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Enhancing Driver Education, Training and Testing in Ireland

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1 INTRODUCTION

1.1 Background

As a result of a number of road safety initiatives, including road user awareness campaigns, collisions, deaths and injuries on Irish roads have reduced in recent years¹. The Road Safety Authority (RSA) now intends to work to ensure that further reductions are realised and Ireland's road safety record is brought into line with the best in Europe.

Within the 'Road Safety Strategy 2007-2012'², RSA states that it aims to make a range of improvements to the existing driver education, training and testing regime including, for example, the implementation of a Graduated Driver Licensing System (GDLS).

In December 2008, CAS was commissioned by RSA to provide it and other stakeholders with an evaluation of the current Irish 'learning-to-drive' experience and international best practice in promoting road safety through driver training and assessment.

The final report comprises two volumes of which this is the second. Volume 1 contains the recommendations from the project and this document, Volume 2, contains its detailed findings.

1.2 Project Objectives

The key objectives of the project were to provide RSA with:

- Information on the Irish 'learning-to-drive' experience (including the two years after learners pass their driving test).
- Information on international best practice in driver education, training and testing.
- Appropriate, practical recommendations on the improvements needed in Irish driver education, training and testing to align it more closely with best practice.

In particular, information on the following issues has been collected:

1. The attitudes and motivations of learner drivers in Ireland as they go through the learning-to-drive process.
2. The role that formal driving instruction currently has in preparing learners to drive in Ireland.

¹ Garda Síochána Collision Statistics 2001-2008. <http://www.garda.ie/statistics98/nroadstats.html>.

² Road Safety Authority. Road Safety Research Strategy 2007-2012.

3. The manner in which accompanied driving in Ireland contributes to good driving practice and if and how this can be enhanced.
4. The way in which the Irish driver licensing system manages deviant driver behaviour and encourages safe driving.
5. Current best practice approaches to counter and manage delinquent driver behaviour.
6. The potential of the existing Theory Test to enhance road safety.
7. The role the practical driving test plays in helping to produce safe drivers and whether changes to the test will yield a road safety dividend.
8. Current international best practice on post-driving test measures that could most effectively be implemented in the Irish context.
9. Methodologies that will encourage a lifelong learning approach to driving.

1.3 Project Overview

The work undertaken by the project was divided into three Work Packages (WP), as follows:

- WP1 – Analysing the learning-to-drive experience in Ireland.
- WP2 – Identifying and reviewing international best practice.
- WP3 – Defining the way forward.

This report contains a full account of the methodology and a detailed analysis of the research findings in the following sections:

- Section 2: Project Approach.
- Section 3: The Learning-to-drive Experience in Ireland.
- Section 4: International Best Practice.

The report also contains the following Appendices:

- Appendix A – Irish Stakeholder Groups Consulted.
- Appendix B – Databases Searched and Experts Contacted.
- Appendix C – Reference List.
- Appendix D – Research Summaries.

2 PROJECT APPROACH

2.1 Overview of project approach

The project comprised three work packages as follows:

Stage	Description
WP1	Analysing the learning-to-drive experience in Ireland – The aim was to gain a fully rounded view of the attitudes, motivations, experiences and requirements of Irish learner drivers.
WP2	Identifying and reviewing international best practice – The aim was to gather information on best practice at all key stages of the driver education process both within and beyond the driver licensing system, driver testing and licensing and lifelong learning. Information was gathered by a literature review and through discussions with experts in driver education, training and testing internationally.
WP3	Defining the way forward – The aim was to identify the gaps between existing Irish driver education, training and testing and known best practice, draw conclusions and draft recommendations. Irish road safety experts were consulted on the appropriateness and practicality of the draft recommendations and then the final report was produced.

The following sections provide a more detailed summary of the work undertaken within each Work Package.

2.2 WP1 – The learning-to-drive experience in Ireland

In order to gather information about the learning-to-drive experience in Ireland, stakeholders' views were gathered through workshops, interviews (both telephone and face-to-face) and questionnaire surveys. All stakeholders were asked questions covering their own attitudes to driving and driving behaviour, their views on existing driver education, training and testing in Ireland and their opinions on a series of proposed changes.

2.2.1 Participants

The following stakeholder groups were consulted as part of this work:

1. Pre-learner and Pre-practical learner drivers.
2. Post-practical drivers.
3. Long-term provisional drivers³.

³ Drivers who have held their provisional licence for more than 5 years.

4. Parents.
5. Approved Driving Instructors (ADI).
6. Driver Testers.
7. Teachers.
8. Gardai.
9. Road Safety Officers (RSOs).
10. Interest Groups (Mothers Against Drunk Driving, Public Against Road Carnage, Irish Insurance Federation, Motorcycle Action Group, Irish Cycling Group, Sim2Learn, Irish Drivers Education Association, AA Ireland, SWOV, Medical Bureau of Road Safety, Trinity College).

RSA provided CAS with contact details for the majority of stakeholders e.g. RSOs. In other cases, RSA provided CAS with contact databases for use when recruiting participants. A more detailed breakdown of how each stakeholder group was accessed and the number of stakeholders consulted is provided in Appendix A. With all stakeholder groups, every effort was made to recruit participants of both genders from a range of socio-economic backgrounds.

All surveys, workshops and interview schedules were developed in consultation with RSA. A structured approach was taken to all aspects of the stakeholder consultation to ensure that a consistent set of relevant questions was asked to all participants in each group. Following consultation, all stakeholders were provided with a project information sheet giving a short description of the project and CAS contact details.

The outputs from all interviews, workshops and surveys were written up in detailed notes. The CAS project team then reviewed these notes in a series of workshops and extracted key themes.

2.3 WP2 – International best practice

The following sections describe the approach taken to identifying relevant information and defining best practice.

2.3.1 Identification of Review Questions

In order to focus the review a structured set of research questions was developed. Research questions were identified based on the project objectives and an initial review was carried out of core issues and research areas in driver education, training and testing. The full set of

research questions (agreed with RSA) is listed below. Research questions were divided into the following four themes:

Driver Education and Training – Outside of the Driver Licensing System

This research question covered any training or education activities, outside of the licensing system, provided to those who have held their licence for less than 5 years. Examples include road safety education in schools or clubs, cognitive skills training and advanced driver training for novice drivers (not part of a graduated licensing programme).

1. Is driver education and training, outside of the driver licensing system, an effective way of promoting knowledge and positive driving skills and attitudes?
2. When is the most appropriate time to provide driver education or training (outside of the driver licensing system)?
3. What educational methods and techniques are most effective when providing driver education or training outside the driver licensing system and the driver disciplinary system (e.g. pre-driver education and driver initiatives, such as drink-drive campaigns)?⁴

Driver Training – Within the Driver Licensing System

This research question covered all driver training provided to those in the process of applying for a licence. Examples include study materials for the Theory Test, hazard perception training and driver training using ADIs.

1. What are the most effective approaches for imparting the knowledge (e.g. knowledge of road rules) required to gain a drivers licence?
2. What are the most effective approaches for training hazard perception skills?
3. What are the most effective approaches for training driving skills?
 - a. What are the costs and benefits associated with different approaches?
 - b. What are the costs and benefits of accompanied driving?
 - c. What are the costs and benefits associated with using an instructor?
 - d. What is the optimal amount of training required to develop driving skills?

Driver Testing and Licensing

This research question covered all aspects of driver testing and licensing including testing knowledge, hazard perception skills, driving skills and graduated licensing.

1. What are the most effective approaches for assessing and testing driver knowledge (e.g. content, question types)?
2. What are the most effective approaches for testing and assessing hazard perception skills?
3. What are the most effective approaches for assessing physical driving skills and ability?
4. Have graduated licensing schemes been successfully introduced and used?

⁴ This included consideration of who should be involved in delivering training e.g. schools, teachers, youth groups etc.

Lifelong Learning

This research question covered all education and training provided to drivers who have held their licence for more than five years. Examples include advertising, training for those convicted of a driving offence, training for older drivers and advanced driving training.

1. Is it necessary to provide on-going driver education and training (do driving skills deteriorate over time)?
2. What techniques have proved successful in encouraging lifelong learning?
3. What is the best time to provide post driving test training and educational interventions?

The research themes and questions described above enabled the research team to break down a large body of research literature into manageable chunks. However, it is acknowledged that the question sets are not entirely discrete.

2.3.2 Information Gathering

To answer each research question, a detailed search to identify relevant research papers and other information was undertaken⁵. As part of the search, industry experts and researchers were identified and contacted to gather unpublished work and/or to find out about the practical implications of implementing various initiatives. A full list of literature was compiled and sent to RSA for approval prior to beginning the review⁶.

2.3.3 Identifying best practice

Because the aim of this part of the project was to identify best practice (rather than undertake an in-depth literature review), a three-step methodology was devised to develop best practice statements linked to each research question. The aim of the best practice statements was to provide RSA with a clear indication of what 'good' looks like in the various areas of driver education, training and testing. The three-stage process is described below:

Step 1 – Literature Quality Check

In order to identify high-quality research that could be used to develop best practice statements each document was reviewed and (where possible) graded. The following grading system was used:

Grade 1: The paper describes a study that used methodologically sound research design e.g. controlled for external variables, appropriate data collection and analysis techniques.

⁵ A list of databases searched and industry experts contacted is provided in Appendix B.

⁶ A full list of research literature collected is provided in Appendix C.

OR, the paper cites a large number of methodologically sound research studies e.g. a comprehensive literature review or meta-analytical paper and/or presents the views of many of the key researchers/practitioners in the field.

Grade 2: The paper describes a study that used a good general research methodology with no major design flaws. OR, the study cites a reasonable number of methodologically sound research papers e.g. a literature review or meta-analytical paper, and/or presents the views of a number of researchers/practitioners in the field.

Grade 3: The paper describes a study which contains a number of design flaws indicating that the results must be treated with caution. OR, the paper cites only a small number of studies that also have methodological weaknesses e.g. a literature review or meta-analytical paper, and/or presents the views of just a few stakeholders.

Step 2 - Document Review

Studies graded either 1 or 2 were reviewed by a CAS team member and statements highlighting the main study findings were developed. For example, if a study found that a Graduated Driver Licensing System (GDLS) restricting night-time driving had resulted in reduced crashes amongst drivers aged 17-24 the following type of statement would be developed:

'Restricting night-time driving, as part of the Graduated Driver Licensing System, was shown to be an effective means of reducing crashes amongst young drivers.'

Step 3 – Identify Best Practice

Following the review of individual papers, team members worked together to identify best practice. An approach was only considered to be best practice if the research team felt that a suitable number of high-quality studies had found evidence to support a particular approach or intervention. For example, in the case of restricting night-time driving, a number of studies have found that it results in reduced crash incidence and these were judged sufficient to classify night-time curfews as best practice.

Where the research team felt that it was not possible to identify best practice for a particular research question e.g. because the research findings were contradictory, a short summary of the issues surrounding research in the area has been developed.

For all research questions, a full summary of the literature has been written to provide RSA with background information (see Appendix D). For ease of reference, the key points from these are contained in Section 4.

2.4 WP3 – Defining the way forward

CAS undertook a comparison between the best practice identified during WP2 and information gathered during workshops and interviews. The comparison aimed to identify:

- Where current practices in Ireland are inconsistent with known best practice.
- Where current practices in Ireland are consistent with known best practice.
- Where current practices in Ireland are advanced in comparison to practices in other countries.

The results of this analysis were presented at a meeting on 13 May 2009 with RSA and Department of Transport representatives. The purpose of this meeting was to discuss the policy implications of the findings, to agree a set of recommendations which are considered feasible within and appropriate for the Irish context and consider how to move towards best practice in driver education, training and testing in Ireland.

3 THE LEARNING-TO-DRIVE EXPERIENCE IN IRELAND

The following sections take each of the research issues defined by RSA in turn and explain the general findings from all the stakeholder consultations carried out as part of this project. In addition, findings from the literature review are presented where appropriate. Where direct quotations are relevant, they have been added in quotation marks.

3.1 Attitudes and motivations of learner drivers

RSA issue for consideration: The attitude/motivation of learner drivers in Ireland as they go through the learning-to-drive process.

To expand on this issue, a series of telephone interviews and face-to-face interviews were carried out with long-term provisional drivers, pre-practical drivers and post-practical drivers. The following sections explain the motivation and attitudes to driving within each of the different driver categories. Where differences between genders were found, these are examined in further detail.

3.1.1 What makes a ‘good’ or ‘bad’ driver?

Long-Term Provisional

Long-term provisional drivers felt that a ‘good’ driver would be ‘responsible’, ‘observant’, ‘careful’, ‘patient’ and ‘considerate towards others’. They also felt that a good driver would obey the rules of the road, show good driving manners and use signals correctly.

A ‘bad’ driver was thought to be either ‘too slow’ or ‘too fast’ and ‘inconsistent’ in their driving. They were also thought to carry out reckless manoeuvres and exhibit road rage frequently.

Pre-Practical (females)

The pre-practical female group felt that a ‘good’ driver would be ‘patient’, ‘confident’, ‘careful’, ‘alert’ and ‘responsible’ in their driving. The interviewees in this group also felt that a ‘good’ driver would have a sufficient amount of road knowledge, would obey the law and the regulations e.g. comply with the speed limit, be a safe driver and be in control of the car. A ‘bad’ driver was described as being ‘timid’, ‘careless’, ‘irresponsible’, ‘easily irritated’, ‘cocky’ or ‘over confident’. A number of interviewees described a ‘bad’ driver as a ‘boy racer’, somebody displaying frequent road rage or somebody that does not know or obey the rules of the road e.g. someone who uses a mobile phone whilst driving or breaks the speed limit.

Pre-Practical (males)

The male pre-practical group expressed very different opinions of what makes a 'good' or 'bad' driver from those of the female group. The males separated the concepts of being a 'good' driver and being a 'safe' driver. The majority of males thought that being a 'good' driver was more important than being 'safe'. A 'good' driver was described as 'steady', 'controlled but fast' and 'confident'. Being a good driver was often associated with doing a lot of driving for work reasons. A 'bad' driver, in turn, was described as being 'too cautious', 'cocky', 'stubborn', 'nervous' or 'anxious'.

3.1.2 Who influences learner drivers?

Long-Term Provisional

The long-term provisional driver group felt that ADIs had the most influence on their driving and that they felt most comfortable in their company whilst learning-to-drive. Additionally, individuals in the long-term provisional group reported that peers influence their driving in a way that made them more nervous.

Pre-Practical (females)

All participants in this group suggested that a combination of ADIs, parents, friends and family members had an influence on their driving skills and abilities. However, most participants indicated that parents had the most influence on their driving.

Pre-Practical (males)

Males thought, almost without exception, that their friends will have the most influence on the way they drive. They considered it very important to drive in a similar manner to their friends. Again, males thought, almost without exception, that their parents did not influence their driving very much.

Post-Practical

The post-practical participants indicated that their parents and ADIs had the most influence on their driving.

3.1.3 How useful are the learning materials?

The majority of learner drivers and post-practical drivers thought that the materials available to help with the Theory Test e.g. books and DVDs, were very useful and helped them to pass their theory test. Interestingly, some participants felt that although the materials helped them

to pass their test, they did not help them become better drivers. In some cases this was because much of the knowledge gained prior to taking the Theory Test is forgotten by the time the full driving licence is obtained. In others, it reflects a belief that the theory and practical tests are just hurdles to be crossed and that the real process of learning to drive happens after obtaining a driving licence.

Long-Term Provisional

The materials available to help with the Theory Test were considered to be fairly useful. However, some participants did question whether they had actually learnt the information in the materials. One said that the 'layout of the practice tests is the same as those used in the actual test - all you have to do is memorise'.

Pre-Practical (females)

The majority of people in this group found the materials useful or very useful. Many felt that they would not pass the test without access to practice test items (e.g. in books and DVD). The materials were considered helpful because not only do they 'give scenarios that you could find yourself in' but also because 'they give you an insight into what to expect'.

Pre-Practical (males)

The consensus was that the materials were very useful for passing the Theory Test. As with the pre-practical females, the majority of the males felt that they could not pass the Theory Test without having practised using the available materials.

Post-Practical

Most post-practical drivers considered the content of the materials to be comprehensive and straightforward. One participant stated that 'the book tells you exactly what you need to know to pass the test'. Another participant indicated that the driving material covered in the book 'closely replicated the test'. However, some considered both the book and the DVD to be 'a waste of time' because they 'do not make you learn anything' and 'you only learn the content for the test, and then forget it'. One participant suggested that it was not the most effective way to learn the rules of the road.

3.1.4 Why are the participants learning-to-drive?

Long-Term Provisional

Most of the long-term provisional drivers said that they drove every day. However, some had dramatically reduced or given up driving since the new legislation came into force that

requires provisional drivers to be accompanied. The main reasons given for driving concerned: transporting family members, carrying out school runs and travelling to work. Almost all drove only on local roads.

Pre-Practical (females and males)

The majority of the pre-practical group indicated that they drive for everyday purposes: to get to school or work, to see friends, go shopping or for leisure reasons. Many had long distances to travel and felt that they needed to drive because the public transportation system is poor.

Post-Practical

Most of the post-practical group indicated that they need to drive every day for work and for family purposes. Several had taken and passed their driving test so that they could become independent and subsequently less reliant on their friends, partners or other family members.

3.2 Formal driving instruction

RSA issue for consideration: The role formal driving instruction currently has in preparing learners to drive in Ireland.

To address this issue a series of telephone, face-to-face and group interviews were conducted with various stakeholders. The stakeholder sample consisted of:

- Driver Testers.
- ADIs.
- Irish Cycling Group.
- Irish Driver Education Association.
- Irish Insurance Federation.
- Irish Motorcycle Action Group.
- Gardai.
- Long-term provisional drivers.
- Representatives from the National Roads Authority.
- Parents.
- Post-practical drivers.
- Pre-learner and Pre-practical candidates.
- RSOs.

3.2.1 How ADIs are currently used within the learning-to-drive process

Virtually all interviewees (long-term provisional drivers, post-practical drivers, parents and ADIs) stated that they had used a mixture of professional driving instruction, characterised as formal lessons with an ADI, and practice with an accompanying driver e.g. friends and relations. The number of professional driving lessons ranged between 2 and 25. On average, long-term provisional drivers engaged in more lessons than post-practical drivers.

In the accompanying driver category, parents (mainly fathers) provided the majority of driver training. However, friends and relations were used to help individuals gain familiarity with their vehicle and to provide initial training covering basic car driving skills. Once these had been mastered, professional driving instruction was sought. Interviewees justified this approach by saying that initial driver training provided by friends and relations was convenient and valuable for obtaining basic skills and confidence. Indeed, one post-practical driver commented by saying ‘they (referring to relations) get you into the car and you can be less nervous’. However, some interviewees suggested that training supplied by friends and family is often less than ideal. In fact, all interviewees commented on the increased probability of arguments and picking up bad driving habits as a result of this method of instruction.

Moreover, information obtained from the interviews conducted with pre-learner and pre-practical candidates indicates that the large majority intend to obtain professional driving instruction when learning-to-drive.

When ADIs were asked about their views and opinions regarding accompanying drivers, they felt it was easier to teach learners good driving habits from the start rather than train out bad habits learned from accompanying drivers. Professional instructors suggested that ‘in about half of the cases, the accompanying drivers have done a good job in teaching their children how to drive and in half of the cases have caused more problems than if they hadn’t taught them’.

It was suggested that accompanying drivers require direction and guidance to provide them with effective teaching techniques. Specifically, one ADI suggested that accompanying drivers sit in on a formal driving lesson first so that they can be shown how and what they should teach the learner driver in subsequent lessons. Another ADI suggested that accompanying drivers should be supported by RSA published training materials that they can use to help plan the lessons they give. Some states in the USA and Australia e.g. Victoria, offer voluntary training programmes for accompanying drivers. These courses typically cover

the complexities of driving; risk factors; statistics on young driver casualties; the effects of alcohol, speed, fatigue and poor concentration; and the roles and responsibilities of the learner and adult accompanying driver (U.S. Department for Transportation, 2007).

3.2.2 The benefits associated with using an ADI

All interviewees were in favour of receiving some professional driving instruction and most supported the idea of some compulsory lessons with an ADI. Overall, interviewees mentioned that professional driving instruction could provide:

- Effective dissemination of up-to-date driving information and rules.
- A structured approach to learning and feedback.
- A professional and educated approach to driving.
- Better preparation for the practical driving test.
- An empathetic and patient approach to training.

3.2.3 The disadvantages of using an ADI

Long-term provisional drivers, post-practical drivers and parents suggested that there were only two disadvantages associated with formal driving instruction, the financial burden and inconvenience (due to set appointment times and bookings). Driver Testers, RSOs and Gardai officers added that too many ADIs were only teaching learner drivers the practical driving test routes. This implies that ADIs are not educating candidates to become safe and responsible drivers. Indeed, Driver Testers were quoted as saying that ADIs 'teach learners how to pass, not how to drive'. Although long-term provisional and post-practical drivers also raised the point of 'test tipping', they considered this to be a benefit of obtaining professional driving instruction. Moreover, Driver Testers believe that there are marked discrepancies between what ADIs teach students and the interpersonal and driving skills they possess.

However, ADIs criticised learner drivers who, at the beginning of the formal instruction process, often enquire as to 'the minimum amount of lessons that I need to pass the test and how much is it going to cost me?' ADIs suggested that learner drivers do not consider driving skills as relevant and that 'they just want to go and practice on the test route with as little time and money as possible'. It was suggested that this could be rectified if there was a rule that every learner should take a set amount of lessons before they are able to take the practical driving test. It was also suggested that test routes are modified since they have remained unchanged since 1982. It was considered important to change this as learner drivers should be taught to 'think at the moment rather than thinking of what is coming next on the route'.

3.2.4 Suggested areas for improvement

As previously mentioned, all interviewees were in favour of some professional driving instruction and the idea of compulsory lessons with an ADI. However, some stakeholders suggested that professional driving instruction could be improved with the introduction of:

- Strict regulation and standardisation of ADI registration.
- An Irish version of the UK 'Driving Instructor Manual'.
- Compulsory education and training for ADIs in instructional design principles and the delivery of education in a practical setting.
- A compulsory requirement for ADIs to have effective communication skills, 'general people skills' and a comprehensive knowledge of driving and the road.
- Government rebates and subsidisation of lessons if mandatory driving lessons with an ADI were to become a prerequisite for obtaining a drivers licence.
- A fixed amount of compulsory driving lessons with an ADI.
- A compulsory requirement for accompanying drivers to be present during driving lessons with an ADI.
- Support materials for accompanying drivers to help them plan their lessons.

3.3 Accompanied driving

RSA issue for consideration: The manner in which accompanied driving in Ireland contributes to good driving practice and if/how this can be enhanced.

Information obtained from interviews with long-term provisional drivers, pre-practical drivers and post-practical drivers was used to expand on this issue. In addition, findings from the literature review were mentioned where relevant. The information from the interviews suggests that parents (predominantly fathers) are the main providers of accompanied driving in Ireland. The benefits of accompanied driving practice include:

- Cost effectiveness.
- Convenience.
- Familiarity.
- Effective acquisition of basic driving skills and knowledge.
- Early gains in confidence and self-efficacy.
- Diverse driving conditions (night-time driving, terrain variations).

In addition to the interviews, research findings suggest that novices taught to drive by parents are often more competent than those taught by ADIs and go on to have a lower crash risk relative to those who received only professional instruction. Indeed, there appears

to be a strong link between parental monitoring, driving restrictions and reductions in young driver crash risk. As such, parental management of young drivers is an important mechanism for managing young driver risk. Moreover, VicRoads (Victoria, Australia) report that learner drivers taking at least 120 hours of accompanied driving practice have a significantly reduced crash rate.

On the other hand, interviewees mentioned the following disadvantages associated with this mode of driver training:

- The acquisition of poor/bad driving habits.
- Interpersonal conflict.
- Minimal transfer of road knowledge and awareness skills.
- Unstructured teaching approaches.
- Not all parents are comfortable with the level of responsibility.

In addition, findings from the research literature suggest that accompanying drivers should have a minimum amount of driving experience. This is thought to be necessary as it increases the likelihood that the accompanying driver will have developed the critical higher-order cognitive skills which will enable them to enhance the learning experience.

The opinions of interviewees were sought on the matter of implementing such a minimum requirement for accompanying drivers. Although there were some people who did not think this would be a good idea, most interviewees recognised the potential safety and educational value that this initiative could provide. Even those opposing the change recognised the likely benefits of such imposed restrictions and were mainly concerned with the practicality of the initiative. Specifically, it was suggested that minimum requirements for accompanying drivers ‘might not be practical given some peoples’ circumstances’.

3.4 Management of deviant driver behaviour

RSA issue for consideration: The way in which the Irish driver licensing system manages deviant driver behaviour and encourages safe driving.

Bad driving behaviours are often referred to as ‘delinquent’ or ‘deviant’. These terms are often used to categorise bad driving behaviours although they have slightly different meanings. We have defined deviant driver behaviours as acts that go against the norms of ‘good’ driving. These behaviours may not involve breaking the law directly but can lead to increased risk and indirectly to committing offences. For example, a neglectful driving style may not be defined as an offence but may lead to running a red light. Delinquent driver

behaviour is defined as knowingly driving illegally. It involves carrying out continuous and deliberate violations of road rules and the law e.g. driving under the influence of alcohol or regularly breaking the speed limit.

A picture of how the current licensing system manages deviant behaviour and encourages safe driving was drawn from workshops conducted with a variety of Gardai officers, fire officers and ambulance service representatives.

Findings from the workshops revealed that the current licensing system was poorly equipped to deal with road traffic violations. Indeed, many workshop attendees felt that the management of deviant drivers was taken away from the licensing system and held solely by the courts, which try all cases of traffic violation, even those involving minor traffic infringements. This was a major concern for the Gardai who reported that the current system:

- Is slow and expensive, even for minor infringements of the law.
- Classified drink driving and speeding convictions as low priority and often did not convict offenders. Members of the Gardai felt that this has sent out a bad message to the public.

Overall, the current system is felt to be inflexible in its approach and removes any powers from the Gardai (e.g. minor infringements could be dealt with by the Gardai through on the spot fines). The culture of the system needs to be changed if the current penalty system is to provide enough incentive and/or justification for motorists to obey the law.

Furthermore, current penalties and punishments for deviant driver behaviour take the form of penalty points and disqualifications. Rehabilitation is not used. Penalty points and disqualifications focus on punishing the offender not on changing behaviour. This suggests that the driving licensing system currently provides little encouragement for safe driving.

In conclusion, comments from the workshop suggest that deviant driver behaviour is thought to be managed by the courts and not by the licensing system, even though the option exists for offenders to opt for a lower fine and half the penalty points by electing not to go to court. This approach has led the public to believe that driving violations will not be prosecuted, especially speeding violations. The current system needs to be re-evaluated in order to discover how it can best improve the culture surrounding deviant driving behaviours.

Some countries including Finland, Sweden and France have successfully implemented schemes to manage deviant driver behaviours. Finland, in particular, has topped the EU Traffic Law Enforcement League Table for its speeding enforcement records (European Traffic Safety Council, 2009). They use on-the-spot fines enforced by police officers. Fines for speeding can range from €35 for not wearing a seat belt to a 60th of the person's monthly

income for speeding offences (Finnish National Traffic Police, 2009). Furthermore, France has been successful in managing deviant behaviour by using severe punishments (fines up to €15,000 and imprisonment for up to three years) for dangerous driving offences (Hampshire, 2003).

3.5 Best practice approaches to managing delinquent driver behaviour

RSA issue for consideration: Best practice approaches to counter and manage delinquent driver behaviour.

In order to address this issue we have reviewed literature concerning how other countries currently manage and improve delinquent driving behaviour in other countries. Traditionally, the most common approaches to counter and manage delinquent driver behaviour have involved engineering, education or enforcement.

Recently, attitude measurement and interventions aimed at changing attitudes have been considered in connection to road safety issues. This is because research findings have shown that attitudes, which are formed at a young age, have an important influence on driving behaviour (Christmas, 2008). For example, research carried out by Clark, Ward and Truman (2002) concluded that road collisions are, to a large extent, caused by 'failures of attitude' (relating to speeding, recklessness and the use of alcohol), rather than a 'lack of driving skills'. For this reason, they suggest that educational programmes aimed at changing driver attitudes should be implemented to manage unwanted driver behaviours.

Best practice approaches to counter and manage speeding and drink driving are included because they are the main causes of road fatalities in Europe (European Traffic Police Network, 2009). Aggressive driving is discussed in relation to intentional aggression and deliberate violation of road rules. Deliberate aggression has been found to cause more collisions than errors caused by inexperience or misjudgement (AAA Foundation for Traffic Safety, 1995).

3.5.1 Speeding drivers

In recent years, the preferred approach to countering speeding behavior has been the use of automated enforcement. The most common engineering initiative used is speed cameras although some in-vehicle adaptations have also been successful at controlling speed (Watson, 1998), including:

- In-vehicle 'smart cards' which register speeding offences and can be read at regular intervals by police.
- In-vehicle feedback and warning systems that advise drivers when they are exceeding a posted speed limit.

Outside the vehicle, changes to the road environment can be engineered by traffic calming measures such as:

- Road humps.
- Chicanes.
- Traffic islands.

A study carried out by Cameron (2008) reviewed speed enforcement in the UK, France, Sweden and Australia (states of Queensland and Victoria). Cameron concluded that point-to-point speed cameras are likely to be effective speed enforcement systems. The UK system was considered to rely on a general deterrence by employing a large number of fixed and mobile cameras. A four year evaluation report by the Department for Transport (DfT) in the UK found positive results from the National Safety Camera Programme. The report (DfT; The effects of speed cameras: how drivers respond; No.11) concluded that safety cameras reduced speeding and thereafter collisions, casualties and deaths. Although these conclusions have been challenged recently (e.g. Smith, 2007; European Traffic Safety Council, 2009) the general opinion across Europe appears to be that where safety cameras have been introduced (e.g. France) they have had a marked positive effect on accident rates at targeted locations.

Educational programmes have proved successful in changing the public's attitudes towards speeding. For example, UK programmes such as the Speed Awareness course and the National Driver Improvement Scheme (NDIS), which explore individuals' beliefs about the causes of traffic collisions and then challenge those beliefs, have been found to have a significant effect on self-reported behaviour and attitudes towards traffic violations (Burgess and Webley, 1999).

McKenna and Poulter (2008) looked at the effects of education and punishment on driver attitudes towards speed control. They concluded that the educational speed awareness course was more promising than traditional approaches of punishing drivers with fines and penalty points in 'improving attitudes towards speed control, the level of breach in speed limit that is acceptable and future speed control' (McKenna and Poulter, 2008, p25).

3.5.2 Drink drivers

Although licence restrictions have traditionally been considered the most effective sanction in controlling drink driving, more recent research has supported remedial actions.

Watson (1998) reviewed the effectiveness of three sanctions used to manage drink driving offences in Australia. The sanctions were:

- Licence restrictions (restriction or removal of driving privileges e.g. disqualification).
- Vehicle based sanctions including vehicle impoundment or immobilisation and alcohol ignition interlocks.
- Remedial programmes including assessment, treatment and rehabilitation.

Watson's (1998) review confirmed that licence restrictions are effective in reducing the overall crash rates of offenders. However, remedial programs were found to be more effective in reducing alcohol related offences. In terms of vehicle based restrictions, alcohol ignition locks (alcolocks) were found to reduce illegal driving amongst offenders.

The reduction in the level of alcohol related crashes in Australia has been connected to introducing Random Breathalyser Tests (Watson, 1998). Overall, Watson (1998) concluded that the best way to reduce alcohol related offences is to use a combination of licence actions and remedial programs.

An example of a successful intervention method for road safety offenders is the Drink Driver Rehabilitation (DDR) course which is provided by DfT in the UK. This is a programme aimed at individuals convicted of a drink driving offence who opt to have their sentence reduced by undertaking this training. The DDR course aims to increase attendees' awareness of the dangers of drink driving.

Research on the impact of course attendance has demonstrated a statistically significant reduction in drink drive reconviction rates. Offenders who do not complete a DDR course are up to 2.7 times more likely to be re-convicted for a drink drive offence in the two years following their original drink drive conviction than those who have attended a course (Smith et al, 2004).

By means of strict legislation, new technology and visible enforcement, Finland has achieved one of the lowest drink drive rates in Europe. Offenders are offered alcohol rehabilitation programmes that use alcolocks which require the offender to take a alcohol test in order to start the vehicle. These will be a compulsory device in all new cars by 2012 and in all new buses, coaches and heavy goods vehicles by 2010 (European Traffic Safety Council, 2009).

In Japan, drink driving laws are strict. If drivers are caught drink driving there is a maximum penalty of a three year jail sentence. Furthermore, if the police have reason to believe that the passengers were aware that the driver was intoxicated they can also be subject to a fine (English Tree, 2008).

3.5.3 Aggressive drivers

Typically, behaviours associated with aggressive driving include:

- Exceeding the posted speed limit.
- Following too closely.
- Erratic or unsafe lane changes.
- Improperly signalled lane changing.
- Failing to obey traffic control devices e.g. stop signs, yield signs, traffic signals, railway crossing signals.

The USA National Highway Safety Traffic Administration (NHTSA) includes the running of red lights as one of the most dangerous forms of aggressive driving.

The NHTSA has carried out extensive research on managing aggressive driving. It recommends that every law violated by aggressive drivers needs to be enforced by either making statutory changes or, if possible, by making changes to the licence points system. In particular, it has recommended:

- Enhanced penalties to repeat violations or those involving serious injury or death.
- New and advanced technology is employed.
- Education programmes on aggressive driving are given to:
 - Learner drivers during pre-licence driver education and before gaining the driver's licence.
 - Drivers by combining education on aggressive driving and anger management training.
- Public information programmes are conducted.
- A significant number of points and/or minimum licence suspension should be given to those convicted of aggressive driving.

The NHTSA has recommended that the management of aggressive driving should consist of the following:

- Increasing the public's, judges' and prosecutors' awareness of aggressive driving issues.
- Setting up programmes for judges and prosecutors to enable training of new technology and techniques used for managing aggressive driving behaviour.

- Developing clear guidelines that would provide uniformity and consistency in prosecutions.
- Encouraging co-operation between different law enforcement agencies to create a multi-jurisdictional enforcement programme.

Additionally, various organisations (such as educators, highway safety affiliates, media channels and medical communities) should collaborate to increase public awareness of aggressive driving and help to make it socially unacceptable.

In conclusion, we recognise that all three approaches to managing deviant driver behaviour (engineering, education and enforcement) have their own merits. However, it has become clear that the best solution is to combine them (Department for Transport, 1998). It is important to note that educational programmes directed at changing attitudes are a long-term process. Attitudes cannot be changed using short-term intervention methods. Until attitude change has been achieved, it is important to retain traffic law enforcement (Department for Transport, 1998).

3.6 The potential of the existing Theory Test to enhance road safety

RSA issue for consideration: The potential of the existing Theory Test in enhancing road safety.

This issue was discussed with long-term provisional drivers and post-practical drivers (although it was not a major theme of the interviews). In addition, we have used information gathered in the literature review to expand the issue.

The current Theory Test uses the recommended method of a multiple-choice test, delivered on a computer (CIECA, 1998) and covers the content areas specified for a theory test by EU Directive 91/439/EEC. Although this method is widely used, its validity and reliability in testing driver knowledge is thought to be dependent on good question design and content (Jonsson, Sundström and Henriksson, 2003). In fact, although there is good evidence for the reliability, and the content and, in some cases, construct validity of many of the theory tests in use, there is almost no evidence concerning their predictive or criterion-related validity (European Safe Roads Observatory, 2009; Henriksson et al, 2004). Some indirect evidence has been claimed based on score differences between young male and young female learners in Sweden (Wiberg, 2006), but two other studies in the Netherlands (de Winter and Wieringa, 2008) and Northern Ireland (DVTA, 2007) have failed to replicate this finding.

Interviews with stakeholders revealed the following important issues concerning the current Theory Test:

- The guidance and training materials confused some interviewees into reporting that test items are sometimes irrelevant to the category of licence being applied for.
- Test takers memorised the questions and answers from the learning materials and did not feel they had appropriate knowledge or understanding of the rules of the road following the test.
- The suggested introduction of a Hazard Perception test was very popular.

3.7 The role of the practical driving test

RSA issue for consideration: The role the driving test plays in helping to produce safe drivers and whether changes to the test will yield a road safety dividend.

Information obtained from interviews with long-term provisional drivers, pre-practical and post-practical drivers have been used to assess the role of the current practical test. This is later considered with reference to best practice findings from the literature review.

Results from the interviews revealed a number of key areas for improvement. The majority of interviewees felt that:

- The current practical driving test does not equip new drivers to drive alone. Many interviewees felt unprepared to drive alone after passing their test.
- The test fails to assess certain elements of driving ability, such as driving at night and on motorways.
- They learnt how to drive test routes rather than focusing on the skills needed for lifelong safe driving.
- They were very nervous when taking their practical test.
- They received limited feedback after the practical driving test and some reported not fully understanding the reasons why they had failed.

Interviewee confidence in the current practical driving assessment was very low. Many interviewees felt that a number of key driving skills were not being evaluated. Results from the literature review show that an increased number of driver skills could be assessed with the introduction of a logbook (Roach, Taylor and Dawson, 1997).

A logbook provides a checklist of driving situations, procedures and activities which the learner has to experience, demonstrate competence in, and be assessed in (by accompanying drivers, ADIs and, finally, the Driver Tester). The logbook is designed to be progressive and to integrate assessment throughout the learning-to-drive process.

Furthermore, interviewees reported learning test routes not driving skills. The main objective of using test routes is to ensure that each candidate experiences similar driving situations

and environments during the practical driving test. However, researchers (Henriksson, Sundstrom and Wiberg, 2004; Senserrick and Haworth, 2005) have expressed concern that standardised test routes compromise the validity of the assessment.

An alternative method used in the Netherlands (Vissers, 2009) to promote independent driving uses a series of 'coordination points' (landmarks) to direct test takers. A major concern related to the removal of test routes is that some rural areas will not have enough variety in their road network to support such an approach. This may be the case in some areas of Ireland. However, this problem can be solved by reducing the number of test centres available to candidates (Christie, 2000).

Information obtained from the interviews revealed that the current practical assessment fails to give productive feedback on candidate performance. This is an important issue as findings from the research literature show that feedback is an essential element in the progression of learner drivers' skills and abilities (Jonsson, Sundström and Henriksson, 2003).

Finally, there are reported problems with the current fault based assessments used in the practical driving test. A review undertaken by the Transport Research Laboratory (Baughan and Sexton, 1998) reports that candidates who pass the practical test, having made a large number of less serious faults, may actually be intrinsically less safe as drivers. Furthermore, the test - re-test reliability of fault based tests is low.

Our review of the literature indicated that several countries (Germany, France, UK and The Netherlands) are either on the point of introducing or are trialling competence-based approaches to the assessment of driver's practical skills. Most of these trials are favouring a holistic assessment of the test taker's performance. This method is reported (Senserrick and Haworth, 2005) to produce a fairer, more reliable assessment of driver skill.

In conclusion, a logbook system should provide a more progressive approach to the training and assessment of driving skills and remove pressure from the practical driving test (in terms of candidate anxiety during the practical driving test). In fact, researchers (Machu, 2007) in France reported a 22% increase in the practical driving test pass rates following the introduction of an accompanied driving scheme similar to the logbook. Furthermore, a more progressive approach to assessment can ensure that the majority of driving situations and environments are assessed.

3.8 International best practice approaches to post-driving test measures

RSA issue for consideration: International best practice on post-driving test measures that could be implemented most effectively in the Irish context.

This issue has been explored mainly using information from the literature review. However, where appropriate these issues were discussed in workshops and interviews. The literature (Hallmark, Veneziano, Falb, Pawlovich, and Witt, 2008; Begg and Stephenson, 2003; Williams, 1999 and Foss and Goodwin, 2003) on post-driving test measures is concise and consistently makes the following best practice recommendations:

- Zero Blood Alcohol Content (BAC) for young novice drivers (in practice this usually means less than 20mgs / dl to allow for such things as traces of alcohol resulting from medication).
- Night-time driving measures starting before 12pm for novice drivers.
- No passengers to be carried under the age of 21 by novice drivers.

These measures have all been successfully linked to reduced crash rates and fatalities (Foss and Goodwin, 2003; Masten, 2004 and McKnight, 1992). However, comments made in the interviews and workshops revealed that night-time driving and passenger initiatives were very unpopular. Concerns expressed by interviewees relating to the introduction of post-test restrictions are described below:

- The mobility of new drivers would be greatly restricted by a night-time driving curfew. Many drivers would have problems getting to and from work or school.
- The measures are unfair if only applied to young drivers. Interviewees felt that this would single out young people and may infringe their civil liberties.
- The measures would be almost impossible to enforce so people would not follow the measures as they would not fear getting caught.

These issues were considered in the context of the research literature. This revealed that many other jurisdictions have encountered similar problems with implementing unpopular measures. The following have been successfully implemented to tackle these problems:

- Exemptions were given from night-time driving measures when travelling for work and education and from passenger measures when carrying family members. Begg et al (1995) reported that this improved compliance by reinforcing that non-recreational driving was not being targeted.
- Restrictions were applied to all new drivers, irrespective of age. This was successfully implemented in New Zealand and Canada. Both reported reduced crash rates across age groups (Maycock et al, 1991).

- Parents are required be more involved in the learning-to-drive process. Beck et al. (2003) reported that this improved compliance and acceptance of post-test initiatives in Maryland.

Overall, researchers (e.g. McKnight, 1992; Senserrick and Haworth, 2005) conclude that although many post-test measures were initially unpopular their popularity increased following their implementation.

Additionally, acceptance has been linked to enforcement measures (Williams, 2006).

Interviewees indicated that enforcement was very important as many young drivers reported driving illegally with their parents' permission. This will have implications on how any post-test measures are implemented. The following approaches have been recommended in research literature and are considered viable options for Ireland:

- The introduction of a logbook system. This is linked to increased compliance with post-test measures and improved acceptance from accompanying drivers. A well implemented logbook system gives accompanying drivers more ownership and involvement in the learning-to-drive process and reinforces to learners that learning-to-drive is a progressive process.
- The introduction of in-car tracking devices. This motivates the driver to comply with initiatives by offering reduced insurance premiums for their co-operation (Senserrick and Haworth, 2005).
- The removal of driving restrictions after 6 months if no violations are recorded. This is thought to greatly improve compliance for post-test measures by using rewards instead of punishment to motivate compliance (Haworth, 1994).
- A graduated punishment system (used in Maryland and Victoria). This system gradually increases the number of penalty points allowed at each stage of gaining a full license. For example, a learner's permit allows 4 points, an intermediate license allows 6 points and a full license allows 12 points. If points are exceeded the individual is moved down one or more license phases.

It should be noted that the recorded success of post-test measures is thought to be dependent upon the system as a whole. The post-test measures are most effective when implemented together and may not necessarily affect crash reductions on their own (Hallmarket al., 2008).

3.9 Methodologies to encourage a lifelong approach to driving

RSA issue for consideration: Methodologies that will encourage a lifelong learning approach to driving.

Opinions on this issue, were sought from ADIs, post-practical and long-term provisional drivers, Gardai and RSOs in a series of telephone, face-to-face and group interviews.

Information obtained from interviews indicates that Ireland needs to develop and provide ongoing driver education and training. It was evident that drivers are failing to stay up-to-date with changes in road rules, associated technological advancements and emergent road systems e.g. the majority of interviewees were unaware that the law relating to BAC levels had recently changed. There was particular concern for older drivers with one RSO indicating that they 'have no idea how to conduct themselves...some have never seen a roundabout until they've hit a big city'. It was also suggested that older drivers 'lack agility and so to get where they're going they just drive slow'. It was further noted that older drivers lack judgement and cognitive processing speed. Moreover, post-practical and long-term provisional drivers as well as ADIs commented that older drivers exhibit bad driving habits and lack knowledge of the rules of the road.

Media campaigns, similar to those mentioned in section 3.5, are an effective way of disseminating knowledge to the public and could be used to encourage participation in lifelong learning programmes. These can be carried out using multiple techniques; printed material (such as educational booklets and questionnaires), audio-visual media and face-to-face communications (Erwin, 2001). These types of media campaign might be a good way to ensure that the public is kept up to date with changes to the Highway Code.

Overall, it was suggested that additional driver education and training be delivered to drivers who are 40 years of age and older. Interviewees also indicated that this education and training should be made compulsory. There were suggestions that education and training programmes should cover driver theory and road rules, as well as practical skills. Moreover, education and training should contain practical assessments, that measure cognitive, physical and driver skills and abilities, followed by bespoke driver re-training and re-education addressing the deficits identified during the assessments. It was presumed that professional driving experts (such as ADIs, Driver Testers etc.) would facilitate re-training and re-education programmes.

Finally, some eco-safe driver training programmes in Germany and The Netherlands have incentivised participation by promoting potential cost-savings gained from a more efficient driving style (CIECA Eco-driving project, 2007). Lifelong approaches to driving could be encouraged by working with insurance companies and other organisations to incentivise participation.

4 INTERNATIONAL BEST PRACTICE

Appendix D provides detailed summaries of the literature and other sources of information which were reviewed in the course of the project. For ease of reference, this section highlights the key points arising from these. They are organised under four headings, as follows:

1. Driver Education and Training outside the Licensing system.
2. Driver Training within the Licensing system.
3. Driver Testing and Licensing.
4. Lifelong learning.

4.1 Driver Education and Training outside the Licensing System

Is driver education and training, outside of the driver licensing system, an effective way of promoting knowledge and positive driving skills and attitudes?

Recent findings suggest that driver education has some beneficial effects on driver attitudes and road safety knowledge (Deighton and Luther, 2007; O'Brien et al., 2002) but that both, especially attitude changes, fade quite quickly (Senserrick, 2007). Although a small reduction in crashes may be attributable to driver education (Di Pietro et al., undated), there is little evidence that it has a lasting effect on behaviour, mainly because it is often a one-off intervention rather than a structured long-term programme (McKnight, 2001). Training for newly licensed drivers can have a positive impact provided it is broad based and not limited to vehicle control skills where it can be counterproductive (Twisk and Stacey, 2007).

When is the most appropriate time to provide driver education or training (outside of the driver licensing system)?

There is little research on the most appropriate time to deliver driver training or education but substantial evidence that attitudes, including risky attitudes, towards driving are formed at a young age (e.g. Waylen and McKenna, 2002; Christmas, 2008). This suggests driver education initiatives should be targeted on young people before they start learning to drive to counter any misconceptions or risky attitudes they may be exposed to through their families or peers.

What education methods and techniques are most effective when providing driver education or training outside of the driver licensing system?

The content and methods of traditional driver training have attracted much research attention. Lynam and Twisk (1995) argue that improvements in driver training are more likely if cognitive skills, the emotional meaning of driving and the social responsibility of drivers are addressed. The CIECA Group (CIECA, 1998) concluded that practical driving skills need to be reinforced over a longer period than the time spent learning for the test. McKnight (2001) contends that recent trends towards highly participative education and training methods, including the use of interactive multi-media, should aid the development of driver education and that techniques such as self-pacing, frequent feedback, rewards for achievement, self-direction and group goal planning should feature from early stages in the curriculum.

4.2 Driver Training within the Licensing System

What are the most effective approaches to imparting the knowledge required to gain a driver's licence?

Effective knowledge transfer is most likely to be achieved by education programmes which *are realistic and simple, multi-method, provide prompt and specific feedback and communicate learning expectations* (McKnight 2001; Chickering and Gamson, 1987).

What are the most effective approaches to training hazard perception?

Training should focus on real-life traffic situations and focus on hazard detection abilities and risk perception (McKenna and Crick, 1997; Deery, 1999; Fisher et al, 2006). This is more likely to improve hazard awareness and risk perception and to enhance attentional control and time-sharing skills (Williamson, 2008; Sumer et al, 2000; Kuiken and Twisk, 2001; Isler et al, 2008; McKenna and Crick, 1997; Deery, 1999; Fisher et al, 2006). Effective educational methods include computer mediated instruction, classroom instruction, video and driving simulators (McKenna and Crick, 1997; Deery, 1999; Fisher et al, 2006).

What are the most effective approaches to training driving skills?

There is broad consensus that effective driver training is a consistent, slow building experience, rich in instruction and feedback and accompanied by driving practice with friends and relations (Forsyth, 1992; Christie and Harrison, 2003; Dorn and Barker 2005; Emmerson 2008, Engstrom, Gregerson, Granstrom and Nyberg, 2008). However, it is recognised that problems can arise from inconsistencies between professional instructors, family and friends (AA Report, 2002; Emmerson, 2008; Groeger and Brady, 2004) or where the accompanying driver lacks confidence (Christie and Harrison, 2003; Christie, 2001). Some argue that

practice with friends and relations has a more positive affect than professional instruction on a driver's chances of passing the driving test (Groeger and Brady, 2004; Gregersen and Nyberg, 2002). Other research findings suggest that less capable pupils learn to drive more effectively with ADIs (Emmerson, 2008; Hall and West, 1996) whereas more able pupils benefit more from training with accompanying drivers (Emmerson, 2008; Hall and West, 1996; Groeger and Brady, 2004).

4.3 Driver Testing and Licensing

What are the most effective approaches to assessing and testing driver knowledge?

Most licensing authorities in the EU, America and Australia have a policy of not publishing theory test questions and answers (Jonsson et al, 2003). By 2004, most EU countries were using multiple-choice items to test driving theory, the main reason being that this was the most consistent, objective and cost effective means of testing large numbers of candidates within the resources available. However, it is important that there are enough items to cover all areas of the driver curriculum (Henriksson et al, 2004).

What are the most effective approaches to assessing and testing hazard perception skills?

EU Directive 91/439/EEC strongly recommends the testing of hazard perception skills. Catchpole et al (2000) argue this is best done by computer-based assessment using video images of real-traffic situations rather than animated graphics. Many think a hazard perception test should be an 'exit' rather than an 'entry' test in a GDLS (e.g. Christie, 2000). There is no recognised best practice approach but it is suggested that assessments of traffic insight and hazard perception should focus on reaction time, search strategies, situation awareness and behaviour (Dutch National Road Safety Research Institute, SWOV, 2008).

What are the most effective approaches to assessing physical driving skills and ability?

An on-road practical driving test is the most commonly used method of assessment across international licensing systems (CIECA, 1998). Where compulsory logbooks are used to supplement evidence from the practical driving test, evaluation has shown that fatality rates amongst newly licensed drivers have reduced significantly (Twisk and Stacey, 2007).

Have Graduated Driver Licensing Systems been successfully introduced and used?

In 2000, the Insurance Institute for Highway Safety classified a 'good' GDLS as involving a mandatory learner's permit being issued for at least six months. The most important feature of a GDLS is the restrictions it puts on novice drivers in high-risk conditions (Foss and

Goodwin, 2003). New Zealand and Canada both reported reduced crash rates following the introduction of restrictions on all newly licensed drivers (Maycock et al, 1991). GDLS restrictions contribute to reduced crashes involving young people and not just because they reduce their exposure to risk (Begg and Stephenson, 2003). Although often very unpopular before their introduction, most young drivers affected by restrictions feel only marginal inconvenience and support GDLS (Begg et al, 1995; Mayhew et al, 2005). Police enforcement is not significant in a successful GDLS (Mayhew, 2000). It is parents who are the chief enforcers of US night-time driving and passenger restrictions (Williams, 1999).

4.4 Lifelong Learning

Is it necessary to provide on-going driver education and training?

Older drivers as a group have more traffic convictions and crashes and incur more fatalities per mile driven than any other adult age group (Anstey and Low, 2004). It is well established that normal ageing sees a decline in physical and cognitive abilities (Anstey and Low, 2004; Ballet et al, 1993; Bayam et al, 2005) which may be particularly apparent in an emergency or stressful driving situation (DfT, Lit Review No.25). Some driving skills, including vigilance, speed and distance judgements, co-ordination and hazard perception, are more difficult for older people (Anstey and Low, 2004; Ball et al, 1993; Bayam et al, 2005).

What techniques have proved successful in encouraging lifelong learning?

Computers are an ideal tool for exercising the brain and developing the cognitive skills needed to improve driver skills (Breznitz, 2005). Education programmes which target perception and cognitive skills may enhance driving performance and safety in older adults (Nasvadi, 2007; Marmeleira et al, 2008; Kua et al, 2007). Driving simulators can be an effective means of delivering training in these skills for older, more experienced drivers.

What is the best time to provide post driving test training and educational interventions?

There is evidence that physical and visual perception retraining can improve the driving performance of older drivers (Marmeleira et al, 2008). The best time to provide post-driving test training and educational interventions is from the age of 40 (Anstey and Low, 2004; Ball et al, 1993; Bayam et al, 2005; Bherer et al, 2005; Roge et al, 2004) although, of course, it continues to offer benefits to older age groups.

APPENDIX A – IRISH STAKEHOLDER GROUPS CONSULTED

Stakeholder Group	Number Consulted	Access Strategy
Pre-Learners - Individuals who have yet to enter the formal learning-to-drive process (including those who have attempted the Theory test but not yet passed)	Six workshops with 125 attendees.	Workshops (School Based) Workshops undertaken in Dublin, Wexford, Mayo, Cork, Kerry, Donegal.
Pre-Practical - Individuals who have passed the Theory test (including those who have attempted the Practical test but not yet passed)		
Post-Practical - Individuals who have passed the Practical test (including those who passed their Practical test up to two years previously)	29	Telephone Interviews.
Long Term Provisional – Individuals who drive but have not passed a formal driving test	26	Telephone Interviews and Workshop (Donegal).
Parents	Two workshops with 25 attendees.	Workshops undertaken in Dublin and Donegal.
Approved Driving Instructors	Two workshops 30 attendees.	Workshops in Cork.
Driving Testers	One workshop with 8 attendees.	Workshop in Mayo.
Teachers	n/a	Survey.
Gardai, Fire Officers, Ambulance Services	One workshop with 6 attendees.	Workshop in Mayo.
Road Safety Officers	Phone interviews with 2 RSOs.	Survey and Phone Interviews.
Stakeholder Groups – MADD, PARC, Irish Insurance Federation, Motorcyclists Action Group, Irish Cycling Group, Sim2Learn, RSOs, Irish Drivers Education Association, AA Ireland, SWOV, Medical Bureau of Road Safety, Trinity College.	Phone Interviews with 8 Stakeholders. Emails to 4 Stakeholders.	Phone Interviews and Emails.

APPENDIX B – DATABASES SEARCHED AND EXPERTS CONTACTED

Databases Searched

Organisation	Web Link
Australian Transport Safety Bureau	http://www.atsb.gov.au/
Australian Transport Safety Bureau - Australian Government	http://www.infrastructure.gov.au/
BNET	http://findarticles.com/p/articles/mi_qa3927/
CIECA	http://www.cieca.be/projectsstudies_en.pp
Department for Transport	http://www.dft.gov.uk
Department for Transport, Energy and Infrastructure - Government of South Australia	http://www.transport.sa.gov.au/index.asp
Department of Transportation	http://www.dot.gov
Human Factors and Ergonomics Society	http://www.hfes.org/Publications
Informit – Road and Transport Research: (A Journal of Australian and New Zealand Research and Practice)	http://search.informit.com.au/browseJournalTitle;res=IELENG;issn=1037-5783
Ingenta Connect	http://www.ingentaconnect.com
Ministry of Transport - New Zealand	http://www.transport.govt.nz
Monash University – Accident Research Centre	http://www.monash.edu.au/muarc/
National Highway Traffic Safety Administration	http://www.nhtsa.dot.gov
OECD – Road Transport Research	http://www.oecd.org
PsycINFO	http://www.apa.org/psycinfo/
Retail Motor Industry Federation	http://www.rmif.co.uk/association
Road Safety Scotland	http://www.road-safety.org.uk/research
Science Direct	http://www.sciencedirect.com/
Transport Canada	http://www.tc.gc.ca/en/menu.htm
Transport Research Knowledge Centre	http://www.transport-research.info/web/
Transport Research Laboratory UK	http://www.trl.co.uk

Transportation Research Board	http://ntlsearch.bts.gov/tris
Transportation Research Institute - University of Michigan	http://www.umtri.umich.edu/pubsdata.php
Umea University	http://www8.umu.se/edmeas/publikationer/index_eng.html

Experts Contacted

Name	Organisation
Niki Harre	The University of Auckland
Robert Isler	The University of Waikato
Chris King	LARSOA
Paul Rees	Roads and Traffic Authority, Australia
Nick Sanders	CIECA
Teresa Senserrick	The George Institute
Dr. Jean T. Shope	University of Michigan
Bob Smalley	RoSPA
Anna Sundström	Umeå University

APPENDIX C – LIST OF REFERENCES

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APPENDIX D – RESEARCH SUMMARIES

D1: Driver Education outside the Licensing System

In order to answer the research questions, literature was gathered that considered any type of training or educational activities outside of the licensing system that has been provided to drivers who have held their licence for less than 5 years. Examples of relevant literature included road safety education in schools or clubs, cognitive skills training and advanced driver training for novice drivers (not necessarily part of a graduated licensing programme).

Is driver education and training, outside of the driver licensing system an effective way of promoting knowledge and positive driving skills and attitudes?

Evidence from the literature review indicated that four main types of training are provided to pre/novice drivers (outside of the formal licensing system):

1. Pre-driver education targeting risky attitudes and behaviour with no in-car component (usually provided within a school curriculum).
2. Pre-driver education covering driving knowledge, skill (in-car) and attitudes (often provided within a school curriculum)⁷.
3. Pre and/or novice driver cognitive skills training. This training is often provided to novice drivers either during the learning-to-driver process or shortly after they gain a driving licence (either full or restricted).
4. Advanced/defensive driver training provided to novice drivers.

This review considers the effectiveness of each of these types of training separately.

Pre-Driver Education (without in-car component)

A large number of pre-driver education programmes (with no in-car component) have been developed and evaluated in the last 20-30 years (such as DfT's 'THINK' campaign and the Royal Society for the Prevention of Accident's (ROSPA) 'Safety and Education' suite). These types of training course are most often provided by schools, RSOs or other interest groups. Training tends to focus on raising awareness of road safety issues and promoting positive driving attitudes. However, there is little consistency in the way this training is delivered (methods range from classroom based 'chalk and talk' to theatre groups).

⁷ Note: this type of training is often intended to support pre-drivers in gaining a licence e.g. providing lessons to help them pass their practical test).

One of the key issues when assessing the effectiveness of pre-driver education is the quality of the evaluation studies undertaken. In many cases evaluations contain significant methodological flaws and, therefore, the results must be treated with caution. However, as part of the current work a substantial number of studies (including several general reviews) have been considered and it is possible to draw a number of conclusions with some confidence:

- Driver education has been shown to effect a small degree of short-term attitude change and to increase road safety related knowledge (Deighton and Luther, 2007; O'Brian et al, 2002).
- Results from one study has found a slight effect of driver education in terms of delayed licensure (Senserrick, 2007) and another suggests that driver education (when linked to a licensing system) may have a small effect in terms of reduced crashes (Di Pietro et al, undated). However, there is very little other evidence in the research literature in general to indicate that driver education has any effect on either age of licensure or driver behaviour.
- A substantial body of research findings indicates that attitude changes resulting from driver education fade after a relatively short period of time (Senserrick, 2007; Deighton and Luther, 2007; Elkington, 2005; Clayton et al, 1998; Carcary, 2001, Haare and Field, 1998).

In general, the results of pre-driver education evaluations tend to provide little support for their effectiveness. However, there are a number of possible reasons why existing courses may fail to achieve lasting attitudinal or behavioural change. Most courses are 'one off' training interventions with little follow up. As Fuller et al (2002) noted, the effect of this training is probably quickly over-ridden by other influences (e.g. peers, media and parents). It is possible that an educational intervention more closely linked to education provided at other stages of the learning-to-driver process e.g. post-licence, or to a GDLS may be more effective.

Pre-Driver Education (with in-car component)

A large number of pre-driver/driver training programmes which include driver training have been developed (particularly in the U.S.A and Australia) and several large scale evaluations of training of this type have been undertaken e.g. the DeKalb study in the United States.

Based on a review of a number of these studies a number of conclusions can be drawn:

- Pre-driver driving skills training was not found to provide any benefits in terms of reduced crashes (Senserrick, 2007; Vernick et al, 1999; Lonerio, 2008; Williams and Fergusson, 2004; Haworth et al, 2000; Twisk and Stacey, 2007).
- Some studies reported that pre-driver driving skills training can, at a population level, reduce the average age of licensure and therefore contribute to a small increase in crash rates (Senserrick, 2007; Vernick et al, 1999; Lonerio, 2008; Williams and Fergusson, 2004; Haworth et al, 2000; Twisk and Stacey, 2007).

The results of the review clearly indicated that providing driver skills training to pre-drivers does not result in any identifiable benefits in terms of reduced crashes. In fact, Williams and Fergusson (2004) noted that:

‘There is also considerable evidence that driver training that attempts to impart advanced skills such as skid control to learner drivers may contribute to increased crash risk, particularly among young males. This pattern of results has been confirmed and replicated across numerous studies conducted in Australia, New Zealand, North America, Europe and Scandinavia during the last 30 years’.

Pre and/or Novice Driver Cognitive Skills Training

While earlier pre-driver and novice driver education was centred on driving attitudes or skills training, more recently a number of training programmes focusing on driving related higher-order cognitive skills have been developed. These programmes tend to focus on training skills such as attention management and hazard perception. Only a few of these programmes have been developed to date and even fewer have been evaluated formally. However, some promising results have been found. Senserrick (2007) described a training programme called ‘Drive Smart’ which aims to improve drivers’ cognitive and perceptual skills. The programme targets learners who have already completed 40 hours of driving experience. Early evaluation results showed that trained novices performed better than a control group when tested on a driving simulator. Interestingly, the author noted that the programme did not appear to engender overconfidence in the drivers tested which is a key concern of other ‘advanced’ training. In addition, Isler et al (2008) reported a trial of another cognitive skills training programme. This training was all conducted off-road and involved video traffic simulations, road commentary, driving self-evaluation, focus groups, coaching and peer teaching. Higher skills training was found to significantly improve searching behaviours, hazard detection, driving attitudes and the composite score for the on-road driving test. Based on the results of studies such as these it can be tentatively concluded that:

- Cognitive skills training provided to novice drivers has the potential to improve higher order driving skills (e.g. attention management).
- Cognitive skills training provided through simulation does not appear to engender overconfidence.

The conclusions listed above should be treated with some caution. As Lonero (2008) noted, in the U.S.A, Europe and Australia interest in developing training of this type is growing. However, the development of these advanced programmes appears to be separated from other driver education initiatives and graduated licence schemes. In addition, few of the training interventions have been fully evaluated. Further research work is required before it

can be confidently concluded that cognitive skills training results in significant improvements in driver behaviour.

Advanced/Defensive Driving Training Provided to Novice Drivers

In addition to training interventions provided in the pre-driver phase, a number of training courses have been designed that aim to help drivers to improve or develop their driving skills after they have gained a driver's licence. Depending on the system, advanced training is given 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. Other European countries have a voluntary two-phase system.

The CIECA group has undertaken a review of a number of European programmes of this type and drew the following conclusions:

- Post-licence training interventions can have a positive impact on novice driver behaviour. However, not all training interventions are successful and further work is needed to identify what aspects should be included in the ideal programme to ensure success.
- Post-licence training is counterproductive if it focuses on vehicle skills only (Twisk and Stacey, 2007). Training programmes need to concentrate on the development of higher order driving skills, in-car training and driver attitudes.
- Post-licence training should not be a repeat of pre-licence training.

Whilst post-licence training does show some promise in terms of influencing novice driver behaviour, much work remains to be done to identify a model that consistently promotes behavioural change. The Road Transport Authority of New South Wales is currently undertaking a large scale research project which includes building a post-licence curriculum based on best practice behavioural and educational theory. The results of studies such as this one will provide a clearer picture of the potential of post-licence training interventions.

When is the most appropriate time to provide driver education or training (outside of the driver licensing system)?

While the literature gathered as part of this review identified a substantial body of research about the effectiveness of education and training for novice drivers (including the most effective training techniques), relatively little specific information was found about the most appropriate time to deliver training or education. However, it is possible to draw on a range of more general research findings to arrive at some tentative conclusions about the timing of education and training interventions.

Research findings cited in Waylen and McKenna (2002) indicated that some relatively young children exhibit behaviours and attitudes associated with risky drivers (even though they

have not yet begun to learn to drive). These findings, which are supported by other research (e.g. Carcary, 2002) indicated that attitudes towards driving are formed at a relatively young age. Taken in isolation, this suggests that driver education initiatives should begin in the years before young people begin to learn to drive in order to counter any risky driving attitudes at the earliest possible opportunity. However, general research on pre-driver education and training initiatives has shown that, while they might affect short term attitude change, they are not effective in reducing crash involvement in young people. As a result, it can be tentatively concluded that while it might be appropriate to provide pre-driver education at age 15-17 as an early intervention to counter negative driving attitudes and behaviours this training must be reinforced post-licence to try to ensure that positive driving attitudes are translated into safe and responsible driving behaviours. While the findings on the effectiveness of post-licence training interventions have been somewhat mixed (Christie, 2001), there is relatively more support for training provided at this stage than pre-driver training (in terms of behaviour change and crash reductions).

The available findings tentatively suggest that two-phase driver education programmes (pre and post licence) may represent the most appropriate schedule for providing education/training outside of the formal learning-to-drive process e.g. studying for the Theory Test and preparing for the practical driving test. It should also be noted that many industry experts advocate aligning this type of training with a GDLS⁸.

What education methods and techniques are most effective when providing driver education or training outside of the driver licensing system?

In general, research findings on education (not related to driver education) Chickering and Gamson (1987) recommended that educational practices should:

- Encourage contact between students and teaching bodies.
- Develop reciprocity and cooperation among students.
- Encourage active learning.
- Provide prompt feedback.
- Emphasize time-on task.
- Communicate high expectations.

The CIECA group (CIECA, 1998) has suggested that one-off classroom based interventions have not, generally, been found to be successful. Messages need to be reinforced over time

⁸ Graduated Licences are discussed in a later research question.

(the longer the better). It has been suggested that it is better to run a course over several sessions.

McKnight (2001) suggested that the classical education model is inadequate and that fundamental changes in content, methods, and organization are required for the effective reduction of novice drivers' crashes. He further suggested that driver education be linked more closely with parental and conventional community influences, graduated licensing and other influences such as incentives and disincentives.

Moreover, McKnight indicated two principal trends that could move drivers' education forward. These involved:

- More participation and group work by the students in the classroom.
- Individualised, computer-based, interactive multimedia training and testing. Computer-based instruction and part-task simulation are thought to have reached a point where driver education needs to make use of their largely untapped potential for training relatively complex capacities, such as allocation of attention (e.g. Gopher, 1992).

Further, McKnight recommended that self-pacing, diagnostics, frequent performance feedback, rewards for process effort and interim accomplishments, and a certain amount of self-direction and group goal planning should be included even in the early curriculum. Peer learning models and group work could help consolidate rational peer influences.

If attitude change is desired then programmes need to be interactive and use personal experiences and reflective thinking.

Computer-based training could be effective for some skills and does not result in the same kind of over-confidence issues as in-car training (Senserrick, 2007). Several packages, such as DfT's 'THINK' campaign and ROSPA's 'Safety and Education' suite, have been developed and used successfully.

D2: Driver training – within the licensing system

In order to answer the research questions literature was gathered that considered any type of training or educational activities within the licensing system. Examples of relevant literature included road safety training currently delivered to novice drivers.

What are the most effective approaches to imparting the knowledge required to gain a drivers licence (e.g. knowledge of rules of the road)?

The objectives of driver licensing, education and training programmes are to ensure the learner or novice driver has the skills, knowledge, and attitudes to drive safely and responsibly. The textbook and classroom components of drivers' education have often been referred to as theory. Much of this theory consists of written and graphic descriptions of basic manoeuvres as well as rules of the road and road signs. However, young and novice drivers continue to be over-represented in road crashes (McKnight, 2001; McKenna and Crick, 1997) and the absolute extent of the problem will almost undoubtedly increase due to impending demographic changes expected to produce a dramatic rise in the number of drivers. Recognition of these facts has underscored the continuing need for improved driver theory education and training.

The literature reviewed indicates that the classical education model of driver training is inadequate and that fundamental changes in content, methods and organisation are required for effective driver knowledge and skill transfer as well as attitude shifts. Methods that are considered effective and desirable for knowledge transfer include programmes that (McKnight, 2001; Lynham and Twisk, 1995; Te Braak et al, 1998; Wells et al, 2008; Chickering and Gamson, 1987):

1. Are realistic and simple.
2. Are multi-method (computer mediated, interactive, group-based, lecture style).
3. Provide prompt and specific feedback.
4. Communicate learning expectation.

This review will consider the effectiveness of each of these trends and methods separately.

Realistic and simple theory education

Experts suggest that the main aim of theory education is to aid learner drivers in preparing for real driving and traffic situations (McKnight, 2001; Lynham and Twisk, 1995; Te Braak, Groot, and Ruyters, 1998). Therefore, the knowledge gained in preparation for the theoretical test should be linked closely with the practical driver training and offer support to preparations for the practical test. Traditional theory courses remain too academic and removed from the reality of driving and consequently do not transfer to practical training.

Research conducted by the Transport Research Laboratory (1995) indicates that education should place greater emphasise on cognitive skills, personal assessments and the development of responsible attitudes to driving. Moreover, it was suggested that if theory education were to more effectively relate to the practical task of driving, learners' interest and motivation in the program will be lifted. Moreover, doing this will send a strong message that the program is practical and relevant to driving. Furthermore, experts agree that theory education should be clear and as simple as possible to remain suitable for foreigners and candidates with reading problems and varied education backgrounds (Te Braak et al, 1998). Indeed, failure of the Theory Test is sometimes thought to be caused when candidates understand the traffic rules but do not understand the way the questions are phrased (Te Braak et al, 1998).

Multi-method education methods

Gopher (1992) identified two developments that have been shown to be effective in educating learner drivers:

1. Increased participation and group work by learner drivers.
2. Individualised, computer-based, interactive multimedia training.

In general, education experts (e.g. Kay et al, 1987; Lewis and Neighbors, 2007) indicate that participatory and interactive teaching methods are widely seen as desirable and feasible for driver education. It was argued (McKnight, 2001) that many of the highest risk young drivers have low self-esteem, low self-control and low social responsibility, as well as irrational beliefs such as invisibility. It was further argued that the highest risk young drivers may be the very ones who learn least well through conventional lecture / text methods (McKnight, 2001). Drivers' beliefs regarding their actions and responsibilities within their community, as well as their perceptions of self-esteem, mastery of driving abilities, independence and self-control, are critical to the achievement of driver education safety goals. Therefore, driver education should both target the growth of these qualities and provide opportunities for practising them in the curriculum. Furthermore, self-pacing, frequent performance feedback, rewards for knowledge acquisition as well as short and long term task accomplishments and a certain amount of self-direction and group goal planning should be included even in the theory curriculum. Peer learning models and group work could help consolidate rational peer influences (Kay et al, 1987). Additionally, research (McKenna and Crick, 1997; Deery, 1999) indicates that of the study aids available to learner drivers, multimedia-based materials represented the most appropriate when preparing for both the theory and hazard perception assessments.

Providing prompt feedback

Providing learners with prompt and specific feedback reinforces their strengths and positive attitudes, as well as uncovering areas where improvements can be made. Moreover, there is compelling empirical evidence (Amons, 1956, cited in Ilgen et al, 1979; Kulik and Kulik, 1988) indicating that the longer the delay in the receipt of feedback, the less effect feedback has on learning and performance.

Communicating learning expectations

Communicating learning expectations involves establishing specific, measureable and time-limited objectives. Learner drivers can actively engage the subject matter when they see a purpose in the learning. Moreover, making expectations explicit will ensure that learners are clearly aware of what is expected of them and provides a process that allows them to work towards their objectives.

What are the most effective approaches to training hazard perception skills?

Compared to experienced drivers, novice drivers generally are less able to divide attention, scan the environment effectively, detect potential hazards early, and make tough decisions quickly (Crundall et al, 2003; Fisher et al, 2006; McKenna and Crick, 1997; Deery, 1999). Novice drivers perceive less risk in specific violations and high-risk situations but more risk in some low-risk situations. They often choose to drive too fast, too close to others, accept small gaps in traffic, leave inadequate safety margins and have unrealistic confidence in their own abilities. The safety mission of driver education has been to help novice drivers perform as safely as they will when they become more mature and experienced.

In the context of driving, hazard perception refers to the ability to read the road and anticipate forthcoming events. Hazard perception then is training that aims to sensitise learners to risk and hence decrease risk taking.

A large number of hazard perception education programmes have been developed and evaluated in the last decade (Crundall, et al, 2003; Fisher, et al, 2006; McKenna and Crick, 1997; Deery, 1999). Educational methods range from computer mediated instruction, classroom instruction, video and on-road hazard perception training as well as driving simulators. Training tends to focus on real-life traffic situations that aim to improve hazard detection abilities and risk perception, such as effective visual scanning, prediction of potential hazards, and safe decision making.

In the USA in the late 1990s, the AAA Foundation for Traffic Safety introduced the 'Driver-Zed' programme and in Australia the Monash University Accident Research Centre (MUARC) developed the 'Drive Smart' programme which was introduced in 2000.

In Driver-Zed, the participants follow the training modules: Scan; Spot; Act and Drive for three different road types. In the Scan module they are shown video fragments. After each fragment, questions are asked such as: Did you see the pedestrian? Did you see the car approaching you in the mirror? Did you see how fast you were driving? In the Spot module the participant has to click, in good time, where a hazard is looming in the video fragment. After this an explanation is also given. In the Act module, the participant is shown a video fragment of a looming hazard. Just before the hazard has completely developed, the fragment stops. The participant is asked what he/she would do in such a situation: brake, slow down, change direction, and such. After that the participant is shown the rest of the film, based on his/her answer. It is also explained why the answer was correct or not. The Drive module takes one step further. The participant now also has to decide on the moment at which he/she would take action.

The modules in Drive Smart are Scan, Keep Ahead and Play Safe (SKAPS). As well as focusing on hazard detection and threat appraisal, as Driver-Zed does, Drive Smart also focuses on assessing priorities and situational awareness. The state of Victoria in Australia has a GDLS which incorporates a compulsory hazard perception test. Training on Drive Smart has been found to significantly improve performance on this test.

Overall, evaluation research has provided support for the effectiveness of hazard perception education and training (Fisher et al, 2006; McKenna and Crick, 1997; Deery, 1999). More specifically, it has been found that, after training, novice drivers have improved their awareness of hazards and risk perception, recognise risks earlier, and have enhanced attentional control and time-sharing skills (Fisher et al, 2006; McKenna and Crick, 1997; Deery, 1999).

Programmes such as Driver-Zed and Drive Smart provide models of what an effective programme should contain. Training should provide learners with practice in critical elements of hazard detection and risk perception, such as effective visual scanning, prediction of potential hazards, and safe decision making.

What are the most effective approaches to training driving skills?

Research indicates (Christy and Harrison, 2003; Dorn and Barker, 2005; Emmerson, 2008, Engstrom et al., 2008; Forsyth, 1992) that a wide variety of methods are used in learning-to-

drive. These include a mixture of practice with accompanying drivers and professional tuition, which is thought to provide a slower but more consistent learning experience, rich in instruction and feedback. Regarding the former, parents are the main providers of supervised driving experience to their offspring. However, not all parents feel confident in this role and many find the task frustrating and stressful.

Results suggest that learning with accompanying drivers and learning with ADIs gives rise to different learning experiences (due to the variability and consistency of the methods used). Each approach has its pros and cons and both can play an important role in acquiring driving skills, although, on balance, practice with accompanying drivers would appear to be more important than professional tuition in enhancing the chances of passing the driving test. (Groeger and Brady, 2004; Gregersen and Nyberg, 2002; Dorn and Barker, 2005). Results from simulated driving performance suggest that professional tuition results in a potentially safer driving style. However, such tuition seems to only be beneficial up to five lessons. Beyond that it appears only to be effective with learners who have little or no practice with accompanying drivers, while practice appears to help all learners independently of the amount of tuition (Hall and West, 1996; AA Report, 2002; Christy and Harrison, 2003; Dorn and Barker, 2005; Emmerson, 2008, Engstrom et al, 2008). Similarly, less able pupils seem to learn more effectively with ADIs while more able pupils benefit more from the greater variety, faster learning, and reduced instruction and feedback that characterise informal practice with accompany drivers (Emmerson, 2008; Hall and West, 1996; Groeger and Brady, 2004). This suggests that different learners will benefit from varying amounts of formal tuition and informal practice. A single approach to teaching and supporting learner drivers will not be as effective as a tailored regime which takes account of individual learner's aptitudes and preferred learning styles.

D3: Driver testing and licensing

To answer the research questions, literature was gathered that examined as many different types of driver testing and licensing activities as we could find. Examples of relevant literature included research reports and reviews of current licensing systems in a large number of driver licence jurisdictions.

What are the most effective approaches to assessing and testing driver knowledge (e.g. content, question types)?

Results from the literature review indicate that the most widely used approach to assessing driver knowledge is a multiple-choice based test (Christie, 2000). However, although popular, the effectiveness of the theory test varies between tests and is reliant upon the quality, content and coverage of the test items (Jonsson et al, 2003).

A CIECA group seminar (1998) on enhancing the quality and consistency of the theory test made the following recommendations:

- The theory test should, as a minimum, include questions on:
 - Road traffic regulations
 - Driver alertness
 - Attitude
 - Risk factors
 - Other road users
 - Rules for administrative documents.
- The theory and practical tests should be closely linked and not taken more than a year apart.
- Each category of vehicle should have a separate test aimed at the specific skills and knowledge needed to operate the vehicle.

Results from the literature review clearly indicate that to obtain an accurate measure of driver knowledge the test items must be fully integrated with the driver curriculum and the practical test (Henriksson et al, 2004). In Sweden, the theory test has been successfully linked to the driving curriculum by awarding scores to test items based on their weighting and importance in the curriculum (Henriksson et al, 2004). The test can be passed in two ways; achieving 52 out of 65 or reaching a specific cut-off score for each area of the curriculum.

Finally, the CIECA group (CIECA, 1998) recommended that the theory and practical test should be taken no more than a year apart. Although there is no conclusive evidence concerning what is the optimal time to administer the theory test, Henriksson et al (2004) reported some initial positive results in Sweden where test takers are required to pass their theory test as close to their practical driving test as possible (no sooner than two weeks before and no later than six weeks afterwards).

A major problem is that there is a limited amount of validation evidence concerning theory testing. Where detailed technical evaluations have been carried out, these have been limited to the reliability, content validity and construct validity of the tests. There is almost no criterion-related or predictive validity evidence (European Road Safety Observatory, 2009). Henriksson et al (2004) argue, following Messick (1980, 1989), that these different types of validity are all part of a single conception of validity but this is only partially true. Messick makes the point that tests do not have validity. It is the inferences made from test results that need to be validated. If the inference from a driving theory test is that someone who passes the test will be a safer driver, then the correlation between test scores and safe driving needs to be assessed.

Therefore, overall, it cannot be concluded with certainty that the measures suggested for improving the design of theory tests will produce a valid assessment of driver knowledge. Many of the recommendations have not yet been implemented or fully evaluated. The case for their application is based almost entirely on expert opinion.

What are the most effective approaches to testing and assessing hazard perception skills?

Results from the research literature indicate that the testing of hazard perception is an essential element in the assessment of driver skills and safety (Williams, 2008). The European Union Directive (Directive 91/439/EEC on driving licences) strongly recommends the testing of hazard perception skills and many countries have introduced hazard perception tests as a compulsory element of the licensing system. The success of these assessments is not yet known as they are currently under investigation.

Results from early evaluations of the hazard perception test in the state of Victoria in Australia are encouraging. Catchpole et al (2000) reported that the test was a reliable assessment and could successfully discriminate between novice and experienced drivers. The test presented drivers with computerised traffic scenes and asked candidates to touch the screen when they would attempt the behaviour in question (Christie, 2000). Based on results from the Victoria test and a UK evaluation study (Emmerson, 2008) we can tentatively conclude that:

- Hazard Perception is best tested with a computer-based assessment (Catchpole et al, 2000).
- Scenarios should use video images of real-traffic situations rather than animated graphics.
- A hazard perception test is best used for assessment at the end of the driver licensing process, not as part of the knowledge (theory) assessment (Christie, 2000).

Although there are no conclusive best practice recommendations on the design and assessment of hazard perception tests, many researchers have advised that the following four aspects should be considered when measuring traffic insight and hazard perception skills (SWOV, 2008):

1. Reaction Time – testing the time it takes to react to a hazardous traffic situation.
2. Search Strategies – measuring eye movements in a road traffic situation.
3. Situation Awareness – testing if candidates can describe from a video traffic situation what they have seen and mention points that are important for road safety.
4. Behaviour Choice – testing candidates on what must be done to avert a hazardous situation.

Because diverse skills play a role in hazard perception, a full assessment should include a number of different tasks. However, hazard perception tests in the UK and Australia only assess individual aspects (for example, the UK hazard perception test only assesses identification reaction time). Although, these tests are not thought to provide a full evaluation of hazard perception they have been linked to hazard detection skills and reduced collision rates (SWOV, 2008).

What are the most effective approaches to assessing physical driving skills and ability?

An evaluation of the research literature indicates that there are three important aspects to consider when assessing physical driving skills:

1. The method of assessment.
2. The approach to the assessment.
3. The assessment criteria and contents.

An on-road practical driving test is by far the most favoured method of assessment across international licensing systems (Christie, 2000; Jonsson et al, 2003; Emmerson, 2008). The following recommendations were made by the CIECA group (CIECA, 1998) on enhancing the effectiveness of the on-road practical driving test:

- The test should last at least 35 minutes.
- The presence of the instructor in the car was seen as a positive factor, but was not essential.
- As a minimum, the curriculum should consist of the following:
 - Safety checks.
 - Getting in and out of the car.
 - Driving away.
 - Driving on straight roads.
 - Driving on bends.
 - Crossroads.
 - Changing direction.
 - Approach/ exit of motorways.
 - Overtaking/ Passing.

- Manoeuvres.
- A certificate of night-time driving should be obtained by the driving school before taking the practical driving test.

The final recommendation, a certificate of night-time driving, is currently being implemented in a number of licensing systems (including Victoria, Australia and Maryland, USA) which are supplementing the practical driving test with a record of compulsory accompanied practice, referred to as a logbook (Jonsson et al, 2003).

The logbook system requires learners to complete a minimum amount of accompanied driving practice in a range of specified driving conditions. One aim of introducing these logbooks is to introduce into the official assessment process an opportunity to assess skills not covered in the on-road practical driving test (e.g. driving at night and on motorways, and independent driving). Initial evaluations indicate that when logbooks were implemented as a compulsory national requirement they significantly reduced fatality rates (Twisk and Stacey, 2007).

Although the on-road practical driving test is the favoured method of assessment (CIECA, 1998) the approach taken to scoring and assessing the practical driving test differs greatly across licensing jurisdictions (Senserrick and Haworth, 2005).

Until recently, most systems assessed performance by identifying errors or faults. The decision to pass or fail was determined by the number and seriousness of the faults. (Mulvihill, 2003). Evaluations of this traditional scoring system have shown that the approach directs examiner's attention to a small number of fault categories instead of overall driving performance. The effect of this approach is that the practical driving test becomes unreliable (Baughan and Sexton, 1998). In the light of these limitations, many EU licensing jurisdictions are moving to a more competence-based approach where candidates' ability to perform specified driving skills and manoeuvres is assessed. This allows for a more holistic approach to driver assessment (Jonsson et al, 2003).

To try to improve the reliability and validity of the practical driving test, attempts have been made to standardise the assessment. Standardisation usually takes the form of ensuring that candidates encounter certain situations and driving environments. This has led to the use of set test routes. Though set routes do improve standardisation, it has been concluded from research that they compromise the validity of the assessment and remove the element of independent driving and decision making (Senserrick and Haworth, 2005).

The content of the practical driving tests also varies across licensing systems. This seems to be related to what is considered to be essential in different countries and what is merely

desirable. Senserrick and Haworth (2005) conclude that it is not essential to assess all aspects of driver knowledge and skill in the on-road test. Indeed, they favour a more integrated, progressive approach to driver training and assessment whereby some practical driving skills can be signed off before the practical driving test.

Finally, a review of the research (Jonsson et al, 2003) suggests that providing feedback on driver performance is essential to the training and progression of learner drivers but that it is not a feature of all practical driving tests. It is highly recommended that time is scheduled into the assessment process to give feedback.

In conclusion, the assessment of physical driving skills should be progressive and integrated throughout the learning-to-drive process (e.g. the CIECA group (CIECA,1998)). The use of logbooks has been essential in this approach and some initial success has been reported for this approach. However, it should be noted that the logbook system is heavily reliant on gaining the support and cooperation of an accompanying driver.

Have graduated licensing schemes been successfully introduced and used?

The goal of GDLS is to phase in exposure to increasingly complex and risky driving tasks and environments (OJJDP, 2000). This is relevant for all novice drivers but particularly for young people as they mature and develop their driving skills.

The literature review indicates that GDL systems are currently being successfully implemented and used across America, Australia, New Zealand and parts of Europe (Begg and Stephenson, 2003; Chen et al, 2001; Shope, 2007; Preusser and Tison, 2007). Many of these systems have been directly linked to the reduction of fatal collisions involving young drivers (Senserrick and Haworth, 2005).

Several large scale evaluations (e.g. EU projects GADGET and DAN) and an investigation by the Insurance Institute for Highway Safety (2000) classified GDLS into four categories; good, acceptable, marginal and poor. A 'good' program, that is, one clearly associated with crash reductions, includes the following initiatives:

- A mandatory learner period of at least six months.
- An intermediate/provisional licence phase that includes either:
 - A night-time driving restriction that begins before midnight OR.
 - Passenger restrictions on carrying persons under 21.
- A zero Blood Alcohol Content (BAC) limit for both learner and provisional drivers.
- No age-based exemptions from GDLS initiatives.

The above are regarded as the most effective elements in any GDLS. However, Senserrick and Haworth (2005) claim that the success of a GDLS is highly dependent upon public opinion and enforcement measures. These issues are considered below.

One of the main complications in implementing a GDLS is that the recommended initiatives are often the most unpopular (Mayhew, 2000). Senserrick and Haworth (2005) concluded that acceptance and support for GDLS initiatives were significantly linked to offering appropriate exemptions. This is evident in America and New Zealand where exemptions from night-time driving restrictions when travelling for work and education purposes improved support amongst drivers and parents (Begg et al, 1995).

One conclusion from the research literature is that the success of any post-test initiative is highly dependent on enforcement measures (Foss and Goodwin, 2003). An evaluation of international licensing systems suggests four best practice approaches to improving enforcement:

1. **Increased parental involvement** – Licensing systems that adopted the logbook approach to accompanied driving reported improved compliance and reduced driving risk among teenagers (Beck et al, 2003). Maryland reported further compliance with the introduction of guidance designed to help parents enforce restrictions on teen drivers.
2. **In-car technologies** - Insurance companies in the USA and the UK have offered GPS-based tracking systems in the vehicles of young drivers in exchange for up to a 40% discount on their insurance premiums if they agree not to drive between 11 p.m. and 6 a.m. In one UK scheme, the novice driver is charged £25 every time they are caught by the tracking device breaking the agreement. This initiative has not yet been evaluated though it is thought to have the potential to reduce young novice driver crash risk, based on results from a similar scheme aimed at drink driving (Senserrick and Haworth, 2005).
3. **Severe penalty points** – Many jurisdictions have introduced severe penalty points for novice drivers. However, research has concluded that it is the perception of detection and punishment that improves compliance not the severity of punishment (Senserrick and Haworth, 2005).
4. **Motivation** - Haworth (1994) reported that compliance has been improved by motivating safe driving rather than punishing violations. Haworth has claimed that compliance could be encouraged by rewarding good driving, for example, by the removal of licence restrictions after 6 months, rather than a year.

Overall, it seems there is no requirement for the intensive enforcement of GDLS initiatives, but rather a need to establish the threat of detection. Many systems reported that the initiatives are self-enforcing when supported by parents (Senserrick and Haworth, 2005).

In conclusion, the GDLS model is thought to reinforce a progressive learning process by providing hurdles to graduate from one licensing phase to the next (Baughan, 2000; Siegrist, 1999). However, it is important that the most effective GDLS approach is considered and tailored for each licensing jurisdiction.

D4: Lifelong learning

To answer the following research questions, research literature was gathered that considered any type of age related decline in ability and skill and potential interventions for driving. Relevant literature from medical journals, international research, public policy groups, conference proceedings, government agencies and research organisations was reviewed.

Is it necessary to provide on-going driver education and training (do driving skills deteriorate over time)?

The elderly represent the most rapidly growing segment of the driving population in western societies, both in the total number of drivers on the road, and the number of miles driven annually per driver. It is estimated that by the year 2024 one out of four drivers in Western Europe will be over 65 years old (Ball et al, 1993). Older drivers as a group have more traffic convictions and crashes and incur more fatalities per mile driven than any other adult age group (Ball et al, 1993). Older adults exhibit marked individual differences in many skills and abilities. Driving is no exception. The car has become the preferred mode of travel in western societies, and the elderly are relying increasingly on the car to maintain mobility. Therefore, there is a pressing need to better educate older adults about potential individual issues, deficits and impairments and provide them with interventions that will lower their crash risk.

Research indicates that in normal ageing there is a decline in physical as well as cognitive abilities, particularly those involving mental speed and problem solving (Anstey and Low, 2004; Roge et al, 2004). These cognitive abilities are thought to peak in the mid 20s and thereafter decline slowly until the 60s when a more rapid decline takes place. In relation to driving, some skills are intrinsically more difficult for older people, such as, vigilance, speed and distance judgements, coordination and hazard perception abilities (Anstey and Low 2004; Bayam et al, 2005; Roge et al, 2004).

Evidence suggests (Nasvadi, 2007; Marmeleira, Godinho, and Fernandes, 2008; Kua, Korner-Bitensky, Desrosiers, Man-Son-Hing, and Marshall, 2007) that post-licence education and training may be effective in modifying and enhancing several abilities critical for the driving performance and safety of older motorists.

Studies have shown that older drivers may be disadvantaged during driving assessments because of their age or their medical conditions (Wiseman and Souder, 1996). Existing licensing procedures for older drivers typically contain certain elements that will screen age-related deficits. In particular, the assessment criteria have a high percentage of psychometric measures requiring good visual acuity and quick reaction times for successful performance.

However, such measures may fail to reflect the actual functional ability of older drivers (Summala, 1988; Carr et al, 1994).

Research comparing simulated driving performance and on-road driving performance for elderly drivers has shown that conventional road tests to screen older drivers are not only costly, but also stressful and impractical for routine testing (Waller, 1991; Carr et al, 1994; Carr, 2000). Rapidly evolving electronic and computer technology have made laboratory-based driving simulators available at relatively low cost (Janke and Eberhand, 1998). It is thought to be a safe and economical means of testing driving performance. The driving simulator also allows testing of those unsafe and risky driving behaviours which have potentially dangerous consequences (Carsten et al, 1997). Indeed, many studies have concluded that driving simulators can provide accurate observations of drivers' behaviours and functions (Alicandri, 1994; Fraser et al, 1994; Van der Winsum, 1996). Overall, research supports the validity of the driving simulator and indicates that it is a safer and more economical method than on-road testing to assess the driving performance of older adult drivers. Moreover, apart from being used as an initial screening and testing tool, research indicated that it is likely to play an increasingly important role in assisting occupational therapists in the off-road assessment of older drivers as well as assisting driver training (Lee, 2002; Lee et al, 2003).

What techniques have proved successful in encouraging lifelong learning?

Evidence indicates (e.g. Ball et al, 1993) that older adults with driving problems can improve their driving skills through targeted treatment (e.g. treatment of ocular conditions that impair visual function such as cataracts or glaucoma) or through training or educational programmes. Specifically, Bherer et al (2005) provide evidence that, even under conditions in which older adults have previously shown most difficulty, e.g. in performing two discrimination tasks where both tasks require manual responses, training has provided substantial positive benefits for learning and performance. Furthermore, training aimed at driving showed substantial benefits amongst old and young drivers for both the ability to perform multiple tasks (such as steering, changing gear, indicating) concurrently and to maintain this ability over time (Nasvadi, 2007; Marmeleira et al, 2008; Kua et al, 2007). Such effects suggest that even older adults possess sufficient flexibility to learn new tasks and driving skills. Consequently, lifelong learning programmes must be designed to encourage individuals to seek specific ways to exercise and develop their cognitive functioning. One of the best ways to do this is to engage in activities that require some effort and are relatively new. Researchers investigating cognitive training for advancing driver skills suggest that

computers provide an ideal tool for exercising cognitive abilities (Breznitz, 2005). This is primarily because software programmes can adjust the level of challenge for each person individually.

Moreover, reviews of evaluative studies assessing the effectiveness of classroom based driver education (Ker et al, 2008) have found that older drivers who attend post-licence education appear to understand the need for increased alertness and visual awareness while driving and that they change their driving style as a result of attending.

Taken together, these findings indicate that older drivers are capable of learning new skills and facts about driving and are also capable of retraining these for long periods of time. They also suggest that education for mature drivers may be used successfully to both teach driving techniques and motivate drivers to use them. Nasvadi (2007) and Marmeleira et al (2008) suggest that older drivers consider attention to the driving task, awareness and tolerance of other drivers, and knowledge of road rules and road signs to be particularly relevant to their personal situation.

Furthermore, post-licence education for older drivers may be effective in modifying their aggressive driving behaviours and increasing their avoidance of hazardous driving situations (such as night-time driving, driving in bad weather) (Nasvadi, 2007; Marmeleira, et al, 2008). Similarly, other studies (Kua et al, 2007) have indicated that elderly people who are physically fit display better driving performance. They also have a potentially reduced crash risk through diminished stress, enhanced sleep and alertness, reduced fatigue, improved cognitive functioning, enhanced psychological and physical health status, greater efficiency in information processing, enhanced attention capacity in dual-task situations, better performance on tasks that demand visual-spatial processing, and better visual perception.

Results from a number of studies (Nasvadi, 2007; Marmeleira et al, 2008; Kua et al, 2007) have shown that specific exercise programmes incorporating open skills (defined as skills requiring physical co-ordination in fluid situations, such as collective ball games), as well as perception and cognitive activities can enhance several abilities critical for driving performance and safety in older adults.

Given the findings above, it is recommended that post-licence education programmes are developed which incorporate open skills, perceptual tasks and cognitive activities that may enhance several abilities critical for driving performance and safety in older adults.

Furthermore, classroom delivered programmes that present information on the effects of ageing on driving, general rules of the road and road signs, and strategies for reducing

driving risk can be used successfully to both teach driver techniques and motivate older drivers to use them.

What is the best time to provide post driving test training and educational interventions?

Evidence indicates (e.g. Welford, 1962) that from 40 years of age and onwards driving performance may show a decrement in an emergency or stressful situation. Similarly, marked declines in the useful visual field and visual acuity have been noticed in drivers over 54 years of age. Furthermore, rapid declines in cognitive abilities occur after the age of 60. Moreover, evidence suggests (Anstey and Low, 2004; Ball et al, 1993; Bayam et al, 2005; Bherer et al, 2005; Roge et al, 2004) that physical retraining and visual perception retraining can improve driving related skills in older drivers (defined as over 55 years of age). Given the differences in age related declines of abilities, it is recommended that the best time to start providing post driving test training and educational interventions is at age 40 but that it becomes a greater priority after the age of 60.