed by the Office of Road Safety, thereby also providing a good example of multi-agency co-operation (see www.roadaware.wa.edu.au/default.asp). Section 3.7.6 showed us that programmes engaging young adolescents and their parents in discussions about the risks of drinking alcohol can positively influence the children's use of alcohol in later years. In the US, parent/young driver contracts have also been used during the learning process.

Lastly, it is important to note that many organisations either led by or involving youth are also actively engaged in promoting driver safety, and should be involved in any discussions regarding the issue of young driver risk, as well as in the implementation of countermeasures. Examples include *Responsible Young Drivers* (www.ryd.be) and *Drive Up Safety* (www.dus.to) in Belgium; *MALINA* in the Czech Republic (www.nadace-malina.cz); *La route des jeunes* (www.laroutedesjeunes.com/), *Voiture and co.* (www.voiture-and-co.com/) and *La Fondation Anne Cellier Junior* in France; *TeamAlert* in the Netherlands (www.teamalert.nl/portal/), and *Students Against Destructive Decisions* (www.sadd.org), the *National Organizations for Youth Safety* (www.noys.org/) and the *National Student Safety Program* (http://adtsea.iup.edu/nssp/about/default.aspx) in the US.

6.3.5. Communication campaigns

The success of any countermeasure is subject to the public's eventual acceptance of it. Even if the measures are initially unpopular, experience shows that public attitudes are subject to change and influence.

Campaigns designed to educate the public about the dangers and potentially disastrous consequences of certain driving behaviour can be highly effective, particularly if they are supported by

legal sanctions. Social pressure can play a part and the media can also be influential in helping to shape public opinion. Widespread condemnation about the irresponsibility of drinking and driving is a good example of this, as is the recognition that seat belt wearing is an integral part of safe driving behaviour. However, it is important to note that influencing attitudes through communication will only occur over long periods of time.

Chapter 3 provided an extensive discussion of best practices with regard to persuasive communication. Public authorities should employ "social marketing"[6] techniques to assess the demand for and resistance to a given countermeasure, and ideal channels for promoting its acceptance (OECD, 1993). Where possible, this should involve joining forces with stakeholders, such as parents and insurance companies, who recognise a vested interest in reducing young, novice driver risk. The work of groups like MADD has already been noted above. Other examples include the UK's Royal Society for the Prevention of Accidents (www.rospa.com/), and France's Association Marilou (www.association-marilou.org/) and Prévention Routière (www.preventionroutiere.asso.fr/).

6.3.6. Transition and flexibility

Changes that break radically with previous practice will meet with the greatest resistance and require commensurate efforts to manage. Practical measures can be adopted to ease the transition.

Phasing in measures will assist in achieving acceptance of them. Setting realistic targets and identifying priorities will also help. It is important to start with measures that have clear benefits and are known to deliver results, meaning that concrete gains will be seen with each phase. Furthermore, there should be room for modifications if measures are not achieving their desired goals. This requires a review of new measures within a set time frame, which should also be based on well-founded research.

Flexibility in implementing measures may assist in their acceptance. For example, restrictions on passengers or night driving in GDL systems often allow exceptions to prevent interference with educational or family obligations. In Great Britain, there was concern that the introduction of the new hazard perception test from November 2002 would lead to a significant drop in pass rates. To avoid negative publicity and claims that it was unfair, the new test was phased in by gradually raising the pass mark. The mark was initially set at a level to enable the majority of candidates to pass the test and was raised in stages over the first year.[7]

Having said that, a clear, forthright policy that demands adherence and is easily enforced is very often required to bring about behaviour change. In contrast, programmes that seek to coax their targets into a given behaviour, or those that are highly convoluted, are more likely to be ignored and not be enforced. An example is found in GDL laws – efforts to persuade parents and teens to voluntarily undertake specific high levels of practice before licensing or to limit exposure to more dangerous circumstances after licensing would likely have failed, whereas including this as part of the licensing process has proven to be highly effective. Once again, such proactive measures, when they are likely to be unpopular with their targets, require that decision-makers have the courage of their convictions.

Different national circumstances mean that there is no single solution for reducing novice driver crashes. Countermeasures must be appropriate to the legal and social contexts where they are implemented. Countermeasures that severely restrict access to driving will be unsuccessful in communities where public transport is not a practical option. Having said that, this report has shown that certain countermeasures are basic and should be included under any circumstances, such as allowing for accompanied practice prior to solo driving.

Where possible, countermeasures should be seen to offer new opportunities, as opposed to restrictions. For example, the introduction of accompanied learning in Norway and Sweden was combined with a reduction of the minimum age for learning from 17 to 16 years-old, while the age for solo driving remained at 18 (Gregersen *et al*., 2000; Sagberg, 2002).[8]

New measures should not add additional complications to the licensing process, such as increased bureaucracy. In Norway, the opposite was true; when revisions to the licensing regulations and curricula were introduced in 2005, the system was rationalised so that driving test candidates for different classes of vehicles did not have to repeat elements of the educational material that they had already completed (Norwegian Public Roads Administration, 2005).

6.3.7. Resource issues

Resource questions, including the costs to taxpayers and stakeholders, may be among the most difficult to deal with. Resistance to change will inevitably be linked to questions of costs.

As noted above, the most convincing response to this will be one based on well-researched facts, showing that the savings generated from the measures outweigh the costs. Road traffic crashes have economic and financial consequences and understanding these costs can be used to support the introduction of new measures. Calculations of actual savings should also be included in *ex post* analysis and any implementation of new measures should be accompanied by evaluation research.

Chapter 1 provided an estimate of the enormous costs assumed by societies and individuals as a result of young, novice driver crashes. For example, it notes that, in 2002, the US government estimated the costs of 15-20 year-olds' crashes at $40.8 billion, not including human costs. In Great Britain, the benefit of preventing a single fatal road crash is estimated to exceed £1 million. For its 1997-2001 road safety programme, the European Commission introduced the "1 million euro test" (EC, 1997), a rough rule of thumb to judge the return on road safety measures. Estimates show that each traffic fatality costs 1 million euros, based on the total costs of 45 billion euros for all crashes in Europe in 1995 (including fatalities, injuries, and material-damage-only crashes) and on 45 000 fatalities in that year. Thus, any measure may be economically justified if it costs less than 1 million euros per fatality prevented. However, these calculations only considered registered crashes and "hard" economic costs, such as medical, production loss, material and settlement costs. Had they taken unregistered crashes and immaterial costs into account, the cost per fatality would likely be 3.6 million euros (ETSC, 1997).

A fundamental point is that resources employed to successfully avoid crashes are better spent than those used to deal with the aftermath of crashes, in terms of medical, legal, police, rehabilitation, funeral, survivor counselling and other costs. Furthermore, as Section 1.5 notes, in economic terms, the "human costs" of crashes, in terms of suffering, pain, etc., are estimated to be 2.3 times greater than the material costs, according to the concept of the Value of Statistical Life. However, clearly, it would never be possible to truly put an economic value on human life and suffering, which makes it all the more worthwhile to invest in preventing crashes, rather than in dealing with the consequences.

Questions regarding the impact of new costs on the underprivileged will also need to be addressed. Governments should ensure that they are aware of the equity impacts of new measures. In the United Kingdom, for example, all new measures are scrutinised from a social inclusion perspective. As part of its proposed improvements to its graduated licensing system, the State of Victoria is proposing a volunteer programme to assist learners in gaining access to accompanied driving experience where they otherwise lack opportunities (VicRoads, 2005).

There is another side to the social equity issue that should also be noted, namely that traffic crashes have been shown to impact disproportionately on the poor (WHO, 2004). Thus, the benefits of road safety measures for the poor, as well as for all of society, should be noted in considering this question.

Stakeholders, such as the insurance industry, can also influence change. As seen in Chapter 3, insurance costs are often higher for young drivers, particularly men. This can be used as a tool to encourage new drivers to participate in risk-reducing initiatives. In Britain, under the PassPlus scheme, newly qualified drivers may take a training course covering those areas where they lack experience, such as driving at night or in adverse weather conditions, and participating insurance companies offer lower insurance premiums to those drivers who complete the course (PassPlus, 2005). As noted above, participants in risk-awareness meetings in Iceland are eligible for reductions in insurance rates. Chapter 4 also notes recent experiments in using insurance premium reductions to induce the inclusion of risk-reducing technology, such as monitoring devices, in vehicles.

Finally, sharing information and learning with other countries and jurisdictions should assist in ensuring that limited resources are targeted to have the greatest possible effect, including by way of reduced research and set-up costs.

6.4. Conclusions

The current high levels of young, novice driver risk are not inevitable. Action can be taken to greatly reduce the gap between the risk levels of young and older drivers. However, as with other road safety measures, these countermeasures will not necessarily be welcomed or immediately accepted by those who will benefit most from them. Thus, the implementation of countermeasures will require a strategic, well-planned approach, based on solid research and effective communication.

The following elements should be considered in taking action to reduce young, novice driver risk:

- The extent of the problem, its costs, and its solutions, must be clearly understood to the greatest extent possible, based on rigorous and independent research.

- The nature of the problem, and the need to act, should be publicly endorsed by high-level decision-makers.

- Stakeholders, and the public in general, need to be informed of the extent of the problem and the costs of inaction. Consideration should be given to assessing the levels of general community support for improvements in young driver safety. Communications efforts should employ social marketing techniques.

- Young driver countermeasures should be closely linked to overall national road safety strategies. Road safety targets and visions will help to ensure ongoing commitment and achievements in this area.

- There needs to be close co-ordination among different areas and levels of government in responding to the problem.

- Stakeholders – including those who are indirectly impacted upon by the problem – and, where possible, the community in general should be sufficiently engaged in consultations regarding any proposed countermeasures. In some instances, stakeholder groups may be the

driving force for change, including influencing opinions at the political level, and may be engaged to assist in the communication and implementation of new measures.

- Countermeasures should be relevant to the situations in which they are introduced. They should be introduced in a manner that is flexible, and phased in where possible. They should be subject to ex-post analysis, which should be compared with prior research and projections, and altered where they are not having desired impacts.

- Consideration should be given to the social equity impacts of measures, and efforts made to reduce any imbalance in their impact.

- Governments should learn from the work of others, and thus decrease the potential costs of developing and implementing new measures.

NOTES

1. A *vision* is defined as "an innovative description of the future traffic system or a desired direction of safety development" (OECD, 2002). Sweden's *Vision Zero*, for example, states that "no one shall be killed or seriously injured in traffic accidents" (cited in Elvik and Vaa, 2004).

2. Australia has set the target of a 40% reduction in road deaths per 100 000 population from 1999 to 2010, and has calculated this based on the expected results of planned measures (Australian Transport Safety Bureau, 2004).

3. Canada's *Road Safety Vision 2010* includes a sub-target of a 20% decrease in the drivers/riders aged 16-19 years killed or seriously injured in crashes in the period 2002-2010 (Transport Canada, 2005).

4. The Western Australia consultation process is described in more detail at: www.officeofroadsafety.wa.gov.au/novicedriverreview/

5. This information was provided by the insurance company in question directly to a member of the working group responsible for this report.

6. Defined as "the design, implementation and control of programmes seeking to increase the acceptability of a social idea, cause or practice in a target group(s). It utilises market segmentation, consumer research, concept development, communication, facilitation incentives and exchange theory to maximise potential target group response." (OECD, 1993)

7. Information provided directly by British government officials.

8. This example is discussed extensively in Section 3.6.

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CHAPTER 7.

YOUNG DRIVERS IN COUNTRIES AT DIFFERENT LEVELS OF MOTORISATION

Abstract

Very little analysis is available examining the question of young driver risk in the context of countries in development, and those that are experiencing rapid economic growth and increasing motorisation. Thus, this chapter examines the question from the general perspective of road safety and economic development. In general, other than in the countries of the Organisation for Economic Co-operation and Development, much of the world is expected to experience growth in traffic fatalities in future years and decades, and this will impact heavily on the young. This includes some non-OECD members of the European Conference of Ministers of Transport.

7.1. Introduction

Much of the data in this report has focused on Organisation for Economic Co-operation and Development (OECD) countries, including European Conference of Ministers of Transport (ECMT) countries that are also OECD member countries, largely because data specifically on young drivers is not available for other countries. However, the challenges with regard to young driver risk are at least as great in countries outside of that group, where they may also be exacerbated by the process of economic development. Unfortunately, very little analysis exists regarding the links between economic growth and young drivers in particular. Thus, in this section we seek to draw conclusions by examining research on the relationship between economic development and traffic fatality risk in general.

In Resolution 57/309 of 22 May 2003, the United Nations General Assembly recognised the existence of a "global road safety crisis", characterised by a rapid global increase in road traffic deaths, injuries and disabilities, a disproportionate fatality rate in developing countries, and the negative impact of road traffic injuries on national and global economies.

7.2. Global Young Driver Risk

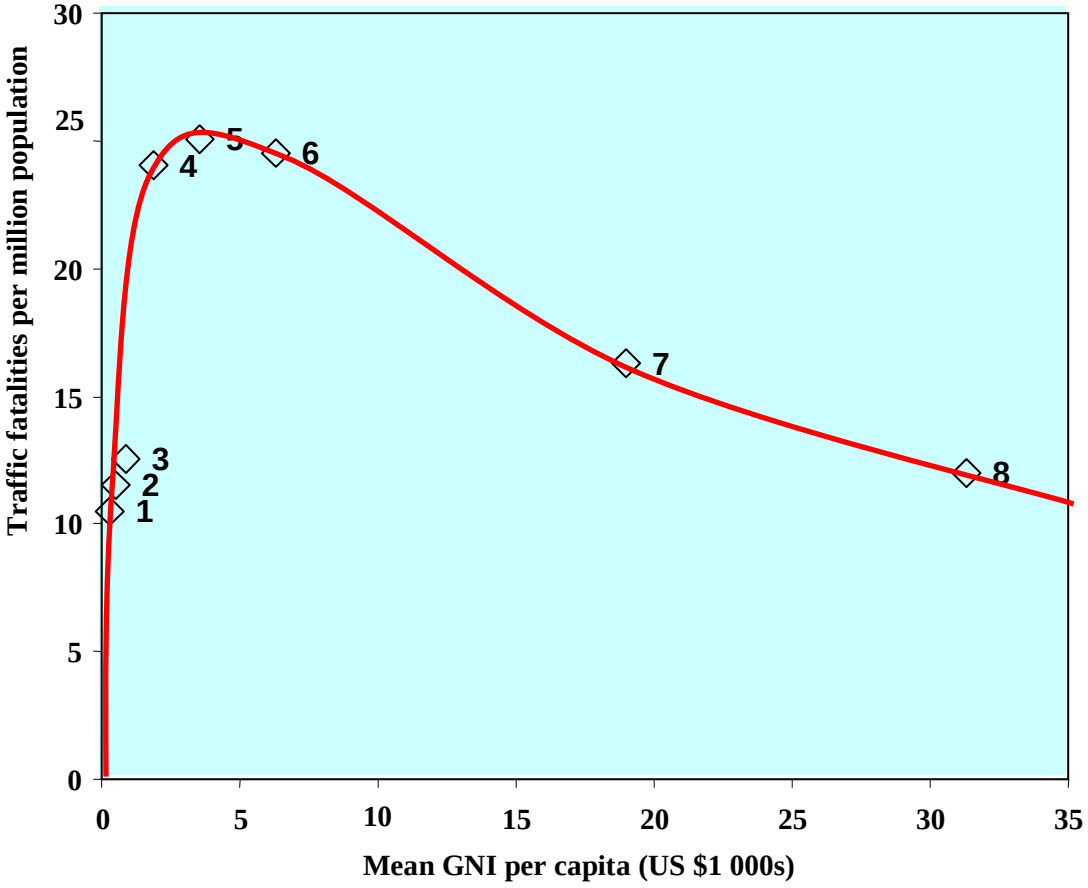
While experts differ on the amounts, it is generally accepted that traffic fatalities per population in future decades will drop steadily in OECD countries, and climb significantly in most other parts of the world. For example, Kopits and Cropper (2005) predict an overall rise in the global road death toll by 66% to 2020, compared to a 28% decline among developed countries alone. This includes a projected 97% increase in China and 147% increase in India. Based on work by Koornstra (2006), the World Business Council on Sustainable Development (WBCSD) (2004) provides several prediction scenarios, whereby fatality levels decline by 40% between 2000 and 2020 in developed countries, while fatality levels increase in developing countries, then decrease at some future point in time depending on rates of motorisation and income growth. It should also be noted that many people in poor countries likely suffer disproportionate economic and social damage as a result of traffic crashes, as they are less likely to have insurance or benefit from a social-safety net that can provide for them and their families in the case of death or injury. Furthermore, the quality of local infrastructure may result in more crashes.

Such figures underscore the importance of the abovementioned UN Resolution, and the ensuing global Road Safety Collaboration, led by the World Health Organization (WHO), which involves various UN agencies, international development banks, national governments, and international non-governmental organisations engaged in road safety (Peden *et al.*, 2004).[1] The OECD and ECMT are partners in this initiative.

Traffic fatality risk (fatalities/population) is a product of the number of vehicles per person and the number of fatalities per vehicle (Kopits and Cropper, 2005). There is an obvious link between an increase in individuals' income levels and the number of vehicles per person. Koornstra discusses the relationship between development and traffic fatality risk, noting that OECD economies are predicted to grow at an average annual rate of 2.0% in the period 2000-2030, while "transition" economies are predicted to grow by an average annual rate of 3.1%, and "developing" economies by 4.1%. Accompanying this growth in transition and developing economies will be an important increase in personal vehicle ownership. Vehicle ownership will grow at a much faster rate in much of Asia, especially China and India, Eastern Europe, the Commonwealth of Independent States and Latin America, in comparison with OECD countries (WBCSD, 2004; Koornstra, 2006).

In most countries, fatality risks per traffic volume are falling. However, in recent decades, vehicle ownership in developed countries has typically increased less than fatalities per vehicle have decreased, leading to an overall drop in traffic fatality risk. In developing countries, the inverse has been true: vehicle ownership has risen more quickly than fatalities per vehicle have fallen (Kopits and Cropper, 2005). Clearly, there is a link between economic growth in less well-off countries and increasing fatality rates.

Figure 7.1. **Relationship of GNI per Capita to Traffic Mortality**



Source: WBCSD (2004)

Fatality risk tends to increase rapidly along with growth in income levels up to a certain level, then decline steadily (WBCSD, 2004; Kopits and Cropper, 2005). In the WBCSD report, Koornstra illustrates this point using Figure 7.1, comparing road deaths per million inhabitants to Gross National Income per capita (GNI/p). The numbers along the curve correspond to categories of countries grouped within ranges of GNI/p, as seen in Table 7.1.

Table 7.1. **Countries Grouped by GNI per Capita**

Group	Countries within the specified category of GNI/p-levels	GNI/p range (1 000 US$)	Mean GNI/p (1 000 US$)	Projected Annual Population Growth 2000-2015
1	Afghanistan; Sub-Saharan, Central-South, and East African countries; Bangladesh; Cambodia; Kyrgyzstan; Laos; Mongolia; Myanmar; Nepal; Tajikistan; Vietnam	< 0.40	0.27	2.36%
2	Cameroon, some CIS countries, Congo, Guinea, Haiti, India, Indonesia, Ivory Coast, Lesotho, Nicaragua, Pakistan, Senegal	0.75 - 0.40	0.49	1.22%
3	Albania, Bolivia, Bosnia/Herzegovina, Cape Verde, China, Egypt, Ecuador, Equ. Guinea, Honduras, Kazakhstan, Morocco, Ocean Islands, Papua New Guinea, Paraguay, Philippines, Sri Lanka, Syria, Swaziland, Turkmenistan	1.50 – 0.75	0.90	0.75%
4	Algeria, Belarus, Colombia, Cuba, many South-Central European countries, Dominican Republic, El Salvador, Guatemala, Jamaica, Jordan, Latvia, Lithuania, Namibia, Oceania Islands, Peru, Russian Federation, Thailand, Tunisia	3.00 – 1.50	1.85	0.69%
5	Brazil, Costa Rica, Estonia, Gabon, Lebanon, Libya, Malaysia, Mauritius, Panama, Poland, Slovakia, South Africa, Chinese Taipei, Turkey, Venezuela	4.50 – 3.00	3.55	1.10%
6	Argentina, Chile, many Central and Eastern European countries, Korea, Mexico, Oman, Saudi Arabia, Uruguay	9.25 – 4.50	6.27	1.07%
7	Australia, Canada, many southern European countries, Israel, New Zealand, United Arab Emirates	24.00 – 9.25	19.02	0.22%
8	Japan, many North-western and Central-western European countries, Hong Kong, Singapore, USA	> 24.00	31.33	0.44%

Source: Adapted from WBCSD, 2004

Various countries within the ECMT are noted as being at a stage where traffic fatality levels can be expected to increase in future. For example, preliminary ECMT (2005) data for 2004 showed a 1.9% increase in traffic fatalities in Central and Eastern Europe over the previous year, including very substantial increases in some countries. Throughout the entire ECMT region, some countries registered increases in fatalities of as high as 11%, 20% or even 30% (ECMT 2005). Kopits and Cropper (2003) have predicted an 18.2% increase to 2020 in the number of traffic fatalities per 100 000 in nine Eastern European and Central Asian countries that are ECMT members, contrasting sharply with the large drop predicted for "high-income" countries.[2] According to Koornstra (2006), the medium-motorised, upper-middle income countries (Category 6 and some of Category 5 in Table 7.1 and Figure 7.1) were expected to have falling traffic fatalities before 2005; in contrast, the traffic fatalities of other upper-middle income countries (some of Category 5) and lower-middle income countries (Category 4, including the Russian Federation) are predicted to start declining, respectively, somewhere before or shortly after 2010.

The overall number of fatalities will obviously also be related to population size. By far the greatest population growth predicted up to 2050 is in Asia, especially India and China, followed by

Africa and Latin America and the Caribbean. An overall drop in population is predicted for Europe (United Nations, 2004). Where young drivers are concerned, the age of the population is also relevant. It is estimated that, in 2000, 18.3% of the population in more developed countries was aged 0-14, compared to 33% in less developed regions (UN, 2004). Thus, there are, in both proportional and absolute terms, far more potential new young, novice drivers in the developing world. Exact numbers are shown in Table 7.2. The proportion of people in this age group is expected to drop in all regions. However, overall numbers of youth will remain very high in those regions expected to experience larger population growth, as noted above.

Table 7.2. **Percentage of Persons Aged 0-14 in Different Regions**

	2000	**2050**
World	30.1	20.1
More Developed Regions	18.3	15.7
Less Developed Regions	33	20.8
Africa	42.7	27.8
Asia	30.4	18.6
Latin America/Caribbean	31.9	18.1
Oceania	25.8	18.1
Northern America	21.6	17.7
Europe	17.5	14.8

Source: UN, 2004

A large part of the explanation for why countries with lower GNI per capita experience higher fatality levels is because of the greater use of two-wheeled vehicles, as well the greater prevalence of pedestrians and cyclists on roadways. Motorcycles and scooters are more economically accessible, and thus may be the first vehicles purchased by persons with increasing incomes.

Kopits and Cropper (2005) conjecture that, at higher levels of income, the drop in the level of traffic fatality levels reflects fewer pedestrians; progressively safer vehicles, including fewer motorcycles and scooters; safer roads; and/or changing attitudes regarding risk. However, there is some indication that, for a short period, there may also be more fatalities associated with increased car use. Table 1.1 in Chapter 1 shows us the relationship between young drivers and young people as a proportion of the population. Those countries where this proportion is lowest are also typically the countries with lower GDP per capita, perhaps indicating less car ownership among younger people.

The most startling example of the impact of increasing motorisation on young drivers is the situation in the former East Germany following reunification, where the traffic death rate per 100 000 for 18-20 year-olds increased 11-fold in 1989-91, compared to the period 1985-9, and eightfold for those aged 21-24. The increase in traffic deaths for all ages was fourfold (Winston *et al.*, 1999). However, it should be noted that this represented a very specific and distinct historic situation.

7.3 Knowledge Transfer to Non-OECD/ECMT Countries

The assessments and findings outlined in this report relate principally to OECD/ECMT member countries. At a global level, the WHO/World Bank's "World Report on Traffic Injury Prevention" indicates that around 1.2 million persons are killed each year and up to 50 million injured. In 2004, road traffic was the ninth leading cause of disease or injury. Unless strong actions are taken, the situation will get much worse, particularly in developing countries. If current trends continue, the WHO expects road traffic will be the 3rd leading cause of disabled adjusted life years lost (an index that combines years of life lost as well as years free from disabilities) from disease or injury in 2020.

In most developing countries around the world, there is little road safety data collection and analysis and, therefore, it is not possible to be specific about the contribution of young drivers to their overall road safety problem. However, given the universality of experience, age and gender factors, all countries need to take concerted and resolute actions to combat young driver-related road traffic crashes, fatalities and serious injuries.

Many of the measures outlined in this report may also be applicable in developing countries. The adoption of a safe transport system approach and the development of policy, legislation and restrictions on speeding and drink-driving, as well as requirements for seat belt wearing – backed by as much enforcement as resources allow – can contribute to preventing the unacceptable global outlook from being realised.

Dissemination of relevant advice from OECD/ECMT countries, including research findings from this Joint Transport Research Centre report, will be valuable and help a wide group of developing countries deal with the major road safety problems they are facing.

7.4 Conclusions

In summary, while the research does not exist to clearly quantify the situation of young drivers in countries in different stages of motorisation, the following overall conclusions can be drawn:

- Most parts of the world will experience less of a decrease in traffic fatalities per inhabitant in future than the OECD countries, and many will experience a substantial increase.
- Any overall trend in road safety will affect young people, and could have a greater effect on young, novice drivers.
- The highest numbers of potential young, novice drivers are in developing countries, especially in Asia.
- Greater research is required regarding the impact of economic development and increased motorisation on young people, including on young drivers.
- Efforts should be made to reduce the impact of road safety risk on people in developing countries, including the young, such as by way of the WHO-led UN Road Safety Collaboration.

Conclusions and Recommendations:

For the foreseeable future, the greatest impact of traffic safety risk on young people may be expected to occur in non-OECD countries, including some that are members of the ECMT. However, relatively little is known about the relationship between economic development, motorisation and young people.

- Co-operate internationally in efforts to reduce the impact of traffic safety on human health, including by way of the World Health Organization-led United Nations Road Safety Collaboration.
- Conduct more research to understand the specific impact of traffic safety on young people in developing and middle-income countries.

NOTES

1. See www.who.int/violence_injury_prevention/road_traffic/en/

2. Kopits and Cropper's list of "high-income" countries includes most OECD countries, and 12 non-OECD members such as Bahamas, Barbados, etc.

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CHAPTER 8.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Abstract

This chapter lists all of the conclusions and recommendations that are presented throughout the previous chapters of the report.

Throughout this report, various specific conclusions and recommendations have been provided in boxes immediately following the discussion of the issues to which they refer. The following is a complete listing of those conclusions and recommendations. In addition, Chapter 5 provides a synopsis of key findings and a suggested strategy for proposed actions, including a prioritisation of how they might be implemented, keeping in mind the primary factors behind young driver risk, and the level of impact, costs and timelines required for each countermeasure.

Recognising the need to take action

The high levels of traffic crash risk of young, novice drivers – especially men – and related fatalities and injuries constitute a serious public health problem. Addressing this risk will be essential to efforts to meet ambitious road safety targets established by governments at the international and international levels, including those of the European Conference of Ministers of Transport.

Understanding the factors behind the problem

While our understanding of the underlying causes of the high levels of young, novice driver risk is extensive, and allows us to reach key conclusions regarding effective countermeasures, there are still some important gaps regarding causal effects between inter-correlated factors.

- Continue to research the causes of young, novice driver risk with a view to designing more effective countermeasures. Areas of particular focus should include:
  - The psychological competencies needed to drive safely (*e.g.* impulse control, self-assessment, etc.).
  - Brain development in the prefrontal cortex.
  - Gender, including the role of testosterone, and whether young women's risk patterns are increasingly resembling those of young men.
  - Emotions.
  - Drugs.
  - Fatigue.

Ensuring high levels of overall road safety

Important road safety benefits for young, novice drivers will likely result from measures aimed at improving the overall safety of a country's road transport system.

- Work to ensure that high standards of road safety are in place, noting, in particular, the important reductions of traffic fatalities that result from effective legislation and enforcement, particularly regarding speed, alcohol, drugs, and seat belts; appropriate driving speeds; state-of-the art injury protection in vehicles; and good standard road infrastructure.
- Ensure that general road safety campaigns focus on the young driver problem by incorporating countermeasures targeting young drivers, and by specifically addressing the circumstances that augment young driver risk by way of enforcement at times when, and in areas where, young drivers are most active.

Considering appropriate driving ages

Particularly before the age of 18, crash risk is inversely correlated with the age at which a driver starts solo driving – the lower the age of solo driving, the higher the crash risk.

- Seriously consider the risk implications of any pressure to lower licensing ages, as well as the implications of unrestricted solo driving before the age of 18.

- Seriously consider raising licensing ages, especially in jurisdictions where solo driving ages are particularly young.

- Encourage young people to contemplate whether they need to obtain licences as soon as they are legally able to, and promote other forms of affordable transport wherever possible.

- Ensure that licensing conditions for motorised two-wheeled vehicles are as strict as for passenger vehicles, in order to avoid migration to less safe modes of transport.

Focussing on the fundamental objectives of training and licensing systems

The fundamental goal of pre-licence training and the licensing process should be to create drivers who are safe, and not just technically competent, by the time they are permitted to drive unsupervised. This will involve instilling novices with an appropriate cognitive skill level and safety-oriented motives. The primary goal of training should *not* be to help novices pass their driving tests.

- Increase focus in pre-licence training on risk-increasing factors and self-evaluation, including on personal motives and the context in which driving is performed.

- Research the benefits of using the GDE Matrix as a basis for developing driver training objectives and testing.

Seeking improvements to formal training processes

At present, there is little evidence of clear safety benefits resulting from formal pre-licence training.

- Conduct science-based research and cost-benefit analysis to better understand the benefits of formal training and to devise means to improve the impact of such training.

- Expand the traditional method of skills-based instruction, whereby the instructor tells the candidate about right and wrong, with methods that engage the candidate personally and emotionally to a larger extent. This is particularly relevant in relation to increasing the “self awareness” of the candidate about his/her difficulties, reactions, etc., with regard to the driving task.

- Ensure that professional driving instructors have the knowledge and pedagogical skills necessary to guide and assist the candidate towards becoming a safe driver – driver trainers should be able to coach and not simply instruct.

Ensuring high levels of experience, via accompanied driving, prior to licensing for solo driving

Training should be conducted in such a manner as to allow young, novice drivers to attain high levels of experience before solo driving.

- Augment formal training by requiring young drivers to attain as much experience as possible before solo driving. While at least 50 hours of pre-licensing practice are recommendable, experience in one country showed that increasing this to about 120 hours reduced crashes in the two years following licensing by approximately 40%.

- Provide accompanying drivers, including parents, with information and advice about how to fulfil their role effectively, and encourage them to provide extensive opportunities for practice. While setting minimum standards for accompanying drivers may be desirable, it should not exclude or discourage people from taking on this role.

Employing advanced training

Training focusing on advanced vehicle skills can have undesirable consequences when applied before the novice has gained sufficient experience.

- Avoid advanced, skill-oriented driver training (*e.g.* skid control, etc.) before the young, novice driver has gained experience as a solo driver.

Improving testing processes

Based on existing knowledge, driving tests are currently unable to accurately discriminate between those drivers who will be safe and unsafe once they start solo driving, although they remain essential as a means of ensuring that novice drivers have essential, basic competencies.

- Conduct science-based research focussed on increasing the ability of driver tests to identify unsafe drivers, as well as on the effectiveness of hazard perception tests.

- Ensure that driving tests are free of all corruption.

Ensuring consistency in all elements of the licensing system

The content and form of the licensing system should be consistent at all levels and based on knowledge of, and insight into factors influencing driving behaviour and crash risk.

- Ensure that the three key elements of licensing (training objectives, training and tests) reinforce one another, and that the essence of each is reflected in the other parts. Test content should be varied and cover all possible aspects of the training objectives. Aspects of the training objectives that cannot be tested should be obligatory elements within training.

Reducing exposure to risk immediately following licensing for solo driving

The greatest risk faced by young, novice drivers is in the period immediately following licensing for solo driving.

- In the period immediately following licensing, impose protective restrictions that limit the level of risk to which young, novice drivers are exposed, and lift these progressively as the drivers obtain skills and experience. Under any system, subject young, novice drivers to a specific BAC limit of a maximum of 0.2 g/l. Limits on driving with peer passengers and/or at night have also shown themselves to be beneficial.

Promoting safe attitudes from an early age

Fundamental attitudes regarding road safety are established in early adolescence, and can be difficult to alter at a later stage.

- Pursue educational programmes and campaigns at an early stage, well before young people actually start driving, to actively encourage children to adopt safe attitudes towards driving.

Ensuring effective legislation and enforcement

Effective legislation and enforcement are fundamental to ensuring the effectiveness and legitimacy of the licensing process, and to reduce young driver risks.

- Strictly enforce safety laws and regulations, including those regarding speed, seat belt use, alcohol, drugs and vehicle safety, focusing particularly on those areas where young drivers are over-represented.

- Ensure strict compliance with the protective measures imposed by the licensing system, such as alcohol, passenger and night-time restrictions.

- Focus police enforcement of drink-driving laws on random breath-testing, targeting times and locations where and when high proportions of impaired drivers might be expected (*e.g.* near bars, discos and leisure areas), and ensure the application of tough penalties for breaking drink-driving rules.

- Conduct research to enhance technologies for the detection of drugs and for measuring the impact of both legal and illicit drug use on driving ability.

- Ensure the existence of an appropriate legal frameworks for dealing with drug-driving.

Providing appropriate incentives and disincentives

Incentives and disincentives can have an important impact on young, novice drivers' behaviour.

- Support other countermeasures with specialised demerit point systems for young, novice drivers that provide a concrete disincentive to inappropriate driving behaviour and non-compliance with driving laws and licensing regulations.

- Working with the insurance industry, conduct more research into the potential benefits of economic incentives by way of automobile insurance.

Communicating persuasively

Persuasive communications campaigns should be employed in combination with other countermeasures, as a means of positively changing attitudes towards safe driving.

- Develop targeted road safety campaigns, combining the resources, efforts and expertise of government and non-governmental agencies, and in consultation with young people themselves.
- Apply these campaigns in conjunction with other initiatives, such as enforcement and legislations.
- Ensure ongoing evaluation and improvement of these campaigns.

Engaging parents and other role models

Parents and other adult role models have an important role to play in reducing young driver risk, including in guiding initial driving experience.

- Proactively inform parents about the degree of risk associated with their children's first driving experience, and provide them with information and guidelines that can help them to participate in reducing that risk.
- Explore and evaluate initiatives aimed at changing adults' attitudes regarding road safety, including by means of education, publicity and enforcement, reinforcing the message that their behaviour will have an important impact on their children's future driving and safety.

Considering the benefits of informal social controls

Governments and civil society should co-operate in taking a holistic approach to preventing drink-driving and drug-driving by young drivers, focusing on both formal and informal social controls.

- Strictly enforce existing laws limiting young people's access to alcohol, and consider the positive road safety impacts of strengthening such laws.
- Stringently enforce drink and drug-driving laws, including by way of random breath testing.
- Accompany such enforcement campaigns with information or publicity aimed at modifying the beliefs and values associated with drink and drug-driving.
- Publicise the dangers of drink and drug-driving in places where young people are likely to see it (*e.g.* schools, discos, the Internet, etc.), and in a manner that they are likely to relate to. Ensure that media campaigns accompany and explain law enforcement initiatives, and target parents, peers and social hosts, as well as drivers.
- Train persons serving and selling alcohol to intervene to prevent underage and excessive drinking.
- Encourage co-operation between different areas of government and members of the community to establish programmes aimed at discouraging alcohol and drug abuse by young people.
- Ensure the availability of alternative transport for young people, where they are likely to be drinking.

Understanding the impact of popular media on road safety attitudes

Little is known about the impact of popular media on young drivers' safety-related attitudes and driving behaviour.

- Conduct research regarding the impact of popular media on young, novice driver risk, including advertising, films, television and video games, and on the impact of voluntary codes of practice for advertising.

Recognising and addressing the problem of young male drivers

The particular over-representation of young males in crash statistics – both in absolute terms and based on adjustments for exposure – needs to be recognised as a serious public health problem, and dealt with in a proactive manner.

- Conduct more research aimed at finding effective approaches to target high-risk groups, particularly young male drivers.

- Place particular emphasis on implementing countermeasures that have been shown to be successful in reducing young, male driver risk.

Considering the impact of non-road safety public policy decisions

Non-road safety policies, such as the existence of an effective public transit system or reduced fares for young users, can have an important impact in changing young, novice drivers' travel patterns, mileage and risks.

- Factor the road safety implications, including the impact on young road users, into consideration of non-road safety legislative, policy and regulatory initiatives.

Exploiting the benefits of new technologies

Certain technological applications have great potential to reduce young driver risk. However, greater knowledge and understanding is required in this area.

- Research the potential value of technological countermeasures in reducing young, novice driver risk, including speed limitation or harmonising systems, black boxes, alco-locks, smart cards, and intelligent protective systems.

- Consider the implications of such technology for driver training, to ensure that novice drivers are prepared to safely use new technologies.

- Note that simulators are not a substitute for practical experience gained under protective conditions, and that they should be employed as an adjunct to, and not replacement for, other training methods. Continue research aimed at improving the usefulness of simulators as a training tool.

- Explore possibilities to better exploit the benefits of e-learning as part of driver training.

Collaborating to assist countries at different levels of road safety performance, motorisation and development

For the foreseeable future, the greatest impact of traffic safety risk on young people may be expected to occur in non-OECD countries, including some that are members of the ECMT. However, little is known about the relationship between economic development, motorisation and young people.

- Co-operate internationally in efforts to reduce the impact of traffic safety on human health, including by way of the World Health Organization-led United Nations Road Safety Collaboration.

- Conduct more research to understand the specific impact of traffic safety risk on young people in developing and middle-income countries.

ANNEX A.

DRIVER LICENSING SYSTEMS AROUND THE WORLD

The purpose of the tables in this annex is to give a descriptive overview of the content and structure of licensing systems in different countries. The tables are based on information from publicly available sources (see list of references below), and input from working group members and other experts on young driver issues. The licensing systems are not listed in any order of priority and the tables have been made with no intention to recommend any particular system. Obviously, these systems are subject to ongoing change, and readers interested in the most up-to-date information regarding licensing in a given jurisdiction should consult local authorities.

In Chapter 3 a distinction was made between (1) "traditional" licensing systems (*i.e.* licensing systems with one training phase), (2) two-phase licensing systems, and (3) graduated licensing (GDL) systems. The following tables list countries employing each system. Generally, traditional licensing systems are widely used in Europe. Two-phase licensing systems are used in a few European countries, such as Austria, Finland, Germany Luxembourg and Switzerland. GDL systems are widely used in Australia, Canada, New Zealand and the United States.

The tables describe elements of licensing systems, such as age limits (*i.e.* minimum age to start learning, minimum full licensing age, etc.), the use of supervised practice, restrictions on learner drivers, restrictions on lay instructors, the use of a probationary licence, and the use of a probationary period. Information about mandatory training units is also included.

The content of each table is described below.

Table A1 shows European countries using traditional single-phase licensing systems. In some of these countries a probationary licence or period is also part of the system, and this is noted in the table. For example, in Great Britain the novice starts with a full licence, which can be taken away if the terms of the probationary period are not met. Similarly, in Denmark the penalty for violation of certain traffic laws is greater during the probationary period.

Table A2 shows one Asian country using the traditional single-phase licensing system.

Table A3 shows European countries using a two-phase licensing system.

Tables A4 -A7 show US jurisdictions using GDL systems. Clearly, many variations of GDL exist. These tables organise the different systems according to a categorisation provided by the Insurance Institute for Highway Safety (www.iihs.org/laws/state_laws/grad_license.html), in which systems are classified as good, fair, marginal or poor. Generally the categorisation is based on an assignment of points. Systems classified as "good" scored 6 or more points; those considered "fair" scored 4 or 5 points; "marginal" 2 or 3 points; and "poor" less than 2 points. However, age-related

aspects such as unrestricted licence age were also included in the categorisation. The points were assigned based on the following:

Learner's entry age:	1 point for a learner's entry age of 16.
Learner's holding period:	2 points for 6 months or less, 1 point for 3-5 months, none for less than 3 months.
Practice driving certificate:	1 point for 30 hours or more; none for less than 30 hours.
Night driving restriction:	2 points for restrictions beginning at 9 or 10 p.m., 1 point for after 10 p.m.
Passenger restriction:	2 points for allowing only one or fewer underage passenger, 1 for a maximum of 2 passengers, none for 3 passengers.
Driver education:	Where completion of driver education changed a requirement, point values were determined for the driver education track.
Duration restrictions:	1 point if the difference between minimum unrestricted licensing age and minimum intermediate licensing age is 12 or more months; night driving and passenger restrictions were valued independently.

The difference between the different categories is the number and potential safety impact of the elements included. Thus, the systems categorised as "poor" have close to no GDL elements included, whereas the systems categorised as "good" include several and different kinds of driver restrictions. These labels are intended as an expression of the relative safety benefits expected from each GDL system analysed by Williams and Mayhew (2004) and the Insurance Institute for Highway Safe (2006). In other words, "good" indicates that a system is among the better GDL systems in the US; however, even the good systems can be improved in accordance with the general recommendations introduced in Chapter 3. Notably, these classifications do not represent the views of the OECD, ECMT or the working group that developed this report.

The descriptions of US GDL systems include no discussion of BAC restrictions as part of the licensing process. However, it should be noted that all US states have "zero tolerance" laws, meaning that the BAC level must be 0.2 g/l or less for drivers under 21 years-old. While most states have the limit set at 0.2 g/l, 12 have it at zero, and two have it at 0.1.

Table A8 shows GDL systems used in Canada.

Table A9 shows the GDL system used in New Zealand.

Tables A*10 - A12* show GDL systems used in Australia.

When examining these tables, the following clarifications should be noted:

- A direct comparison of specific elements of the licensing systems in different countries is difficult because of general differences between the systems. For example, when comparing the mandatory training units in different countries it is also important to consider the use of supervised practice, etc., in order to get full a insight into the amount of driving experience offered in the different licensing systems.

- It has not been possible to make a detailed comparison of curricula in different countries. Thus, only a general distinction between driving theory and practice is provided. *Driving theory* refers to in-class training dealing with subjects such as traffic regulations, risk-awareness and high-risk situations in traffic. *Practice* refers to behind-the-wheel training on a training ground and in real traffic in different situations.

- Where countries are listed more than once in the same table it is because young, novice drivers can choose between different driver education programmes.

- Where spaces are left blank, it is because there is no requirement. N/I is used where information is not available.

- Where a specific number of years and months are required (*e.g.* 17 years and six months), this is shown in the Tables using an abbreviated formulation (*e.g.*"17 and 6 months").

Table A1. **Traditional Single-phase Licensing Systems, Europe**

Country	Min. age to start learning	Min. age for probationary licence	Min. age for full licence	Accompanied driving	Restrictions on learner driver	Restrictions on accompanying lay person	Probationary period and conditions	Mandatory training units	
								Theory (hours)	Practice (hours)
Czech Republic	N/I	N/I	18	N/I	N/I	No lay instructor admitted.	N/I	36	34 28 hours of driving. 6 hours of first aid and basic vehicle maintenance.
Denmark	17 and 6 mths	18 Full licence with probationary conditions during a minimum period of three years.	18	No Practical driving school lessons only.	Driving in traffic during driving school lessons only.	No lay instructor admitted.	3 years	22 (28 lessons of 45 min.) This is a minimum. More lessons are recommended.	18 (24 lessons of 45 min.) This is a minimum. More lessons are recommended.
France (a) Accompanied driving	16	No probationary licence. Full licence issued on passing the practical test.	18	Yes	"A" Plates. Max. 110/100 km/h on motorways. Max. 80 km/h on secondary roads.	28 years-old Full licence for 3 years.	-	N/I	N/I
France (b)	18	No probationary licence. Full licence issued on passing the practical test.	18	No	Driving in traffic during driving school lessons only.	No lay instructor admitted.	-	N/I	N/I
Germany (a) Ordinary form of driver training and licensing. Valid in all 16 federal states.	17 and 5 months	18 Full licence with probationary conditions during a minimum period of two years.	20	No Practical driving school lessons only.	Driving in traffic during driving school lessons only.	No lay instructor admitted.	2 years minimum, can be prolonged to 4 years. Full licence with probationary conditions.	28 Pre-licence training only.	*Pre-licence training only*: Basic training: number of practical hours after the decision of the driving teacher. 12 special drives of 1 hour each.

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Table A1. **Traditional Single-phase Licensing Systems, Europe**

Country	Min. age to start learning	Min. age for probationary licence	Min. age for full licence	Accompanied driving	Restrictions on learner driver	Restrictions on accompanying lay person	Probationary period and conditions	Mandatory training units	
								Theory (hours)	Practice (hours)
Germany (b) Accompanied driving from the age of 17. Valid in 12 of 16 federal states.	16 and 5 mths Lowered age limit for starting driver education	17 a) Lowered age limit for licensure. b) Full licence with probationary conditions during a minimum period of two years.	19	Yes *Before licensure:* practical driving school lessons only. *From licensure up to the age of 18:* accompanied driving	*Before licensure:* Driving in traffic only during driving school lessons. *From licensure up to the age of 18:* Driving in traffic only under (lay) supervision.	Lay instructor has only supervising, but no instructional functions. - Minimum age 30. - Licence for 5 years. - Maximum 3 penalty points. - Maximum BAC 0.5 g/l.	2 years minimum, can be prolonged to 4 years.	28 (Pre-licence training) N/I (Post-licence training)	*Pre-licence training:* Basic training: number of practical hours decided by the driving teacher. - 12 special drives of 1 hour each. *Post-licence training:* - Up to 1 year lay supervised training in real traffic.
Great Britain	17	No probationary licence. Full licence issued on passing the practical test.	17	Yes	"L" plates No driving on motorways.	21 years-old Full licence for 3 years.	2 years	0	0
Greece	18	N/I	N/I	Yes	N/I	N/I	N/I	20	10
Iceland	16	17	19	Optional	N/I	24 years-old. Full licence for 5 years Lay instructor must be approved by the police.	2 years	18	12
Luxembourg (a)	17 and 6 mths	-	18	Not permitted.	N/I	N/I	N/I	16	12
Netherlands	18	N/I	18	No Practical driving school lessons only.	Driving in traffic during driving school lessons only.	Dual brake pedal.	5 years BAC-limit 0.2 g/l.	0	0
Norway	16	N/I	18	Optional	"L" plates Learner must have completed mandatory course in Basic Traffic Knowledge.	25 years-old. Full licence for 5 years.	2 years	21	15

Table A1. **Traditional Single-phase Licensing Systems, Europe**

Country	Min. age to start learning	Min. age for probationary licence	Min. age for full licence	Accompanied driving	Restrictions on learner driver	Restrictions on accompanying lay person	Probationary period and conditions	Mandatory training units	
								Theory (hours)	Practice (hours)
Poland	16	18	N/I	Yes	N/I	Age, non-penalty record, participation in training.	2 years	N/I	N/I
Sweden	16	N/I	18	Optional	Learners permit	24 years-old. Full licence 5 years. Supervisors permit.	2 years	N/I	N/I

Table A2. **Traditional Single-phase Licensing Systems, Asia**

Country	Min. age to start learning	Min. age for probationary licence	Min. age for full licence	Supervised practice	Restrictions on learner driver	Restrictions on lay instructor	Probationary licence	Probation period	Mandatory training units	
									Theory (hours)	Practice (hours)
Korea	18	-	18	Optional	-	-	No	-	25	10

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Table A3. **Two-phase Licensing Systems, Europe**

Country	Practice (hours)						Second phase					
	Min. age to start learning	Mandatory training units		Accompanied driving	Restrictions on learner driver	Restrictions on lay instructor	Min. age for probationary licence	Probation period	Restrictions on learner driver	Mandatory training units		Min. age for full licensing
		Theory (hours)	Practice (hours)							Theory (hours)	Practice (hours)	
Austria (a) Accompanied driving "L17"	16	2.5	5.8	yes	Driving experience: 3 000 kms. BAC 0.1 g/l Medical fitness. First Aid course (8 hours)	Full licence for 7 years. No serious traffic offences in the last 3 years. Practical driving experience in the last 3 years. Close, personal relationship to candidate.	17	2 years, starting at 18.	No convictions for certain traffic violations.	3 units (50 min. each) Track training 1 unit; Psychological group discussion 2 units.	7 units (50 min. each) Track training 5 units, Feedback drives 2 units.	20
Austria (b)	17 and 6 mths	2.5	7.5	Optional (Replaces 6 hours practical training)	BAC 0.1 g/l Medical fitness. First Aid course (8 hours).	Full licence for 7 years. No serious traffic offences in the last 3 years. Practical driving experience in the last 3 years.	18	2 years, starting at 18	No convictions for certain traffic violations.	3 units (50 min. each) track training 1 unit; psychological group discussion 2 units.	9 units (50 min. each) track training 5 units, feedback drives 4 units..	20
Finland	17 and 6 mths	20	15	Optional	None	Family Full licence for 3 years. Dual brake pedal.	18	2 years	Probationary conditions. Stricter conditions for the novice driver (for 2 years).	4	4	20

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Table A3. **Two-phase Licensing Systems, Europe**

Country	Practice (hours)						Second phase					
	Min. age to start learning	Mandatory training units		Accompanied driving	Restrictions on learner driver	Restrictions on lay instructor	Min. age for probationary licence	Probation period	Restrictions on learner driver	Mandatory training units		Min. age for full licensing
		Theory (hours)	Practice (hours)							Theory (hours)	Practice (hours)	
Germany (c) Second-phase model Additional post licence training course of 10.5 hours, 6-12 months after licensure Voluntary Valid in 13 of 16 federal states	17 and 5 mths	28	Number of hours is decided by the driving teacher. Plus: 12 special drives of 1 hour each.	No Practical driving school lessons only.	Driving in traffic during driving school lessons only.	No lay instructor involved.	18 Full licence with probationary conditions during a minimum period of one year.	1 year minimum, can be prolonged to 3 years.	Probationary conditions. Obligatory driver improvement courses for drivers committing offences.	6 (Three group discussions)	4,5 (Track training and feedback drive)	19 Expiry of probationary conditions after one year instead of two years: bonus for participation in the voluntary second-phase driver training.
Luxembourg (b)	17	12	16	Optional	Learners permit. No trailers in tow. Max. 75 km/h on secondary roads. Max. 90 km/h on motorways. No driving 11 p.m. - 6 a.m.	Full licence for 6 years. Supervised by authorised. Instructor for 2 hours. Special permit. No traffic offences. Dual brake pedal. Identity card valid for training period.	N/I	2 years	Max. 75 km/h on secondary roads. Max. 90 km/h on motorways.	One day with a combination of theory and practice. Also includes skid training.		N/I

Table A4. **Graduated Licensing: United States – "Good" Systems**

Learner Stage (Learners' licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May Be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Minimum hours of supervised driving**	**Restrictions**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
Alaska	14	6	40 - 10 of which must be at night or in inclement weather.	-	16	1 a.m. – 5 a.m.	First 6 mos.: No passengers.	16,6	16,6
California	15 and 6 mths	6	50 – 10 of which must be at night	-	16	11 p.m. – 5 a.m.	First 12 mos.: No passengers <20 (except immediate family).	17	17
Colorado	15	12	50 – 10 of which must be at night.	The driver may not use a mobile phone (learner stage).	16	Midnight – 5 a.m.	First 6 mos.: No passengers Second 6 mos.: Max. 1 passenger	17	17
Connecticut	16	6 (4 with driver education)	Up to 20 hours.	The driver may not use a mobile phone (learner stage and intermediate stage).	16,4	Midnight – 5 a.m.	First 3 mos.: Only a parent if a supervisor is present. Second 3 mos.: No passengers (except immediate family).	18	16,10
District of Columbia	16	6	Learner's stage: 40 Intermediate stage: 10 at night.	The driver may not use a mobile phone (learner stage).	16,6	11/12 a.m. – 6 a.m.	First 6 mos.: No passengers. Thereafter max. 2 passengers.	18	18
Georgia	15	12	40 - 6 of which must be at night.	-	16	Midnight – 6 a.m.	First 6 mos.: No passengers. Second 6 mos.: Max. 1 passenger <21. Thereafter max. 3 passengers.	18	18
Hawaii	15 and 6 mths	6	-	-	16	11 p.m. – 5 a.m.	Max. 1 passenger <18 (household members exempted).	17	17

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Table A4. **Graduated Licensing: United States – "Good" Systems**

Learner Stage (Learners' licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May Be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Minimum hours of supervised driving**	**Restrictions**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
Illinois	15	3	50 – 10 of which must be at night.	The driver may not use a mobile phone (learner stage and intermediate stage).	-	11/12 p.m. – 6 a.m.	First 6 mos.: Max. 1 passenger <20	17	16,6
Kentucky	16	6	60 – 10 of which must be at night.	-	16,6	Midnight – 6 a.m.	Max. 1 passenger <20 unless supervised by a driving instructor.	17	17
Maine	15	6	35 – 5 of which must be at night.	The driver may not use a mobile phone (learner and intermediate stage).	16	Midnight – 5 a.m.	First 180 days: No passengers.	16,6	16,6
Maryland	15 and 6 mths	6	60 – 10 of which must be at night.	The driver may not use a mobile phone (learner and intermediate stage).	16,3	Midnight – 5 a.m.	First 5 mos.: No passengers <18.	17,9	16,8
Massachusetts	16	6	12	-	16,6	Midnight – 5 a.m.	First 6 mos.: No passengers <18.	18	17
Missouri	15	6	20	-	16	1 a.m. – 5 a.m.	First 6 mos.: Max. 1 passenger <19. Thereafter: Max. 3 passengers <19.	17, 11 mos.	17, 11 mos.
Nevada	15 and 6 mths	6	50 – 10 of which must be at night	-	16	10 p.m. – 5 a.m.	First 3 mos.: No passengers <18.	18	16,3
New Jersey	16	6	-	The driver may not use a mobile phone (learner and intermediate stage).	17	Midnight – 5 a.m.	Max. 1 passenger (household members excepted).	18	18

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Table A4. **Graduated Licensing: United States – "Good" Systems**

Learner Stage (Learners' licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May Be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Minimum hours of supervised driving**	**Restrictions**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
New York	16	Up to 6	20	-	16,6	9 p.m. – 5 a.m.	Max. 2 passengers <21.	17 (18 without driver education)	17 (18 without driver education)
North Carolina	15	12	-	-	16	9 p.m. – 5 a.m.	Max. 1 passenger <21 (family members exempted).	16,6	16,6
Oklahoma	15 and 6 mths	6	40 – 10 of which must be at night.	-	16	11 p.m. – 5 a.m.	Max. 1 passenger (household members excepted).	16,6 (17 without driver education).	16,6 (17 without driver education).
Oregon	15	6	50 (100 without driver education).	-	16	Midnight – 5 a.m.	First 6 mos.: No passengers <20. Second 6 mos.: Max. 3 passengers <20.	17	17
Pennsylvania	16	6	50	-	16,6	11 p.m. – 5 a.m.	-	17 (18 without driver education).	-
Rhode Island	16	6	50 – 10 of which must be at night.	Drivers <18 may not use a mobile phone	16,6	1 a.m. – 5 a.m.	First 12 mos.: Max. 1 passenger <21.	17,6	17,6
Tennessee	15	6	50 - 10 of which must be at night.	-	16	11 p.m. – 6 a.m.	Max. 1 passenger	17	17
Utah	15	6	40 – 10 of which must be at night.	-	16	Midnight – 5 a.m.	First 6 mos.: No passengers	17	16,6
Virginia	15 and 6 mths	9	40 - 10 of which must be at night.	-	16,3	Midnight – 4 a.m.	First 12 mos.: Max. 1 passenger <18. Thereafter: Max. 3 passengers <18.	18	18
Washington	15	6	50 - 10 of which must be at night.	-	16	1 a.m. – 5 a.m.	First 6 mos.: No passengers <20. Second 6 mos.: Max. 3 passengers <20.	17	17
Wisconsin	15 and 6 mths	6	30 – 10 of which must be at night.	-	16	Midnight – 5 a.m.	Max. 1 passenger.	16,9	16,9

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Table A5. **Graduated Licensing US: "Fair" Systems**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Minimum hours of supervised driving**	**Restrictions on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
Alabama	15	6	30 (none with driver education).	-	16	Midnight – 6 a.m.	Max. 3 passengers (parents and guardians excepted).	17	17
Delaware	15 and 10 mths	6	-	The driver may not use a mobile phone (learner and intermediate stage).	16,4	10 p.m. – 6 a.m.	Max. 2 passengers.	16,10	16,10
Florida	15	12	50 - 10 of which must be at night.	-	16	11 p.m. – 6 a.m. (age 16) 1 a.m. – 5 a.m. (age 17).	-	18	-
Indiana	15	2	-	-	16,1	11 p.m./1 a.m. – 5 a.m.	First 90 days: No passengers.	18	16,4
Iowa	14	6	20 - 2 of which must be at night.	-	16	12.30 a.m. – 5 a.m.	-	17	-
Louisiana	15	6	-	-	16	11 p.m. – 5 a.m.	-	17	-
Michigan	14 and 9 mths	6	50 - 10 of which must be at night.	-	16	Midnight – 5 a.m.	-	17	-
New Hampshire	15 and 6 mths	-	20	-	16	1 a.m. – 5 a.m.	First 6 mos.: Max. 1 passenger <25.	17,1	16,6
Ohio	15 and 6 mths	6	50 - 10 of which must be at night.	-	16	1 a.m. – 5 a.m.	-	17	-
Texas	15	6	-	-	16	Midnight – 5 a.m.	Max. 1 passenger <21.	16,6	16,6
Vermont	15	12	40 - 10 of which must be at night.	-	16	None	First 3 mos.: No passengers Second 3 mos.: No passengers (family members excepted).	-	16,6
West Virginia	15	6	30 (none with driver education).	The driver may not use a mobile phone (in learner and intermediate stages).	16	11 p.m. - 5 a.m.	Max. 3 passengers <19.	17	17
Wyoming	15	10 days	50 (10 of which must be at night).	-	16	11 p.m. - 5 a.m.	Max. 1 passengers <18.	16,6	16,6

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Table A6. **Graduated Licensing US: "Marginal" Systems**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Minimum hours of supervised driving**	**Restrictions on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
Arkansas	14	6	-	-	16	Unsupervised driving prohibited.	Not allowed under 18.	-	-
Idaho	14 and 6 mths	4	50 – 10 of which must be at night.	-	15	Sunset - sunrise	-	16	-
Kansas	14	6	50 – 10 of which must be at night.	-	There is no intermediate stage.			-	-
Minnesota	15	6	30 – 10 of which must be at night.	The driver may not use a mobile phone.	A provisional licence may be granted at 16. Only restriction: a provisional driver may not drive if a passenger <18 is unbelted. Minimum full licence age is 17.			-	-
Mississippi	15	6	-	-	15,6	10 p.m. – 6 a.m.	-	16	-
Montana	14 and 6 mths	6	50 – 10 of which must be at night.	-	15	11 p.m. – 5 a.m.	First 6 mos.: Max. 1 passenger <18. Second 6 mos.: Max. 3 passengers <18.	16	16
Nebraska	15	-	50 (none with driver education).	-	16	Midnight – 6 a.m.	-	17	-
New Mexico	15	6	50 – 10 of which must be at night.	-	15,6	Midnight – 5 a.m.	Max. 1 passenger <21.	16,6	16,6
North Dakota	14	6	-	-	There is no intermediate stage. The minimum licence age is 16.			-	-
South Carolina	15	6	40 – 10 of which must be at night.	-	15,6	6/8 p.m. – 6 a.m.	Max. 2 passengers < 21 (exceptions: family members and driving students to and from school).	16,6	16,6
South Dakota	14	6 (3 with driver education).	-	-	14,6 (14,3 with driver education).	10 p.m. – 6 a.m.	-	16	-

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Table A7. **Graduated Licensing: US – "Poor" Systems**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)			Minimum Age at Which Restrictions May be Lifted	
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restriction on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night-time restriction**	**Passenger restriction**
Arizona	15 and 7 mths	5	25 – 5 of which must be at night (none with driver education).	-	There is no intermediate stage. Minimum licence age is 16.			-	-

Table A8. **Graduated Licensing: Canada**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)				Minimum Age at Which Restrictions May be Lifted		
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restriction on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Alcohol**	**Night-time restriction**	**Passenger restriction**	**Alcohol**
Alberta	14	12	-	0.0 g/l BAC. No driving between midnight and 5 am. Maximum of 8 demerit points instead of 15.	16 Maximum of 8 instead of 15 demerit points.	-		0.0 g/l BAC	-	-	18
British Columbia	16	12 (9 with driver education).	-	0.0 g/l BAC. No driving between midnight and 5 am. No more than 2 passengers, including supervisor. L plate mandatory. Only 6 demerit points allowed, instead of 19.	16,9 N plate mandatory.	-	Max. 1 passenger, unless accompanied by a supervisor.	0.0 g/l BAC	-	18,9	18,9
Manitoba	16 or 15 and 6 mths if enrolled in high school driver education programme.	9	-	0.0 g/l BAC	16,3	-	Midnight – 5 a.m. max. 1 passenger unless supervised.	0.0 g/l BAC restriction.	-	17,6	18,6 (includes the first year after full licensing).

Table A8. **Graduated Licensing: Canada**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)				Minimum Age at Which Restrictions May be Lifted		
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restriction on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Alcohol**	**Night-time restriction**	**Passenger restriction**	**Alcohol**
Newfoundland and Labrador	16	12 (8 with driver education)	-	0.0 g/l BAC. No driving between midnight and 5 am. No passenger except supervisor. Parent or guardian may accompany if a qualified instructor is also in the car. Maximum 6 instead of 12 demerit points.	16,8 Maximum 6 instead of 12 demerit points.	Midnight – 5 a.m.	-	0.0 g/l BAC	17,8	-	17,8
Nova Scotia	16	6 (3 with driver education)	-	0.0 g/l BAC. No passengers except the supervisor. Lower demerit points.	16,6 or 16,3 with an approved driver training course. Lower demerit points.	Midnight – 5 a.m.	-	0.0 g/l BAC	18,3	-	18,3
New Brunswick	16	12	-	-	17, or 16,4 with an approved driver education course.	-		0.0 g/l BAC	-	-	18, 4 (After 12 months. with restricted licence).
Northwest Territories	15	12	-	0.0 g/l BAC. Lower demerit point threshold.	16	-		0.0 g/l BAC	-	-	17
Nunavut	15	-	-	-	There is no intermediate stage. The minimum licensing age is 16.				-	-	-
Ontario	16	12 (8 with driver education)	-	0.0 g/l BAC. No driving on motorways except with a licensed instructor. 9 instead of 15 demerit points.	16,8	Between midnight and 5 am, unsupervised drivers under 19 cannot carry passengers under 19 for the first 6 months., and drivers under 20 can carry no more than 3 passengers under 19.		0.0 g/l BAC	See description in previous column.		17,8

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Table A8. **Graduated Licensing: Canada**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)				Minimum Age at Which Restrictions May be Lifted		
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restriction on learner driver**	**Minimum age**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Alcohol**	**Night-time restriction**	**Passenger restriction**	**Alcohol**
Prince Edward Island	16 or 15 and6 mths if enrolled in a driver education programme	180 days	-	0.0 g/l BAC. No passengers except family members. 6 instead of 12 demerit points.	16	-	Max. 3 passengers in first year.	0.0 g/l BAC	-	17 (first year in the intermediate stage)	18
Quebec	16	12 (8 with driver education)	-	0.0 g/l BAC. Maximum 4 instead of 15 points.	16,8 Maximum 4 instead of 15 demerit points. This restriction also lasts for 2 years, or until age 25, whichever comes first.	-	-	0.0 g/l BAC	-		18,8 (2 years or age 25, whichever comes first.)
Saskatchewan	16, or 15 if the applicant has completed a high school driver education programme.	9	Supervising driver cannot be a novice.	0.0 g/l BAC. Only immediate family members can be passengers.	16	Two stages: *Novice 1:* Lasts for 6 months. Only 1 passenger allowed, other than immediate family members. 0.0 g/l BAC. *Novice 2:* Lasts for 12 months plus 12 additional months free from at-fault collisions, convictions and suspensions. 0.0 g/l BAC.			16,6	16,6	17,6
Yukon	15	6	50 – of which 10 must be in darkness and 10 in winter conditions.	0.0 g/l BAC. 7 instead of 15 demerit points. L plate mandatory. Maximum 1 passenger.	16 7 instead of 15 demerit points.	Midnight – 5 a.m.	Max. 1 passenger <13 and 1 passenger aged 12 – 20, unless a supervisor older than 20 is present.	0.0 g/l BAC	17,6	17,6	17,6

Table A9. **Graduated Licensing – New Zealand**

Learner Stage (Learners licence)					Intermediate Stage (Restricted licence)				Minimum Age at which Restrictions May be Lifted	
Country	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restrictions on learner driver**	**Min. age**	**Mandatory holding period (months)**	**Unsupervised driving prohibited**	**Passenger Restriction**	**Night time restriction**	**Passenger restriction**
New Zealand	15	6 (3 if completing driving course)	None	"L" plates Only supervised driving BAC 0.3 g/l.	15,3	18 (9 if defensive/ advanced driving course is passed).	10 p.m. – 5 a.m.	If driving unsupervised no passengers <20.	16	16

Table A10. **Graduated Licensing: Australia – Standard Three-stage Systems**

Learner Stage (Learners licence)						Intermediate Stage (Restricted licence)					Full licence
Jurisdiction	**Min. age to start learning**	**Mandatory holding period (months)**	**Min. hours of supervised driving**	**Restriction on lay instructor**	**Restrictions on learner driver**	**Min. age**	**Mandatory holding period (months)**	**Night-time restriction**	**Restrictions on learner driver**	**Passenger Restriction**	**Min. age for full licence**
Northern territory	16	6	Optional	Full licence.	"L" plates. BAC 0.0 g/l. Max. 80 km/h.	16,5	12	-	"P" plates. BAC 0.0 g/l. Max. 100 km/h	-	17,5
South Australia	16	-	Optional	Full licence BAC 0.5 g/l.	"L" plates. BAC 0.0 g/l. Max. 80 km/h.	16,5	12	-	"P" plates. BAC 0.0 g/l. Max. 100 km/h	-	19
Queens land	16 and 5 mths	6	-	1 year intermediate licence.	BAC 0.0 g/l	17	36 if <23; 24 if 23-24, 12 if >24	-	BAC 0.0 g/l	-	20
Tasmania	16	6	50	Full licence. No suspension for 2 years.	"L" plates. BAC 0.0 g/l. Max. 80 km/h No towing.	17	36 if <22; if 22-24 hold until 25, 12 if >24.	-	"P" plates. BAC 0.0 g/l. Max. 80 km/h.	-	20
Victoria	16	6	-	Full licence for 2 years BAC 0.5 g/l.	"L" plates. Supervised driving only. BAC 0.0 g/l. No towing.	18	36	No unsupervised driving between 10 p.m. – 5 a.m.	"P" plates. BAC 0.0 g/l. No high-power vehicles.	If licence is disqualified during the first year, one passenger only.	21

Table A11. **Graduated Licensing, Australia – Two Intermediate Stage Systems**

Learner Stage (Learners licence)						Intermediate Stage (Restricted licence)										Full licence
Jurisdiction	Min. age to start learning	Mandatory holding period (months)	Min. hours of supervised driving	Restriction on lay instructor	Restrictions on learner driver	Min. age		Mandatory holding period (months)		Night time restriction		Restrictions on learner driver		Passenger Restriction		Min. age full licence
						Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	
Australian Capital Territory (stage 2 = optional)	15 and 9 mths	6	-	Full licence	"L plates". BAC 0.2 g/l. Towing max. 750 kg.	17	17,5	36	36	-		"P" plates. BAC 0.2 g/l. Towing max. 750 kg.	BAC 0.2. g/l. Towing max. 750 kg.	-		20
New South Wales	16	6	50	Full licence BAC 0.5 g/l.	"L plates". Supervised driving. BAC 0.2 g/l. Max. 80 km/h. No towing.	17	18	12	24	-		"P" plates. BAC 0.2 g/l No high-power vehicles. Max. 90 km/h Towing max. 250 kg.	"P" plates. BAC 0.2 g/l. No high-power vehicles. Max. 100 km/h.	-		20

Table A12. **Graduated Licensing, Australia: Two learners Stage Systems**

Jurisdiction	Learner Stage (Learners licence)										Intermediate Stage (Restricted licence)					Full licence
	Min. age to start learning		Mandatory holding period (months)		Min. hours of supervised driving		Restriction on lay instructor		Restrictions on learner driver		Min. age	Mandatory holding period (months)	Night time restriction	Restrictions on learner driver	Passenger Restriction	Min. age full licence
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2						
Western Australia	16	-	6		-	25	Full licence for 4 years		"L" plates. BAC 0.0 g/l. Max. 100 km/h. Freeway restrictions.	"L" plates. BAC 0.2 g/l. Max. 100 km/h.	17	24	-	"P" plates. BAC 0.2 g/l. Max. 110 km/h.	-	19

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ANNEX B.

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YOUNG DRIVERS
The Road to Safety

Traffic crashes are the single greatest killer of those aged 15-24 in OECD, and many ECMT, countries. In the OECD alone about 25 000 people in this age group die in crashes every year. In many countries, about 20% to 30% of total fatal crashes involve a young driver. For every young driver killed, more than 1.3 other people likely also die in the same crashes. Thus, young drivers pose a greater risk than other drivers to themselves, their passengers and other road users. This problem imposes substantial costs on individuals, families and societies. This report provides an overview of the scope of the problem of young driver risk, its primary causes and concrete options to combat it.

The high levels of young driver risk result from factors of inexperience and age. In addition, crash and fatality levels are particularly pronounced among young men. There is no single solution. Rather, the goal of reduced young driver crashes must be pursued through a combination of countermeasures involving the licensing process, training and learning methods, enforcement, education and communication, and technology. These actions will require leadership and commitment, as well as a clear understanding of the costs and benefits of action.

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