Study on driver training, testing and medical fitness

Final report

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Executive Summary

The information and views set out in this study are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

Background

Improving the education and training of road users in Europe through a range of training, testing and licensing approaches is an important strategic objective of the Commission's "Policy Orientations on road safety 2011-2020". Another is the protection of vulnerable road users, especially motorcyclists and also older drivers. The Policy Orientation document outlines the promotion of a wide approach across Member States which views education and training, licensing, testing and medical fitness as part of a road safety strategy which operates across the lifespan. The intention is that measures are in place to ensure that all drivers and riders (whether young or old, novice or experienced) are protected as well as possible. The project described in this report supports the Policy Orientation by providing a review of evidence of key topics, with recommendations based on this evidence, and a consideration of implementation opportunities and barriers.

Method

Reviews were undertaken of the evidence of effectiveness for different approaches to training, testing, graduated access to risk for Category B (car) drivers, graduated access to higher motorcycle categories, driving instructor competencies, and requirements on medical fitness to drive (including its relevance for older drivers). These reviews were undertaken using a systematic approach, with defined search criteria and quality assessment of papers to ensure that the findings were based on the best available evidence. The primary focus of the reviews was on road safety outcomes.

Current practice across Europe was also outlined, based on the existing literature (covering the majority of Member States) where possible, and also based on responses to a short online survey (with wide participation from 25 countries in Europe).

Using the evidence reviewed a series of good practice approaches were defined, and then discussed at a stakeholder workshop in September 2016, in Brussels. The focus of the discussion at the workshop was on identifying barriers and enablers to implementation of the different good practice approaches in European countries.

Findings from the reviews

The findings from each of the reviews were as follows:

Driver testing

Although the Directive 2006/126/EC has bought some standardisation to the use of theory tests and practical tests across Europe, a number of areas of variability remain. In particular, hazard perception testing (an approach that has shown promise in terms of having safety benefits) across Europe is rare. In addition, the pace of technological advancement is fast, and testing is not keeping up with this. The evidence also shows that age and inexperience are still the dominant factors impacting on the collision risk of young and novice drivers; a higher licensing age is desirable from a safety perspective,

and greater and more varied on-road practice (with or without a professional driving instructor) are the key things that a test should seek to stimulate.

Good practices suggested from the review covered the inclusion of theory lessons on things that are difficult to test, but which are nonetheless important from a road safety perspective (distraction, peer-pressure, impaired driving), the inclusion of hazard perception testing, a testing system that integrates with any graduated driver licensing system that is in place (for example different tests after different phases), coverage of different road types and times of day during the test, and a test that adapts with technological advancements.

Graduated risk exposure for novice drivers in training and licensing (Category B)

Although the majority of Member States have some kind of graduated access to risk through a 'graduated licensing' system (for example with harsher alcohol limits and stricter penalty points systems for novices), none have what would be termed a 'strong' system according to international experience and evidence. The evidence for the effectiveness of strong graduated licensing systems is overwhelmingly positive.

The good practices suggested centred on the implementation of restrictions on night-time driving and passenger carrying in a probationary period post-test, a minimum learning period, and minimum amounts of pre-test on-road practice.

Graduated access to higher motorcycle categories

Existing practice across Europe shows that the age at which someone can obtain an A1 licence is 16 in most countries. For an A2 licence the age is typically 18, and for a full A licence it is typically 21. A number of countries offer a 'direct access' scheme whereby people are able to move straight to riding an unrestricted power machine (A licence) without first progressing through A1 or A2 licences. The evidence on the impact of restricting access to higher motorcycle categories on road safety is limited, and typically based on very old studies. These studies do show that restricting access does have a safety benefit. The remaining evidence is based largely on international reviews of graduated access systems in the model of those used for car drivers, in which risk factors associated with age and inexperience are targeted through higher licensing ages, and prescribed amounts of on-road practice.

Good practice approaches suggested for discussion with stakeholders were that the licensing age should be higher for all motorcycles, that learners should be subject to minimum requirements of on-road practice, that time-discounting schemes (which can reduce time spent in the learner phase) should be avoided, and that age-based exemptions for direct access to higher machine categories should be avoided.

Driver training

Existing practice across Europe in terms of training differs widely. Some countries have mandatory training, others do not. Some insist on professional instructors, while others allow practice solely with 'lay instructors' (such as parents). The use of a multi-phase training, of national curricula, and post-test courses is again variable. The evidence on training suggests that the key features of a successful system would have little focus on any of this, but would instead focus on encouraging greater training of higher order skills, and on giving learners greater and more varied on-road practice of any kind, with

or without training from a professional instructor (since the evidence that professional instructors lead to safer drivers is weak at best).

The good practices suggested based on the evidence were that training should be based on a curriculum that includes a minimum number of on-road experiences, training of higher order skills such as avoiding distracted driving, training of hazard perception, new technological developments, and the abolishment of short training programmes aimed at enhancing skills to 'regain control' of the vehicle in emergency situations.

Driving instructor competences

Again existing practice across Europe (in terms of requirements on age, driving experience, teaching skills and so-on) for driving instructors is hugely variable. The evidence base directly related to instructor competencies and road safety outcomes is almost non-existent.

Nonetheless there are good practices which seem sensible, given the role instructors need to play in the training of drivers and riders. Ones discussed at the workshop were having minimum age, education and driving experience requirements for instructors (and an entrance test if required), the need for instructors to have no convictions for serious traffic offences or sexual harassment, standardised training objectives and a minimum training period for instructors (including educational competencies), a practical test and a theory test, and compulsory periodic training and quality checks after an instructor is licensed.

Requirements on medical fitness to drive

Understanding the impact of medical fitness is important as the driving population ages, and all countries examined have age based re-testing, including eye tests, and most require medical tests for re-licensing. The legal duty to report health problems, the precise role of medical general practitioners, and the age at which retesting was required were more variable. The evidence base on requirements on medical fitness to drive is substantial. It suggests that age based screening is not effective, and may even have a negative safety (as well as mobility) impact. The frequency with which older drivers need to renew their licence is variable, and along with age limits is not based on current best practice regarding crash risk or incidence of relevant disease. Screening tools also lack an evidence base, and their use is generally shown not to reduce crashes. General medical practitioners often find themselves in a dilemma, needing to balance the (often unfounded) concerns over safety with not wanting to restrict mobility for older people (which can have a major negative impact on health and wellbeing).

Good practices discussed covered the need for a consistent and evidence-based screening process, a validated off-road assessment tool, clearer guidelines and education programmes for medical practitioners, materials to aid in decision making for older drivers (regarding the decision to keep driving or give up) and the use of 'restrictive; licences which permit driving under some circumstances for those known to have some medical issues, which enables such drivers to retain some mobility.

Recommendations

During the workshop, stakeholders were given an opportunity to discuss perceived barriers and enablers to implementation of the good practices. On the basis of the evidence, the good practices are seen as desirable end goals from a road-safety perspective. Taking into account the feedback from stakeholders at the workshop in this

project, the recommendations below have been tailored to reflect the extent to which Member States appear to be ready (or not) for implementation.

In cases in which stakeholders indicated no major obstacles to implementation, recommendations suggest that the EC should take action to facilitate implementation; the key mechanism for achieving this should be (in the absence of updating the main text of the Directive 2006/126/EC) a review and update of the technical annexes in the Directive. Where there are other mechanisms (either in addition to or instead of updates to the annexes) this is noted alongside each recommendation.

In cases in which many barriers to implementation were noted, recommendations take a more pragmatic approach in pointing to the next steps necessary to progress policy in a positive direction.

Driver testing

Based on the mentioned good practices and the opinion of the stakeholders, the following recommendations[1] are made:

1. The EC should promote the inclusion of a hazard perception test in the licensing system of all Member States. Edits to Annex II of the directive are clearly desirable in this case, but the support and evidence for this approach is such that we recommend that the EC promote it regardless, even in the absence of changes to the annex. See also Recommendation 11.

Good practice: Hazard Perception testing in Great Britain

Hazard perception testing was researched thoroughly throughout the 1980s and 1990s. A useful overall summary of the research undertaken in GB and around the world is provided by Grayson and Sexton (2002). An important early finding was that in order to be useful as a test instrument, a hazard perception test needs to be able to discriminate between high- and low-risk road user groups. It should be possible to show that people who score badly on the test are at greater risk of having a collision on-road than people who score well. Another important feature is that the test should measure a driver's ability to anticipate hazards on the road ahead, rather than simply their 'reaction time'. Although many of the valid tests that have been developed rely on some time-based measure of performance, this is typically related to 'spotting hazards early as they develop' rather than 'responding quickly when a hazard is fully developed'.

Great Britain introduced the hazard perception test into the theory test in November 2002. This has resulted in a decline in the number of crashes in the first year after licensing of 11.3% (for certain on-road crash types expected to benefit from greater hazard perception skill) (Wells, Tong, Sexton, Grayson, & Jones, 2008).

Current developments include further development of the test bank using 3D computer animation, which has the benefit of flexibility over the longer term (for example creating hazards using modern-looking vehicles, rather than relying on older-looking filmed stimuli). Some details of such work in GB can be seen at the following link: https://www.gov.uk/government/news/hazard-perception-clips-get-a-modern-makeover

[1] Note that a number of these recommendations stem from the fact that the test is itself a tool for stimulating adequate preparation during the learning to drive process (even when the test itself cannot test everything perfectly)

2. Directive 2006/126/EC includes learning objectives about knowledge of safe attitudes and the willingness to drive safely (Annex II). However, knowledge as such is not enough to change driving behaviour. Therefore, Member States should consider including lessons in basic driver training programs that stimulate risk awareness, low risk acceptance, self-awareness, not to drink and drive, not to get distracted, and so-on.

3. The EC should aim to raise awareness among Member States that the driving task is rapidly changing due to new technologies (e.g. navigation systems, adaptive cruise control, lane keeping systems, inattention warning systems, semi-autonomous driving systems), and that safe and adequate use of these systems needs to be learned during basic driver training, and if possible be tested[2]. One route which might be considered to achieving this is through engagement with relevant stakeholder organisations such as CIECA.

4. Directive 2006/126/EC stipulates that wherever practical, the on-road driving test should include all major road types. However, Directive 2006/126/EC does not stipulate the time of day. Preferably, candidates should be tested both while driving in daylight and while driving during hours of darkness. This is difficult to organize and will increase the costs of the driving test. Therefore, Member States should require that part of the formal driving lessons and part of the hours of accompanied driving are driven during hours of darkness.

5. The driving test is not only an instrument for selection (those who do not meet the standards are not allowed to drive on public roads) it is also a method to assure that learners take driving lessons. Therefore, the EC should enhance those training objectives that are mentioned in Annex II of Directive 2006/126/EC that can be tested and for which an association with road safety or environmentally friendly driving has been found (i.e. those skills, competencies and experiences during driver training that have been shown to benefit safety or environmentally friendly driving).

Graduated risk exposure for novice drivers in training and licensing (Category B)

The generally negative responses to the good practices related a Graduated Driver Licensing (GDL) system were almost all ones that are typically raised and have been discussed elsewhere in the literature (see Kinnear et al., 2013). When we consider that strong GDL systems are in place in a number of countries around the world, and that such systems have been shown conclusively to reduce young driver collisions and injuries, even with less-than-perfect compliance[3], such barriers to implementation cannot be considered as insurmountable.

In the opinion of the report authors, the strength of the evidence base on the effectiveness of the GDL components proposed makes it important that the adoption of such a strong GDL system across Europe is seen as a priority. However, it is also understood that such change cannot happen overnight. Therefore, as with other topic

[2] How systems such as adaptive cruise control (ACC), blind spot detection systems, and lane keeping systems should be used in a responsible and safe manner can differ from vehicle type to vehicle type. Therefore car manufacturers also have a responsibility to train drivers in using these novel technologies.

[3] It is known that there is some level of non-compliance with GDL restrictions, but such systems are still shown to work. The same argument can be applied to speed limits; we know that at least some drivers break the speed limit, at least some of the time, however we still have speed limits and they still work.

areas covered in this project, we propose the following mix of tangible, but pragmatic recommendations:

6. Member States should consider implementing strong GDL systems with minimum learning periods, minimum requirements for on-road practice before solo driving commences (120 hours is desirable,see Kinnear et al., 2013) and post-test restrictions on night-time driving and the carrying of peer-age passengers. Lower alcohol limits for newly qualified drivers are also desirable if they are not included already in a Member State.

Good practice: Strong graduated driver licensing

The term 'graduated driver licensing' (GDL) has come to mean a range of things, but there is broad agreement in the literature as to what a strong (and therefore effective) system should look like. Kinnear et al. (2013) suggest that the strongest and most effective systems have at least the following components:

1. A minimum period of time spent learning (at least one year is proposed)
2. A minimum amount of on-road practice during this period (120 hours is proposed as a minimum)
3. A probationary period (ideally one to two years) after solo driving begins, during which there are restrictions on night-time driving and the carrying of passengers, unless accompanied by an appropriately experienced supervising driver
4. A lower alcohol limit should also be in place during this probationary period

Some further detail on the effectiveness of various components of GDL systems can be found in: Senserrick, T., & Williams, A. F. (2015). Summary of literature of the effective components of graduated driver licensing systems (Vol. AP-R476-15). Sydney: Ausroads Ltd.

The following website also has a good deal of detail regarding effective systems in the USA. While the 'crash calculator' outputs probably cannot be generalised in absolute terms to other jurisdictions, they are useful in illustrating what has been shown to be effective in the USA:

http://www.iihs.org/iihs/topics/laws/gdl_calculator?topicName=teenagers

7. The EC should see the adoption of a strong GDL system across Europe as a priority. For the first step in this recommendation, the EC should consider promoting research within the Horizon 2020 programme, or another funded research programme, into two things:

    a. (Research) An assessment of the likely casualty savings that would be realised in each Member State, if a GDL system, such as that suggested by Kinnear et al. (2013), were implemented. This research should also consider the likely impact of individual components (with varying 'strengths' of restrictions considered). An example of this for regions in the UK was reported by Kinnear, Lloyd, Scoons and Helman (2014).

    b. (Research) An assessment of how such systems have been implemented in other countries such as New Zealand and Australia, including an understanding of the steps necessary to convince the public, and political

and other stakeholders as to the merits of GDL systems and their individual components.

Such work would seek to 'lay the foundations' for at least some incremental strengthening of licensing systems across Europe in the hope that, as has been observed in other jurisdictions, post-implementation improvements in acceptability from stakeholders (in the light of observed casualty savings) would permit further strengthening of systems over time.

Graduated access to higher motorcycle categories

The literature on young and novice motorcyclists is scarce. Just as for learner drivers however, age and inexperience are key risk factors for motorcyclists and, as such, much can be learned from the driver training literature which is currently very extensive. In light of this, and building on the assumption that age and exposure should be primary concerns in relation to riders, four recommendations are provided.

8. It is recommended that Member States consider increasing the number of on-road supervised training hours that learner riders receive, and ensuring that these are logged and monitored across Member States.

9. Currently, access to an 'A' licence for those riders under 24 requires 2 years' experience on an A2 licence. It is recommended that Member States maintain this stepped process, since it makes it more likely that younger riders have some experience on road before solo riding of larger bikes[4].

10. (Research) It is recommended that the EC undertake research to:

    a. Evaluate the potential benefits and disbenefits (in terms of at least safety and mobility) that would result from the future implementation of a minimum age of licensure for riders that is higher than it is now (for example in line with, or potentially higher, than that for car drivers).

    b. Assess the safety effects of progressive access to higher-powered motorcycles, compared with direct access to an unrestricted category (A)

    c. Understand if rider characteristics influence choices to ride higher-powered bikes and if these relate to increased risk, and use this knowledge to inform the development of rider training approaches

Driver training

Taking into account the results of the literature review and what was discussed during the workshop, the following recommendations are proposed:

11. All Member States should include hazard perception training in basic driver training programmes. See also Recommendation 1.

12. Because safe attitudes and the motivation to drive safely cannot be tested properly during the driving test (see Recommendation 2), Member States should require that driver training programs include lessons about risk awareness, risk acceptance, self-awareness, the dangers of drink driving, distraction, and so-on.

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[4] No Member States currently report such systems, but future-proofing is recommended to maintain current practice.

Good-practice: Mandatory post-licence training in Austria

A good example is the mandatory post licence training in Austria. After having passed the driving test, novice drivers have to attend three separate training programs during the first year of solo driving. This was introduced in 2003. The first training program is a so-called 'feedback drive'. This drive is not about skills but about driving style. During the drive the novice driver gets feedback about his/her driving style and gets tips for improvement. The second training program is on a training ground (test track). This is not an anti-skid course but a method of confronting the novice driver with his or her limitations; the novice driver experiences how easy it is to lose control and learns that he or she should avoid circumstances in which control can easily be lost. The third training program is a group discussion followed by a second feedback drive. The group discussion is chaired by a psychologist. A number of risk situations are discussed and the underlying factors of this risk taking, such as overestimating one's skills, and one's responsibilities in traffic. A similar mandatory post licence training program but without a group discussion had only a marginal effect on crash rate in Finland (Keskinen et al., 1999). However, the extended program with a group discussion and a second feedback drive in Austria resulted in fewer self-reported traffic offences and accidents (Myntinnen et al, 2010).

13. Member States should seek to find ways to increase the amount of supervised on-road driving that learner drivers undertake before solo driving commences. Research suggest that on average 3000 km or 120 hours of supervised driving (see good practice below) is required to reduce crash risk during the first years of solo driving.

Good practice: Greater amounts of on-road experience

Graduated Driver Licencing (GDL) systems in the USA, Canada, Australia and New Zealand start with a supervised driving phase. During this phase the learner driver gains driving experience while being supervised by a lay instructor (usually a parent). There is some evidence that approximately 120 hours of supervised driving within such a system lowers the crash rate in the first years of solo driving (for an overview of research on this topic, see Senserrick & Williams, 2015). Sagberg & Gregersen (2005) found that on average learners drove 3,800 km while being supervised by a lay instructor in Sweden, compared with only 1,150km in Norway. In Sweden, supervised driving resulted in a lower crash rate in the first years after licencing while in Norway it did not, suggesting that greater amounts of on-road practice are more protective.

14. Because research shows that short training programs to enhance the skills to regain vehicle control in emergency situations such as skid recovery training, do not reduce crash risk and sometimes can even increase crash risk, Member States should discourage to include short training programs that are merely aimed at enhancing vehicle control skills in emergency situations that only rarely occur, in basic driver training programs.

Given the mixed responses from stakeholders regarding the latter two topics, a communication-based approach would seem to provide the best balance between acceptability and an assertion that these good practice approaches are being pursued.

Driving instructor competencies

No studies could be found about the effect the quality of driving instructors has on driving behaviour and the crash risk of newly licensed drivers. The overview of the training programmes for driving instructors and the minimum requirements for becoming a driving instructor shows that they differ considerably between Member States. Considering the lack of studies and the mixed opinions of stakeholders, the following recommendations are proposed:

15. (Research) Member States should promote research to investigate whether the quality of driving instructors has an effect on behaviour, especially with regard to higher order driving skills.

16. If such research indicates that the higher order driving skills of formally trained drivers (those trained by a professional driving instructor) are better than those of informally trained drivers (those who have relied on practice whilst supervised by a so-called 'lay instructor' such as a parent), Member States should then consider improvement of training programmes of professional driving instructors, to ensure that any advantage of professional tuition is maximised.

17. Given the self-evident need for driving instructors who respect learners, Member States should take precautions that driving instructors have not been convicted for sexual harassment and have not committed serious traffic offences (if such measures are not already in place).

18. (Research) Member States should consider evaluation studies into the effects of refresher training/CPD of driving instructors on road safety outcomes for young and novice drivers.

19. Member States should see to it that the theory test and the practical test for driving instructors include the testing of knowledge educational methods and the skill to apply these methods.

Good practice: Learner-centred approaches

First and foremost, more research is required on the effect the quality of driving instructors has on the crash rate of newly licenced drivers. However, we do know that most crashes by novice drivers are caused not so much by a lack of basic driving skills but are caused by the lack of higher order skills (e.g. hazard anticipation, risk awareness, and self-awareness). There is some evidence, (although more research is required), that learner-centred methods such as coaching are more appropriate for acquiring higher order skills than just instruction. This suggests that driving instructors should be capable of applying learner-centred methods. A good example of learner-centred or 'coaching' methods is seen in Bartl, (2010).

20. Member States should take provisions for mandatory periodic life-long on going vocational training and periodic assessment of proficiencies.

Requirements on medical fitness to drive

From the review, it is apparent that medical fitness to drive is a critical aspect of maintaining and reducing road trauma in Europe, and is especially relevant given the projected increases in the number of older drivers as the population ages. Best practice evidence shows that a person's ability to drive should be based on functional deficit, rather than age or medical condition. The following recommendations are made:

21. It is recommended that a standardised screening process be considered across all Member States when assessing a driver's fitness to drive for a Class B driving licence. The process should be based on international best practice and ideally, consistent across all jurisdictions.

Good practice: Standardised screening process

A standardised screening process ensures that there is a consistent approach to assessing medical fitness to drive across Member States, optimising safe driving and reducing opportunities of licensing malpractice in Europe.

Current best practice suggests the following: (i) referral by a General Practitioner to a specific traffic medicine centre, (ii) assessment of fitness to drive using validated off-road screening tools with acceptable sensitivity and specificity measures, (iii) referral to expert medical advisory boards for final assessment by expert medical advisors, and (iv) an appropriate appeal process by the individual for disputed claims.

Best practice models currently operate in Sweden, Canada, parts of the USA, and Australia, although the lack of a validated off-road screening tool has led to use of on-road assessments that have questionable validity and are potentially dangerous for clients and assessors.

22. It is recommended that, while a consistent screening tool or protocol should ideally be applied across all Member States, international best practice suggests that these judgements should at the very least be made using the same functional criteria.

23. It is recommended that the existing practice across all Member States of General Practitioners (GPs) being the primary point of call for initiating an assessment of a person's fitness to drive (as shown in Table 12) be continued. The development and implementation of consistent guidelines by Member States for all GPs is strongly recommended based on international best practice.

24. It is recommended that evidence-based education programs, shown to be effective and accepted by GPs, be promoted, and adopted across all Member States for consistency in assessing a person's fitness to drive. Appropriate incentives for GPs to participate in this area should be evaluated.

Good practice: Education programmes for general practitioners

General Practitioners are for the most part willing to be the primary point of call for initiating an assessment of a person's fitness to drive. However, they often acknowledge the lack of details on specific assessment criteria to use and some feel uneasy about making the assessment, especially around key unsafe driver functions. It is recommended therefore, that educational programs for GPs be established to assist in this process.

Best practice examples of such educational programs for general practitioners can be found in Ireland and Canada in Continuing Medical Education (CME) programs involving master classes, clinical updates, case studies, and online courses, designed to provide vital skills in specific traffic medicine topics related to standards in national guidelines and practices.

25. It is recommended that the EC consider development and promotion of materials to support successful self-regulation and transition to reduced driving and driving

cessation. These materials should be made freely available to all Member States, to assist individuals in undertaking assessment of their own fitness to drive.

Good practice: Self-Regulation Materials

While it is a difficult task for people with questionable fitness to drive to decide to stop driving at an appropriate time, especially those with severe dementia, nevertheless many elderly and medically challenged drivers do seek out information on self-assessing their own driving abilities. Family members of these individuals also require such materials to help them in deciding whether to initiate an assessment process.

There are best practice examples of brochures, test procedures and online courses that could be made available or used to assist individuals and family members in this process. These include classroom education courses that provide criteria and strategies for safe driving and transition to non-driving, online self-assessment tools, hazard perception assessments (Australia and USA), test-track training courses with individual feedback on driving performance (Canada and Australia), and brochures outlining safe and unsafe medical and functional abilities with recommended thresholds (Australia).

26. Codes 61 to 69 in the Directive 2006/126/EC list a range of Limited Use Codes for conditional licences which may be of benefit for those with a range of medical conditions. The EC should recommend that Member States make wider use of such conditional licences where possible. (see good practice below).

Good practice: Conditional and restricted licences

Conditional or restricted licences are currently used in at least 3-European countries (Austria, Belgium, and Hungary) as shown in Table 12. Other countries such as Australia and Canada also have adopted restricted or conditional licences for those shown to be marginally at risk but who require personal mobility for basic medical and social activities.

Restricted and/or conditional licences come with a minimum likelihood of an increase in crash exposure and risk (only marginal if applied in low traffic conditions). Authorities need to balance this increase in crash risk with health and social needs of the individual and should be regularly reviewed (commonly yearly). There is always the risk, too, that an individual needing their car for important mobility may drive unlicensed if their licence is stopped entirely.

27. (Research) It is recommended that further research be commissioned in three key areas, which will provide much needed evidence to support the implementation of a consistent approach in the assessment of a person's fitness to drive namely:

    a. Undertake research to develop an effective and transparent screening protocol for possible use across Europe in testing the functional capabilities of someone suspected of being an unfit driver of a Class B vehicle.

    b. Undertake research to develop evidence-based guidelines for GPs across all Member States to use in assessing a person's fitness to drive.

    c. Undertake research to develop and evaluate educational programs for GPs that are both effective and accepted by medical practitioners.

Résumé analytique

Mise en contexte

L'amélioration de l'éducation et de la formation des usagers de la route en Europe par le biais de toute une gamme d'approches de formation, examens de conduite et permis est un objectif stratégique important des Orientations politiques de la Commission pour la sécurité routière de 2011 à 2020. Un autre objectif est la protection des usagers vulnérables de la route, notamment les motocyclistes et les conducteurs plus âgés. Le document sur les Orientations politiques décrit la promotion d'une vaste approche parmi les États membres qui considère l'éducation et la formation, les permis, les examens et l'aptitude médicale dans le cadre d'une stratégie de sécurité routière qui s'étend sur toute la vie. L'intention est que des mesures soient en place pour s'assurer que tous les conducteurs et motocyclistes (qu'ils soient jeunes ou âgés, novices ou expérimentés) soient aussi bien protégés que possible. Le projet décrit dans ce rapport soutient le document sur les Orientations politiques en fournissant une analyse des preuves de sujets clés, avec des recommandations basées sur ces preuves, et une prise en compte des opportunités et obstacles à la mise en œuvre.

Méthode

Des analyses ont été entreprises sur les preuves de l'efficacité de différentes approches sur la formation, les examens, l'accès progressif au risque pour les conducteurs de la Catégorie B (voitures), l'accès progressif aux catégories supérieures de motos, des compétences des moniteurs d'auto-école, et des exigences relatives à l'aptitude médicale à conduire (y compris sa pertinence pour les conducteurs plus âgés). Ces analyses ont été entreprises en adoptant une approche systématique, avec des critères de recherche définis et une évaluation de la qualité des documents pour s'assurer que les résultats sont basés sur les meilleures preuves disponibles. Les analyses étaient avant tout axées sur les résultats en termes de sécurité routière.

La pratique actuelle en Europe a également été décrite, sur la base de la documentation existante (couvrant la majorité des États membres) dans la mesure du possible, mais aussi sur la base des réponses à une brève enquête en ligne (avec une large participation de 25 pays européens).

À partir des preuves passées en revue, une série d'approches de bonnes pratiques a été définie et a ensuite fait l'objet d'une discussion lors d'un atelier réunissant les parties prenantes à Bruxelles en septembre 2016. L'objet de la discussion lors de l'atelier était l'identification des obstacles et des facteurs favorisant la mise en œuvre des différentes approches de bonnes pratiques dans les pays européens.

Résultats des analyses

Les résultats de chacune des analyses ont été les suivants:

Examens de conduite

Bien que la Directive 2006/126/CE ait créé un certain degré de standardisation dans l'utilisation des examens théoriques et des examens pratiques à travers l'Europe, un certain nombre de domaines de variabilité demeurent. En particulier, les tests de perception des dangers (une approche qui s'est avérée prometteuse en termes d'avantages de sécurité) en Europe sont rares. En outre, le rythme des avancées technologiques est rapide, et les examens de conduite ne parviennent pas à le suivre. Les preuves montrent également que l'âge et le manque d'expérience sont toujours les facteurs dominants qui ont un impact sur le risque de collision des jeunes conducteurs novices ; un âge plus élevé pour le permis est souhaitable du point de vue de la sécurité, et une pratique routière plus importante et plus variée (avec ou sans moniteur d'auto-école professionnel) sont les éléments clés qu'un test doit chercher à stimuler.

Les bonnes pratiques suggérées par la analyse couvraient l'inclusion de leçons théoriques sur les aspects qui sont difficiles à tester, mais qui sont toutefois importants du point de vue de la sécurité routière (distraction, pression des pairs, conduite déficiente), l'inclusion de tests de perception des dangers, un système de test qui s'intègre à tout système de permis de conduire progressif en place (par exemple différents examens après différentes phases), la couverture de différents types de route et heures de la journée pendant le test, et un test qui s'adapte aux avancées technologiques.

Exposition au risque progressive pour les conducteurs novices dans le cadre de la formation et du permis (Catégorie B)

Bien que la majorité des États membres disposent d'un certain degré d'accès progressif au risque par le biais d'un système de « permis progressif » (par exemple avec des limites d'alcool plus rigoureuses et des systèmes de points de pénalité plus stricts pour les novices), aucun ne possède un « solide » système conforme à l'expérience et aux preuves internationales. Les preuves de l'efficacité des solides systèmes de « permis progressif » sont incroyablement positives.

Les bonnes pratiques suggérées étaient axées sur la mise en œuvre de restrictions sur la conduite de nuit et le transport de passagers pendant une période probatoire post-test, une période d'apprentissage minimum, et des quantités minimum de pratique routière avant le test.

Accès progressif aux catégories supérieures de motos

La pratique existante en Europe montre que l'âge auquel une personne peut obtenir un permis A1 est de 16 ans dans la plupart des pays. Pour un permis A2, l'âge est généralement de 18 ans, et pour un permis A complet, il faut généralement avoir 21 ans. Un certain nombre de pays proposent un programme à « accès direct » où les usagers peuvent passer directement à la conduite d'une moto puissante sans restrictions (permis A) sans avoir progressé avec les permis A1 ou A2. Les preuves relatives à l'impact de la restriction d'accès aux catégories supérieures de motos sur la sécurité routière sont limitées, et généralement basées sur de très anciennes études. Ces études montrent que la restriction de l'accès présente un avantage de sécurité. Les preuves restantes sont principalement basées sur des analyses internationales de systèmes d'accès progressifs s'appuyant sur le modèle de ceux utilisés pour les conducteurs de voitures, dans lequel les facteurs de risque associés à l'âge et au manque d'expérience sont ciblés par des âges plus élevés pour le permis, et des quantités prescrites de pratique routière.

Les approches de bonnes pratiques suggérées pour discussion avec les parties prenantes soulignaient que l'âge du permis devrait être plus élevé pour toutes les motos, que les apprentis conducteurs devraient faire l'objet d'exigences minimales en termes de pratique routière, que les programmes accélérés (qui peuvent réduire le temps passé dans la phase d'apprentissage) devraient être évités, et que les exemptions basées sur l'âge pour un accès direct à des catégories de machines plus élevées devraient être évitées.

Formation des conducteurs

La pratique existante en Europe en termes de formation varie grandement. Certains pays ont une formation obligatoire, d'autres non. Certains insistent sur des moniteurs professionnels, tandis que d'autres permettent la pratique uniquement avec des moniteurs non professionnels (comme les parents). L'utilisation d'une formation à phases multiples, d'un parcours national, et de cours post-test est également variable. Les preuves relatives à la formation suggèrent que les caractéristiques clés d'un système qui fonctionne bien seraient peu axées sur tout cela, mais consisteraient plutôt à encourager la formation en termes d'aptitudes de catégorie supérieure, et à proposer aux apprentis conducteurs une pratique routière plus importante et plus variée, avec ou sans moniteur professionnel (étant donné que les preuves selon lesquelles les moniteurs professionnels mènent à des conducteurs plus prudents sont, au mieux, faibles).

Les bonnes pratiques suggérées basées sur les preuves étaient que la formation devrait être basée sur un parcours incluant un nombre minimum d'expériences routières, une formation sur les aptitudes de catégorie supérieure telles que le fait d'éviter les distractions en conduisant, la formation sur la perception des dangers, les nouveaux développements technologiques, et l'annulation des courts programmes de formation visant à améliorer les aptitudes de reprise de contrôle du véhicule dans les situations d'urgence.

Compétences des moniteurs d'auto-école

Là encore, la pratique existante en Europe (en termes d'exigences relatives à l'âge, à l'expérience de conduite, aux aptitudes d'enseignement, etc.) pour les moniteurs d'auto-école est grandement variable. La base de preuves directement liées aux compétences des moniteurs et aux résultats de sécurité routière est pratiquement inexistante.

Certaines bonnes pratiques semblent néanmoins sensées, étant donné le rôle que les moniteurs doivent jouer dans la formation des conducteurs et des motocyclistes. Les bonnes pratiques évoquées lors de l'atelier étaient le fait d'avoir un âge minimum, des exigences en termes d'éducation et d'expérience de conduite pour les moniteurs (et un test d'entrée si nécessaire), le besoin que les moniteurs n'aient pas été condamnés pour délits de circulation graves ou harcèlement sexuel, des objectifs de formation standardisés et une période de formation minimum pour les moniteurs (y compris des compétences pédagogiques), un test pratique et un test théorique, ainsi qu'une formation périodique obligatoire et des contrôles qualité après l'obtention par le moniteur de sa licence.

Exigences relatives à l'aptitude médicale à conduire

La compréhension de l'impact de l'aptitude médicale est importante pour la population de conducteurs âgés. Tous les pays examinés ont mis en place de nouveaux tests basés sur l'âge, notamment des tests oculaires, et la plupart exigent des tests médicaux pour le renouvellement du permis. Le devoir légal de signaler des problèmes de santé, le rôle précis des médecins généralistes et l'âge auquel les nouveaux tests sont requis étaient

plus variables. La base de preuves relatives aux exigences d'aptitude médicale à conduire est significative. Elle suggère que le dépistage basé sur l'âge n'est pas efficace, et peut même avoir un impact négatif sur la sécurité (ainsi que la mobilité). La fréquence selon laquelle les conducteurs âgés doivent renouveler leur permis est variable, et comme les limites d'âge, n'est pas basée sur les meilleures pratiques actuelles concernant le risque de collision ou l'incidence de la maladie en question. Il manque également une base de preuve aux outils de dépistage, et il s'avère généralement que leur utilisation ne réduit pas les collisions. Les médecins généralistes se retrouvent souvent face à un dilemme, devant trouver l'équilibre entre les préoccupations (souvent non fondées) sur la sécurité et le fait de ne pas vouloir restreindre la mobilité pour les personnes âgées (qui peuvent avoir un impact négatif majeur sur la santé et le bien-être).

Les bonnes pratiques évoquées couvraient le besoin d'un processus de dépistage cohérent et basé sur des preuves, un outil d'évaluation hors route validé, des directives et des programmes d'éducation plus clairs pour les médecins, des supports pour faciliter la prise de décisions pour les conducteurs plus âgés (concernant la décision de continuer à conduire ou d'arrêter) et l'utilisation de permis restrictifs qui autorisent la conduite dans certaines circonstances pour les personnes connues pour avoir des problèmes médicaux, qui permet à ces conducteurs de conserver une certaine mobilité.

Recommandations

Au cours de l'atelier, les parties prenantes ont eu l'occasion de discuter des obstacles et facteurs perçus favorisant la mise en œuvre des bonnes pratiques. Sur la base des preuves, les bonnes pratiques sont considérées comme des objectifs finaux souhaitables du point de vue de la sécurité routière. Tenant compte des retours d'informations des parties prenantes à l'atelier dans le cadre de ce projet, les recommandations ci-dessous ont été personnalisées pour refléter la mesure dans laquelle les États membres semblent être prêts (ou non) pour la mise en œuvre.

Dans les cas où les parties prenantes n'ont indiqué aucun obstacle majeur à la mise en œuvre, les recommandations suggèrent que la CE devrait prendre des mesures pour faciliter la mise en œuvre ; le mécanisme clé pour obtenir ceci devrait être (en l'absence de mise à jour du texte principal de la Directive 2006/126/CE) un examen et une mise à jour des annexes techniques à la Directive. Lorsqu'il y a d'autres mécanismes (en plus ou à la place des mises à jour aux annexes), ceci est noté à côté de chaque recommandation.

Dans les cas où de nombreux obstacles à la mise en œuvre ont été notés, les recommandations prennent une approche plus pragmatique en pointant les étapes suivantes nécessaires à la progression de la politique dans une direction positive.

Examens de conduite

Sur la base des bonnes pratiques mentionnées et de l'opinion des parties prenantes, les recommandations[5] suivantes sont données:

1. La CE devrait favoriser l'inclusion d'un test de perception des dangers dans le système de permis de tous les États membres. Des modifications de l'Annexe II de la

[5] Veuillez noter qu'un certain nombre de ces recommandations proviennent du fait que le test en lui-même est un outil qui permet de stimuler une préparation adéquate pendant le processus d'apprentissage de la conduite (même lorsque le test lui-même ne peut pas tout tester parfaitement)

directive sont clairement souhaitables dans ce cas, mais le soutien et les preuves pour cette approche sont tels que nous recommandons que la CE la favorise dans tous les cas, même en l'absence de modifications de l'annexe. Voir également la Recommandation 11.

Bonne pratique : Test de perception du danger au Royaume-Uni

Les tests de perception du danger on fait l'objet de recherches intensives dans les années 1980 et 1990. Grayson et Sexton (2002) ont produit une synthèse très utile des études réalisées au Royaume-Uni et dans le monde. Une des premières conclusions importantes indique que pour être utile, un test de perception du danger doit pouvoir séparer les usagers de la route en groupes à risques faibles et élevés. Il devrait être possible de démontrer que les personnes qui obtiennent de mauvais résultats sont exposées à des risques plus élevés de collision que celles qui ont de bons résultats. Le test doit aussi mesurer la capacité du conducteur à anticiper les risques spécifiques à sa route au lieu de simplement mesurer son temps de réaction. Bien que dans un grand nombre de tests valides la mesure de la performance soit basée sur le temps, il s'agirait donc de cibler la « perception rapide des risques en cours de développement », au lieu de la « réactivité face à un danger manifeste ».

Au Royaume-Uni, le test de perception du danger fait partie de l'examen théorique depuis novembre 2002. Cela s'est traduit par un déclin de 11,3 % du nombre de collisions dans la première année suivant l'obtention du permis (pour certains types de collision routière pour lesquels une meilleure aptitude de perception du danger se révèle être avantageuse) (Wells, Tong, Sexton, Grayson et Jones, 2008).

Les travaux actuels incluent le développement d'une banque de tests intégrant une animation informatique tridimensionnelle, qui a l'avantage d'une meilleure flexibilité à long terme (par exemple pour créer des dangers en utilisant des véhicules modernes, au lieu de réutiliser des films datés). Des informations sur ces travaux au R.-U. sont accessibles sur le lien suivant : https://www.gov.uk/government/news/hazard-perception-clips-get-a-modern-makeover

2. La Directive 2006/126/CE inclut des objectifs pédagogiques concernant la connaissance des attitudes sûres et la volonté de conduire prudemment (Annexe II). Cependant, la connaissance en tant que telle n'est pas suffisante pour changer le comportement de conduite. Par conséquent, les États membres doivent envisager d'inclure des leçons dans les programmes de formation élémentaire des conducteurs qui stimulent la prise de conscience des risques, la faible acceptation des risques, la conscience de soi, le fait de ne pas boire et conduire, le fait de ne pas se laisser distraire, etc.
3. La CE doit viser à augmenter la prise de conscience parmi les États membres selon laquelle la tâche de conduite change rapidement en raison des nouvelles technologies (par ex. systèmes de navigation, régulateur de vitesse adaptatif, systèmes d'alerte de franchissement de ligne, systèmes d'avertissement d'inattention, systèmes de conduite semi-autonomes), et que l'utilisation sûre et adéquate de ces systèmes doit être apprise pendant la formation élémentaire du conducteur, et si possible être testée[6]. Une voie qui pourrait être envisagée pour obtenir cela est l'implication des organisations de parties prenantes concernées telles que la CIECA.

[6] La façon dont les systèmes tels que le régulateur de vitesse adaptatif, les systèmes de détection de point mort, et les systèmes d'alerte de franchissement de ligne devraient être utilisés de manière responsable et sûre peut différer d'un type de véhicule à un autre. Les constructeurs automobiles ont donc également la responsabilité de former les conducteurs à l'utilisation de ces nouvelles technologies.

4. La Directive 2006/126/CE stipule que dans la mesure du possible, le test de conduite sur route devrait inclure tous les principaux types de routes. Cependant, la Directive 2006/126/CE ne stipule pas l'heure de la journée. Les candidats devraient être testés de préférence dans une situation de conduite en journée et dans une situation de conduite de nuit. Cela est difficile à organiser et augmentera les coûts du passage du permis de conduire. Les États membres devraient donc exiger qu'une partie des leçons de conduite officielles et une partie des heures de conduite accompagnée soient effectuées de nuit.
5. L'examen du permis de conduire n'est pas seulement un instrument de sélection (ceux qui ne remplissent pas les critères ne sont pas autorisés à conduire sur la voie publique), il s'agit aussi d'une méthode permettant de s'assurer que les apprentis conducteurs prennent des leçons de conduite. Par conséquent, la CE devrait renforcer les objectifs de formation mentionnés à l'Annexe II de la Directive 2006/126/CE, qui peuvent être testés et pour lesquels un rapport avec la sécurité routière ou la conduite respectueuse de l'environnement a été reconnu (c'est à dire les techniques, les compétences et l'expérience acquises pendant l'apprentissage de la conduite qui ont prouvé leur utilité en faveur de la sécurité ou de la conduite respectueuse de l'environnement).

Exposition au risque progressive pour les conducteurs novices dans le cadre de la formation et du permis (Catégorie B)

Les réactions généralement négatives aux bonnes pratiques relatives à un système de permis progressif ou GDL (Graduated Driver Licensing) étaient pratiquement toutes celles qui sont habituellement mentionnées et qui ont fait l'objet d'une discussion ailleurs dans la documentation (voir Kinnear et al., 2013). Si l'on tient compte du fait que de solides systèmes GDL sont en place dans un certain nombre de pays à travers le monde, et que ces systèmes se sont avérés réduire de façon concluante les collisions et blessures des jeunes conducteurs, même avec une conformité non parfaite[7], ces obstacles à la mise en œuvre ne peuvent être considérés comme insurmontables.

De l'avis des auteurs du rapport, la solidité de la base de preuves concernant l'efficacité des éléments de GDL proposés fait qu'il est important que l'adoption d'un tel système GDL solide en Europe soit considérée comme une priorité. Cependant, il est également bien évident qu'un tel changement ne peut pas survenir du jour au lendemain. Par conséquent, comme pour d'autres domaines abordés dans ce projet, nous proposons la combinaison suivante de recommandations tangibles, mais pragmatiques :

6. Les États membres devraient envisager de mettre en œuvre de solides systèmes GDL avec des périodes d'apprentissage minimum, des exigences minimum pour la pratique sur route avant que la conduite en solo ne débute (120 heures sont souhaitables, voir Kinnear et al., 2013) et des restrictions post-test sur la conduite de nuit et le transport de passagers de même âge. Des limites d'alcool inférieures pour les jeunes conducteurs sont également souhaitables si celles-ci ne sont pas déjà incluses dans un État-membre.

[7] Il est reconnu qu'il existe un certain degré de non-conformité avec les restrictions GDL, mais il est tout de même prouvé que ces systèmes fonctionnent. Le même argument peut s'appliquer aux limites de vitesse ; nous savons qu'au moins quelques conducteurs dépassent la limite de vitesse, au moins quelquefois, cependant nous avons toujours des limites de vitesse et elles fonctionnent toujours.

Bonne pratique : Un apprentissage progressif et robuste du permis de conduire

L'expression « graduated driver licensing » (GDL ou apprentissage progressif du permis) a pris différentes significations, mais un consensus existe dans la littérature et permet de comprendre ce qu'est un système plus robuste (et par conséquent plus efficace). Kinnear et al. (2013) suggère que les systèmes les plus robustes et les plus efficaces réunissent au moins les composants suivants :

1. Une période d'apprentissage minimale (la durée minimale proposée étant d'une année)

2. Une pratique minimale pendant cette période (la pratique minimale proposée étant de 120 heures)

3. Une période de probation (un à deux ans dans l'idéal) après le début de la conduite en solo, pendant laquelle des restrictions sont appliquées à la conduite de nuit, au transport de passagers, sauf si le conducteur novice est accompagné par une personne ayant une expérience appropriée de la conduite.

4. La limite d'alcoolémie devrait aussi être plus basse pendant cette période de probation.

D'autres exemples de l'efficacité des divers composants des systèmes GDL sont présentés dans : Senserrick, T., et Williams, A. F. (2015). Summary of literature of the effective components of graduated driver licensing systems (Vol. AP-R476-15). Sydney : Ausroads Ltd.

Le site web suivant contient aussi un grand nombre d'informations sur les systèmes efficaces aux États-Unis. Même si les résultats du calculateur de collision ne peuvent probablement pas être généralisés en termes absolus dans d'autres juridictions, ils sont utiles dans la mesure où ils illustrent les solutions efficaces utilisées aux États-Unis :

http://www.iihs.org/iihs/topics/laws/gdl_calculator?topicName=teenagers

7. La CE devrait considérer l'adoption d'un système GDL robuste en Europe comme une priorité. Dans cette recommandation, comme première étape, la CE devrait faciliter la promotion des recherches dans le cadre du programme Horizon 2020, ou d'un autre programme de recherche financé, concernant deux éléments:

    a. (Recherche) Une évaluation de la diminution probable du nombre de victimes qui serait obtenue dans chaque État-membre, si un système GDL, tel que celui suggéré par Kinnear et al. (2013), était mis en œuvre. Cette recherche devrait également tenir compte de l'impact probable des composants individuels (avec des « forces » variables des restrictions envisagées). Un exemple relatif aux régions du Royaume-Uni a été signalé par Kinnear, Lloyd, Scoons et Helman (2014).

    b. (Recherche) Une évaluation de la façon dont ces systèmes ont été mis en œuvre dans d'autres pays tels que la Nouvelle-Zélande et l'Australie, y compris une compréhension des étapes nécessaires pour convaincre le public, ainsi que les parties prenantes politiques et autres, quant aux mérites des systèmes GDL et de leurs composants individuels.

De tels travaux viseraient à « poser les fondations » d'un certain degré de renforcement des systèmes de permis de conduire en Europe dans l'espoir que, comme cela a déjà été observé dans d'autres juridictions, des améliorations post-mise en œuvre dans l'acceptabilité des parties prenantes (à la lumière des gains observés en matière de victimes) permettent un renforcement plus poussé des systèmes au fil du temps.

Accès progressif aux catégories supérieures de motos

La documentation relative aux jeunes motocyclistes novices est limitée. De la même manière que pour les apprentis conducteurs, l'âge et le manque d'expérience constituent toutefois des facteurs de risque clés pour les motocyclistes et, ainsi, de nombreux enseignements peuvent être tirés de la documentation de formation des conducteurs qui est actuellement très vaste. À la lumière de ces informations, et s'appuyant sur l'hypothèse selon laquelle l'âge et l'exposition devraient être des préoccupations majeures pour ce qui concerne les motocyclistes, quatre recommandations sont fournies.

8. Il est recommandé que les États membres envisagent d'augmenter le nombre d'heures de formation sur route supervisées reçues par les apprentis motocyclistes, et de s'assurer que ces données soient consignées et surveillées dans tous les États membres.

9. Actuellement, l'accès à un permis « A » pour les motocyclistes de moins de 24 ans nécessite 2 ans d'expérience sur un permis A2. Il est recommandé que les États membres maintiennent ce processus par étapes, étant donné que les jeunes conducteurs acquerront ainsi probablement de l'expérience sur route avant de piloter de plus grandes motos en solo[8].

10. (Recherche) Il est recommandé que la CE entreprenne des recherches afin de :

    a. Évaluer les avantages et inconvénients potentiels (au moins en termes de sécurité et de mobilité) qui résulteraient de la future mise en œuvre d'un âge minimum de passage de permis pour les motocyclistes qui soit plus élevé que maintenant (par exemple conforme à, ou potentiellement plus élevé que celui des conducteurs de voitures).

    b. Évaluer les effets de sécurité de l'accès progressif à des motos plus puissantes, par rapport à l'accès direct à une catégorie sans restrictions (A).

    c. Comprendre si les caractéristiques des motocyclistes influencent les choix de piloter des motos plus puissantes et si celles-si sont associées à un risque accru, et utiliser ces connaissances pour éclairer le développement des approches de formation des motocyclistes.

Formation des conducteurs

En tenant compte des résultats de la analyse de documentation et de ce qui a été évoqué pendant l'atelier, les recommandations suivantes sont proposées:

[8] Aucun État-membre ne fait état actuellement de ces systèmes, mais la préparation de l'avenir est recommandée pour maintenir la pratique actuelle.

11. Tous les États membres devraient inclure une formation de perception des dangers dans les programmes de formation élémentaires des conducteurs. Voir également la Recommandation 1.

12. Les attitudes sûres et la motivation de conduire prudemment ne pouvant pas être testées correctement pendant le test de conduite (voir Recommandation 2), les États membres devraient exiger que les programmes de formation des conducteurs incluent des leçons sur la prise de conscience des risques, l'acceptation des risques, la conscience de soi, les dangers de boire et conduire, la distraction, etc.

Bonne pratique : Formation post-permis obligatoire en Autriche

Un bon exemple est la formation post-permis obligatoire en Autriche. Après avoir obtenu leur permis de conduire, les conducteurs novices doivent participer à trois programmes de formation séparés au cours de leur première année de conduite en solo. Ce système a été mis en place en 2003. Le premier programme de formation est appelé « Retours d'informations sur la conduite ». Cette session de conduite ne concerne pas les aptitudes, mais le style de conduite. Pendant la session de conduite, le conducteur novice obtient des retours d'informations concernant son style de conduite, ainsi que des conseils d'amélioration. Le deuxième programme de formation se déroule sur un circuit d'entraînement (piste de test). Ce n'est pas un cours de prévention des dérapages, mais une méthode pour confronter le conducteur novice à ses propres limites. Il découvre à quel point il est facile de perdre le contrôle du véhicule. Il apprend à éviter les circonstances dans lesquelles il est facile de perdre le contrôle du véhicule. Le troisième programme de formation inclut une discussion de groupe, suivie d'une deuxième session de retours d'informations sur la conduite. La discussion de groupe est facilitée par un psychologue. Un certain nombre de situations à risque sont évoquées, ainsi que les facteurs sous-jacents de cette prise de risque, tels que la surestimation des aptitudes du conducteur, et ses responsabilités dans la circulation. Un programme de formation post-permis obligatoire similaire, mais sans discussion de groupe, n'a eu qu'un effet marginal sur le taux de collision en Finlande (Keskinen et al., 1999). Cependant, le programme étendu avec discussion de groupe et une deuxième session de retours d'informations sur la conduite en Autriche s'est traduit par un nombre réduit de délits de circulation et d'accidents autodéclarés (Myntinnen et al, 2010).

13. Les États membres devraient chercher des solutions pour augmenter la durée de la conduite sur route supervisée reçue par les apprentis conducteurs avant que ne débute la conduite en solo. Des études suggèrent qu'en moyenne 3000 km ou 120 heures de conduite sur route supervisée (voir les bonnes pratiques ci-dessous) sont nécessaires pour réduire les risques d'accident pendant les premières années de conduite en solo.

Bonne pratique : Augmentation de l'expérience pratique dans la circulation

Les systèmes « d'apprentissage progressif du permis » (GDL) aux États-Unis, au Canada, en Australie et Nouvelle-Zélande débutent par une période de conduite supervisée. Pendant cette phase, l'apprenti acquiert une expérience de la conduite sous la supervision d'un instructeur non professionnel (habituellement un membre de sa famille). Les résultats indiquent que 120 heures (environ) de conduite supervisée dans ce type de système réduisent le taux de collision pendant les premières années de conduite en solo (voir une présentation des études sur cette question dans Senserrick et Williams, 2015). Sagberg et Gregersen (2005) ont constaté qu'en moyenne les apprentis conducteurs ont parcouru 3 800 km sous la supervision d'un instructeur non professionnel en Suède, au lieu de seulement 1 150 km en Norvège. En Suède, la conduite supervisée a réduit le taux de collision pendant les premières années de conduite, alors qu'elle n'a pas eu cet effet en Norvège. Ce qui suggère qu'un entraînement plus long dans la circulation est plus productif.

14. Les recherches indiquant que les programmes de formation courts visant à renforcer les aptitudes de reprise de contrôle du véhicule dans des situations d'urgence telles que la formation en récupération de patinage ne réduisent pas le risque de collision et peuvent même parfois l'augmenter, les États membres ne devraient pas inclure de programmes de formation courts visant tout juste à renforcer les aptitudes de contrôle du véhicule dans les situations d'urgence qui ne surviennent que rarement, dans les programmes de formation élémentaires des conducteurs.

Compte tenu des réactions mixtes de la part des parties prenantes concernant ces deux derniers sujets, une approche basée sur la communication semblerait fournir le meilleur équilibre entre l'acceptabilité et une affirmation selon laquelle ces approches de bonnes pratiques sont suivies.

Compétences des moniteurs d'auto-école

Aucune étude n'a été trouvée sur l'effet de la qualité des moniteurs d'auto-école sur le comportement de conduite et le risque de collision des nouveaux détenteurs du permis. La vue d'ensemble des programmes de formation pour les moniteurs d'auto-école et des exigences minimum pour devenir un moniteur montre qu'ils diffèrent considérablement entre les États membres. Au vu du manque d'études et des opinions mixtes des parties prenantes, les recommandations suivantes sont proposées:

15. (Recherche) Les États membres devraient favoriser la recherche pour déterminer si la qualité des moniteurs d'auto-école a un effet sur le comportement, notamment pour ce qui concerne les aptitudes de conduite de catégorie supérieure.

16. Si ces recherches indiquent que les compétences de conduite des conducteurs ayant bénéficié d'une formation formelle (par un instructeur professionnel) sont supérieures à celles des conducteurs ayant reçu une formation informelle (apprentissage sous la supervision d'une personne non professionnelle, par exemple un membre de la famille), les États membres devraient développer des améliorations pour les programmes de formation des instructeurs professionnels, afin d'optimiser les avantages offerts par les formations professionnelles.

17. Compte tenu du besoin évident en moniteurs d'auto-école qui respectent les apprentis conducteurs, les États membres devraient prendre des précautions en s'assurant que les moniteurs n'aient pas été condamnés pour harcèlement sexuel et n'aient pas commis de délits de circulation graves (si de telles mesures ne sont pas déjà en place).

18. (Recherche) Les États membres devraient envisager des études d'évaluation relatives aux effets d'une formation de perfectionnement/du développement professionnel continu des moniteurs d'auto-école sur les résultats en termes de sécurité routière pour les jeunes conducteurs novices.

19. Les États membres devraient s'assurer que le test théorique et le test pratique des moniteurs d'auto-école incluent le test des méthodes éducatives de connaissances et l'aptitude d'application de ces méthodes.

Bonne pratique : Approches centrées sur les apprentis conducteurs

Avant tout, un plus grand nombre d'études sont nécessaires pour évaluer l'effet que peut avoir la qualité des instructeurs sur le taux de collision des nouveaux titulaires d'un permis de conduire. Cependant, nous savons que la plupart des collisions impliquant des conducteurs novices ne sont pas tant causées par un manque de compétences de base, mais plutôt par une insuffisance en compétences de haut niveau, telles que l'anticipation du danger, la sensibilisation au risque, la conscience de soi. Certains résultats (même si d'autres études sont encore nécessaires) indiquent que des méthodes centrées sur les apprentis conducteurs, telles que le coaching, sont plus efficaces que l'instruction ordinaire pour acquérir des compétences de haut niveau, Ceci suggère donc que les instructeurs devraient être capables d'appliquer des méthodes centrées sur les apprentis conducteurs. Un bon exemple de méthode centrée sur les apprentis conducteurs ou « coaching » est présenté dans Bartl, (2010).

20. Les États membres devraient prendre des dispositions de formation professionnelle périodique obligatoire et d'évaluation périodique des compétences.

Exigences relatives à l'aptitude médicale à conduire

Selon la analyse, il est évident que l'aptitude médicale à conduire est un aspect critique du maintien et de la réduction des traumatismes routiers en Europe, et est surtout pertinente compte tenu des augmentations prévues du nombre de conducteurs plus âgés en raison du vieillissement de la population. Les preuves de meilleures pratiques montrent que la capacité d'une personne à conduire devrait être basée sur le déficit fonctionnel, plutôt que sur l'âge ou la pathologie médicale. Les recommandations suivantes sont proposées :

21. Il est recommandé qu'un processus de dépistage standardisé soit envisagé dans tous les États membres pour évaluer l'aptitude des conducteurs à conduire pour obtenir un permis de conduire de Classe B. Le processus devrait être basé sur les meilleures pratiques internationales et, dans l'idéal, être cohérent entre toutes les juridictions.

Bonne pratique : Processus de dépistage standardisé

Un processus de dépistage standardisé garantit une approche cohérente pour évaluer l'aptitude médicale à conduire dans les États membres, pour optimiser la sécurité au volant et réduire les possibilités de fautes professionnelles au permis de conduire en Europe.

Les meilleures pratiques suggèrent : (i) recommandation d'un centre médical de la conduite spécifique par un médecin généraliste, (ii) évaluation de l'aptitude à la conduite avec des outils de dépistage hors route homologués intégrant un niveau de sensibilité acceptable et des mesures de spécificités, (iii) renvoi à un comité consultatif médical spécialisé à des fins d'évaluation finale par des conseillers médicaux spécialisés, (iv) processus d'appel approprié pour prendre en charge les contestations individuelles.

Des modèles basés sur les meilleures pratiques sont opérationnels en Suède, au Canada, dans certaines régions des États-Unis, en Australie, même si le manque d'outils de dépistage hors circulation validés a favorisé le recours à des évaluations sur route dont la validité peut être mise en doute, et présentant des risques pour les clients et les évaluateurs.

22. Il est recommandé que, alors qu'un outil ou un protocole de dépistage cohérent devrait dans l'idéal être appliqué dans tous les États membres, les meilleures pratiques internationales suggèrent que ces jugements devraient au moins être basés sur les mêmes critères fonctionnels.

23. Il est recommandé de maintenir la pratique existante dans tous les États membres qui consiste à ce que les médecins généralistes soient le point de contact principal pour lancer l'évaluation de l'aptitude d'une personne à conduire (comme illustré dans le Table 12). Le développement et la mise en œuvre de consignes cohérentes par des États membres pour tous les médecins généralistes sont fortement recommandés sur la base des meilleures pratiques internationales.

24. Il est recommandé que les programmes d'éducation basés sur des preuves, qui se sont avérés efficaces et acceptés par des médecins généralistes, soient favorisés et adoptés dans tous les États membres à des fins de cohérence dans l'évaluation de l'aptitude d'une personne à conduire. Des facteurs incitatifs appropriés pour que les médecins généralistes participent dans ce domaine doivent être évalués.

Bonne pratique : Programmes d'éducation pour médecins généralistes

Pour la plupart, les médecins généralistes acceptent d'être le principal contact pour débuter une évaluation de l'aptitude à la conduite des apprentis. Cependant, ils signalent souvent le manque d'information sur des critères d'évaluation spécifiques et certains ne se sentent pas totalement aptes à effectuer des évaluations en particulier lorsqu'elles concernent des fonctions chez des conducteurs à risques. Par conséquent, il est recommandé que des programmes d'éducation pour médecins généralistes soient mis en place pour renforcer ce processus.

Des exemples de meilleures pratiques pour de tels programmes d'éducation pour médecins généralistes sont disponibles en Irlande et au Canada. Ces programmes sont intitulés « Continuing Medical Education » (CME ou éducation médicale continue) et incluent des cours magistraux, des mises à jour cliniques, des études de cas, des cours en ligne. Ils sont conçus pour acquérir des compétences cruciales dans des domaines spécifiques de la médicine appliquée à la conduite des véhicules, en relation avec les normes, les pratiques et les directives nationales.

25. Il est recommandé que la CE travaille sur le développement et la promotion des supports pour soutenir une auto-réglementation réussie et une transition vers une diminution de la conduite, puis un arrêt de la conduite. Ces supports devraient être mis gratuitement à la disposition de tous les États membres, afin d'aider les personnes à entreprendre l'évaluation de leur propre aptitude à conduire.

Bonne pratique : Supports pour l'auto-réglementation

Même s'il est difficile pour toute personne ayant une aptitude à la conduite potentiellement insuffisante de déterminer quand elle devrait s'arrêter de conduire, en particulier en cas de démence grave, de nombreuses personnes âgées ou/et ayant un problème de santé recherchent des informations pour auto-évaluer leur propre aptitude à la conduite. Leurs proches sont aussi des demandeurs de ces informations pour les aider à prendre la décision de débuter un processus d'évaluation.

Des exemples de meilleures pratiques, sous forme de brochures, procédures de test, cours en ligne pourraient être mis à leur disposition ou utilisés pour aider les personnes concernées et leurs proches à suivre ce processus. Ils incluent des cours formels sur les critères et les stratégies de conduite sûres et de transition pour arrêter de conduire, des outils d'auto-évaluation en ligne, des évaluations de la perception du danger (Australie et États-Unis), des formations sur circuit avec des commentaires individuels sur la conduite (Canada et Australie), des brochures expliquant les facultés et aptitudes fonctionnelles et médicales à risques et sans risques avec des restrictions recommandées (Australie).

26. Dans la Directive 2006/126/CE, les codes 61 à 69 couvrent une gamme de 'codes pour usage restreint' pour les permis conditionnels, qui peuvent être utiles aux personnes présentant diverses conditions médicales. La CE devrait recommander que les États membres fassent une utilisation plus généralisée de ces licences conditionnelles, dans la mesure du possible (voir les bonnes pratiques ci-dessous).

Bonne pratique : Permis conditionnels ou restreints

Les permis conditionnels ou restreints sont actuellement utilisés dans au moins trois pays européens (Autriche, Belgique et Hongrie), comme indiqué dans le Tableau 12. D'autres pays tels que l'Australie et le Canada ont également adopté des permis restreints ou conditionnels pour les personnes marginalement en situation de risque, mais qui nécessitent une mobilité personnelle pour des activités médicales et sociales élémentaires.

Les permis restreints et/ou conditionnels sont associés à une probabilité minimale d'augmentation des risques de collision (elle est seulement marginale dans des conditions de trafic faible). Les autorités doivent évaluer cette augmentation du risque de collision en fonction des besoins médicaux et sociaux de chaque personne et réviser régulièrement la situation (une fois par an). Il faut aussi tenir du risque qu'une personne qui a besoin de conduire pour des déplacements importants peut choisir de le faire même sans permis si celui-ci lui a été retiré.

27. (Recherche) Il est recommandé que d'autres recherches soient commanditées dans trois domaines clés, qui fourniront les preuves nécessaires au soutien de la mise en œuvre d'une approche cohérente dans l'évaluation de l'aptitude d'une personne à conduire, à savoir:

a. Entreprendre des recherches pour développer un protocole de dépistage efficace et transparent pour une utilisation possible en Europe dans le test des capacités fonctionnelles d'une personne soupçonnée d'être un conducteur non apte d'un véhicule de Classe B.

b. Entreprendre des recherches pour développer des consignes basées sur les preuves pour les médecins généralistes de tous les États membres, à utiliser dans le cadre de l'évaluation de l'aptitude d'une personne à conduire.

c. Entreprendre des recherches pour développer et évaluer des programmes pédagogiques pour les médecins généralistes qui soient à la fois efficaces et acceptés par les praticiens médicaux.

Abstract

Improving the education and training of road users in Europe, and their medical fitness to drive, is an important strategic objective for the European Commission. The project described in this report supports this objective by providing a review (using a systematic approach) of evidence of effectiveness for different approaches to training, testing, graduated access to risk for Category B (car) drivers, graduated access to higher motorcycle categories, driving instructor competencies, and requirements on medical fitness to drive. Current practice across Europe in these areas was also outlined. Using the evidence reviewed a series of good practice approaches were defined, and then discussed with stakeholders. Based on the evidence and the feedback regarding implementation barriers and enablers, 27 recommendations were made to support progress towards good practice in all these areas across Europe.

Abstrait

L'amélioration de l'éducation et de la formation des usagers de la route en Europe, de même que leur aptitude médicale à conduire, est un objectif stratégique important pour la Commission européenne. Le projet décrit dans ce rapport soutient cet objectif en fournissant une analyse (à l'aide d'une approche systématique) des preuves d'efficacité pour différentes approches à l'égard de la formation, des examens de conduite, un accès progressif au risque pour les conducteurs de la catégorie B (voitures), un accès progressif aux catégories supérieures de motos, les compétences des moniteurs d'auto-école, et les exigences relatives à l'aptitude médicale à conduire. La pratique actuelle en Europe dans ces domaines a également été présentée. Une série d'approches de bonnes pratiques a été définie à partir des preuves passées en revue, et a ensuite fait l'objet d'une discussion avec les parties prenantes. En se basant sur les preuves et les retours d'informations concernant les obstacles et les facteurs favorisant la mise en oeuvre, 27 recommandations ont été élaborées afin de soutenir la progression vers les bonnes pratiques dans tous ces domaines à travers l'Europe.

Contents

1. Introduction

1.1. Background

Improving the education and training of road users in Europe through a range of training, testing and licensing approaches is an important strategic objective of the European Commission Policy on road safety 2011-2020[9]. Another is the protection of vulnerable road users, especially motorcyclists and also older drivers. The Policy Orientation document outlines the promotion of a wide approach across Member States which views education and training, licensing, testing and medical fitness as part of a road safety strategy which operates across the lifespan; the intention is that measures are in place to ensure that all drivers and riders (whether young or old, novice or experienced) are protected as well as possible. The project described in this report supports the Policy Orientation by providing a review of evidence of key topics, with recommendations based on this evidence, and a consideration of implementation opportunities and barriers.

1.2. Aim and objectives

The overall aim of the project is to provide the basis for the European Commission to more accurately assess the value of possible future European Union (EU)-initiatives in the areas of training, testing and medical fitness. This aim is addressed through three broad activities.

First, evidence reviews were undertaken of the effectiveness of different approaches to training, testing and licensing for drivers and riders, and their medical fitness to drive, with a primary focus on road safety. The reviews covered six topics; these were driver testing, graduated access to risk for newly qualified Category B (car) drivers, graduated access to higher motorcycle categories, driver training, driving instructor competencies, and requirements on medical fitness to drive. As part of the reviews, literature was also sought to assist with the understanding of current practice in Member States in these six areas.

The second activity involved stakeholder consultation. This included a stakeholder workshop at which good practice measures identified in the reviews were discussed, with a focus on the barriers and enablers for their implementation in Member States. A short survey was also administered, to assist in understanding current practice in Member States beyond the understanding established from the literature.

The third activity involved a synthesis of the findings from the reviews and stakeholder discussion, and final recommendations for future initiatives (possibly through amendments to the Technical Annex in Directive 2006/126/EC).

1.3. This report

After this introduction, Section 2 outlines the general methodology taken to all the tasks.

Sections 3, 4, 5, 6, 7 and 8 then describe each specific topic in terms of current practice, evidence and good practices identified, and workshop discussion.

Section 9 draws final conclusions, including the recommended next steps for each topic, including methods by which the Commission might action the recommendations.

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[9] Communication from the Commission: Towards a European road safety area: policy orientations on road safety 2011-2020, COM(2010)389.

2. Methodology

The general approach taken in the literature reviews, stakeholder workshop and survey, and synthesis of findings, is described in this section.

2.1. Literature reviews

Each of the reviews was undertaken using a systematic approach in which specific inclusion criteria and date ranges were used to decide which studies were in scope, specific search terms were used to find such studies, and specific quality criteria were used to grade literature returned from the searches.

The inclusion criteria (and dates) varied by topic and are therefore noted in each corresponding chapter (Sections 3 to 8). The search terms are also specific to each topic, and are listed in Appendix A.

The quality criteria, although applied using the judgement of the different authors to their individual reviews, were designed to be applicable to all reviews and are therefore listed here. The rationale behind using quality criteria follows from the fact that it is crucial to ensure that only high quality evidence (or at least the highest quality available) is used to answer questions about the effectiveness of interventions and to inform policy decisions. Table 1 below shows the quality criteria applied to literature returned from the searches. The results of quality scoring for each review are listed in Appendix B.

Table 1: Quality criteria for literature reviews

Grade	Outcome measures	Controls	Analysis
A	Accidents or injuries (recorded or self-reported)	Adequate methods (e.g. control groups) or statistical procedures (e.g. multivariate modelling) to control bias and confounding variables	Appropriate statistical methods to state confidence limits of statistical significance of any effects found
B	Self-reported or observed risk-related behaviours	Incomplete control of confounding variables or bias but some attempt made	Inappropriate or no statistical methods used, but some attempt to assess the likely confidence limits or significance of effects
C	Attitudes or behaviours that have been reliably linked with accident risk as measured through appropriate methods	Controls not applicable or possible (e.g. policy paper or theoretical paper)	Data analysis not applicable or possible (e.g. policy paper or theoretical paper)
D	Performance criteria that apply to the specific aims of the intervention (e.g. driving test or medical fitness appraisal scores)	No controls and the lack of control means that the results cannot be reliably used as evidence	Insufficient report of data analysis or no attempt made to address this where required
E	Data with no reliable link to accident risk (e.g. 'I enjoyed the course') or not measured appropriately		

Any study that attracted a minimum grade (shaded in the darker grey) in one or more of the three categories was excluded for the purpose of research questions that relate to evidence of effectiveness. For those research questions that might be answered using non-effectiveness or non-statistical evidence (for example general feedback on specific

interventions) the criteria were still applied but appropriate adjustments were made by the project team to account for the study type.

The reviews carried out therefore sought to use a systematic approach as far as was possible given the breadth of the research questions and evidence types consulted.

2.2. Stakeholder workshop

A stakeholder workshop took place on September 15th 2016 at the Albert Borschette Conference Center, Brussels. Workshop participants included policy makers from Member States, representatives from international and European associations and organisations as well as project team members. For each of the topics reviewed, good practice measures identified from the literature were presented and discussed. The focus of the discussion was on barriers and enablers to implementation of the good practices in Member States. The findings from the workshop are discussed in the respective chapters (Sections 3 to 8) of this report, and fed into the development of the final recommendations (Section 9).

2.3. Survey of Member States

The survey was designed to gather evidence of current practice in Member States where such (relatively recent) information was missing or incomplete in the existing literature. Specifically it covered the topics of graduated risk (Category B), graduated access to higher motorcycle categories, instructor competencies, and medical fitness to drive. A version of the survey can be seen in Appendix C, although note that the actual survey was administered through participants following a link to an online survey hosted on 'SmartSurvey' (https://www.smartsurvey.co.uk/).

2.4. Synthesis of findings

The final recommendations for each topic were based on a synthesis of the findings from the relevant literature review (the good practices identified) and the discussion of these at the workshop. In the respective chapters for the review topics (Sections 3 to 8) the good practices and the discussion points (barriers and enablers) are noted, and then in Chapter 9 the final recommendations for each topic area are provided. In each case the final recommendations are based on evidence, with some account taken of barriers and enablers for the purpose of prioritising the recommendations and considering the mechanism by which they might be put into place.

3. Driving tests

3.1. Introduction

Driving tests, both the theory test and the on-road practical driving test are intended to exclude drivers from public roads until they possess the competences to drive safely. Unlike fitness to drive tests (see Section 8), driving tests are intended to test knowledge, skills, and attitudes learner drivers have acquired during formal and informal driver training (see Section 6). Their medical and psychological fitness to drive is a precondition for acquiring the required competences during driver training. Selection is not the only purpose of the driving tests. The tests also stimulate learners to take driving lessons and to practice before they are tested (for driver training considerations, see Chapter 6).

What Member states must test (as a minimum requirement) is specified in Annex II of EU directive 2006/126/EC[10]. The theory test must assess knowledge about road traffic regulations, factors that negatively influences one's driving capabilities (e.g. alcohol and fatigue), safe headways and braking distances, the behaviour of other road users (in particular the behaviour of vulnerable road users), rules considering administrative documents regarding driving, precautions when leaving the vehicle, the use of protective equipment (e.g. helmets, safety belts, child seats), some mechanical aspects of the vehicle (e.g. the importance of proper tyre pressure), and the principles of eco driving. Competences that must be tested during the practical driving test are vehicle checks, adjusting the driver position (seat, mirrors), vehicle control skills, the mastering of traffic situations by applying the traffic regulations, and performance of special manoeuvres such as parking. The directive does not specify testing of higher order skills such as hazard perception, risk awareness and self-awareness. However, in Section II of Annex II it is stated that "Drivers of all power-driven vehicles must at any moment have the knowledge, skills and behaviour….to recognize traffic dangers and assess their seriousness."

All Member States have set a minimum age at which learners can take the driving test and at which they are allowed to drive independently without a supervisor. The older learners are, the lower their crash risk is at the beginning of their independent driving (i.e. driving without a supervisor) (see Maycock. Lockwood & Lester, 1991; also for a review of the literature see McCartt, Mayhew, Braitman, Ferguson, & Simpson, 2009). Motor competence becomes a relatively stable trait at six years of age (Gabbard, 2008). This implies that from six years of age improving one's motor competences is only a matter of training. However, the capability to accurately assess speeds of other road users continues to improve throughout adolescence (Wann, Poulter & Purcell, 2011), and with regard to impulse control, identifying risks, planning, and the ability to resist peer pressure, the brain is not fully matured until approximately 25 years of age (Casey, Getz & Galvan, 2008; Gogtay et al., 2004). This indicates that at around 17 or 18 years of age a proportion of newly licenced drivers will still lack the abilities to drive safely. None of this is new. Goldstein (1972) for example noted "That youthful drivers…are over-represented in accidents, fatal accidents, and in fatalities, considerably beyond their proportion in the driving population, has been well known for several decades" (p153).

Driving tests can only be an adequate means for selection (i.e. detecting who has the competences to drive safely and who has not) when they are reliable, valid, and when there are clear criteria for deciding whether candidate has passed or failed. A test is reliable when for instance two driving examiners when assessing the same candidate independently, have the same conclusion whether this candidate has passed or failed the

[10] eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32006L0126

test. A test has predictive validity when candidates with high scores have a lower crash rate than candidates who had low scores (assuming that safety is the criterion against which the test should be judged).

Selection is not the only purpose of the driving tests. The tests also stimulate learners to take driving lessons and to practice before they are tested.

3.2. Aim

The work in this chapter sought to establish what current practice is in EU Member States regarding driving tests. The review then covers the scientific literature regarding what is known about the effectiveness of the theory test, the on-road practical driving test, tests that assess higher order skills such as hazard perception, and the effect of licensing age. Good practices identified were then considered in light of workshop discussions.

3.3. Methodology

The inclusion criteria for the review were as follows:

- All studies where theory and practical driving tests or part task tests (for example hazard perception tests) have been evaluated against crash rates of newly licensed drivers since 1990. Also all studies on higher order skills (e.g. hazard perception, risk awareness) testing in relation to driving.

Table 14 in Appendix A shows the search terms that were used for this review. The online literature databases in which a search with the mentioned terms and strings was conducted were the SCOPUS database of Elsevier (https://www.scopus.com) and the SWOV-library (http://library.swov.nl).

The search using these terms returned 38 potentially relevant references. In the case of studies about the same test or dataset, the study that met the quality criteria (see Table 1) the best was included. This resulted in a short list of 18 references (see Appendix B). One thing that should be noted about this topic is that scientifically sound evaluation studies about the effectiveness of national driving tests are scarce. An obvious reason is that those who have not passed the test are not allowed to drive. That is why there are no studies in which the crash rates of novice drivers who have passed the test are compared with novice drivers who have failed the test. Another reason is that national driving tests are implemented throughout a country and this makes it difficult to construct a control group. What can be studied is (1) the association between the number of crashes before and after change in the driving test, (2) the association between the number of attempts to pass the test and crash rate, and (3) the difference in crash rate between those who just passed the test (i.e. passed with a low score) and those who amply passed the test (i.e. passed with a high score). All these methods have weaknesses. In the first the effectiveness a change in testing is measured without a control group. In the second and the third method all the participants that are included have passed the test. Because of these methodological limitations the validity of the results mentioned in this chapter cannot be taken for granted. The quality check of the included studies can be found in Table 20 in Appendix B.

3.4. Existing practice

Table 2 presents an overview the testing procedures in licensing systems of EU Member States. Some Member States have two rows. These countries have two rows because they have two different licensing systems learners can choose. Most of the time this is an early licensing system with informal instruction (accompanied driving) and a late

licensing system with only formal instruction (see Section 6). The second column (the first column right of the column with the names of the countries) indicates whether learners have to pass the theory test first before they can start with on-road driving lessons. The third column indicates the youngest age at which learners can take the theory test. The fourth column mentions the youngest age at which learners can take the on-road practical driving test. The table is composed on data of surveys carried out by Genschow, Sturzbecher, and Willmes-Lenz (2014), and unpublished data obtained by contacts in Serbia who undertook a similar exercise.

Table 2: Initial knowledge and skill tests in the driving licence systems for licence B of Member States

	Theory Test		Practical driving test		Hazard Perception test	Risk awareness test
	Before/ **D**uring/ **A**fter formal or informal driver training	Minimum age theory test	Minimum age on-road test	Provisional licence with **R**estrictions/ **H**arsher Penalties/ **B**oth[1]	In the **T**heory Test/ **S**eparate test later	**Y**es or **N**o[2]
Austria	D	17 or 18	17 or 18	B		N
Belgium '36m'	B	17	18	H		
Belgium '18m'	B	17	18	H		
Bulgaria	D	17;11	17,9			
Croatia	B	17;11	18	R		
Cyprus	A	18	18			
Czech Republic	B	18	18			
Denmark	B	17;11	18	H		
Estonia	B	17;11	18	B		N
Finland	D	18	18	H		N
France ACC	D	16	18	H		
France Trad.	D	17;6	18	H		
Germany Ab17	D	16;9	16;11	B	T	
Germany Trad.	D	17;9	17;11	B	T	
Greece	D	18	18	R		
Hungary	D	17;9	18	R		
Ireland	B	17	17;6			
Italy	D	18	18	H		
Latvia	A	18	18	B		N
Lithuania	D	18	18	B		N
Luxembourg	D	17;6	18	H		N
Malta	D	18	18	H		
Netherlands to2Drive	D	16;6	17	B	T	
Netherlands Trad.	D	18	18	B	T	
Poland	A	18	18	H		
Portugal	D	18	18	H		
Romania	D	18	18			
Slovakia	B	18	18	H		
Slovenia	B	18	18	B		N
Spain	D	17;9	18	H		
Sweden	D	18	18	H		N
United Kingdom	D	17	17	H	T	

1. A provisional licence with restrictions means that learners who have passed the test can drive independently, but with stricter regulations (e.g. a lower BAC level for newly licenced drivers). A provisional licence with harsher penalties for instance means a special penalty point system for newly licenced drivers.
2. Only when a Member State has a special Risk Awareness training program in their licensing system for all learner drivers a yes or a no is provided. A "No" means that there is a mandatory risk awareness training but no test.

In all countries, after having passed the test people can drive on public roads without a driving instructor. However, in most Member States there are different regulations for young novice drivers than for older more experienced drivers. There for instance can be a lower BAC limit for beginners and/or there can be special demerit point systems for beginners. This is indicated in column five. Column six indicates whether Member States have a special hazard perception test and whether this test is incorporated in the theory test or not. Finally, column seven indicates whether Member States have a risk awareness test or not. This column indicates that most Member States do not have mandatory risk awareness training and where they do they have a mandatory risk awareness training programme (see Chapter 6) but not a risk awareness test.

3.5. Effectiveness and impact on road safety

3.5.1. Age limits

Inexperience and age are the main factors that underlie young and novice drivers' overrepresentation in crashes. The question is which part of the overrepresentations in crashes of teen drivers can be attributed to youthfulness and which part can be attributed to lack of skills due to inexperience? An indication of the separate effects of age and experience can be found in a relatively recent study that was carried out in the Netherlands (Vlakveld, 2011). Figure 1 shows the crash rate (number of self-reported crashes divided by self-reported annual mileage) of drivers that passed the driving test when they were 18 years of age by the number of years the licence was possessed.

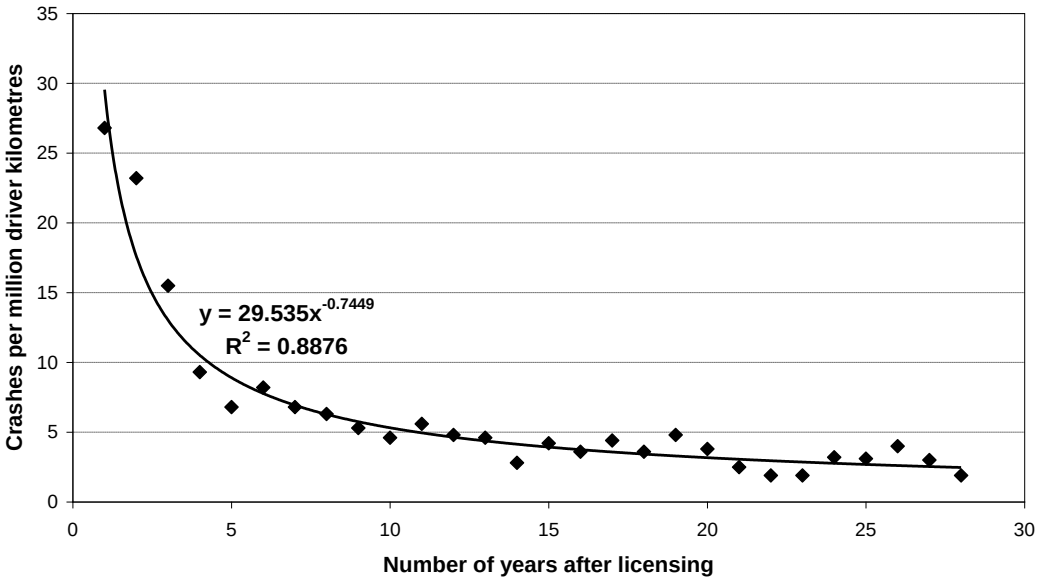

Figure 1: Crash rate by number of years after licensing of drivers that passed the driving test when they were 18 years of age. The curve is the trend line with the best fit. Source: Vlakveld, 2011.

Figure 1 shows that the crash rate decreases strongly in the first years after licensing. After about 5 years, the decline in crash rate slows. A steep decline in crash rate in the first period after licensing for young drivers has also been found in other studies from other countries (for example Maycock et al., 1991; for a review see McCartt et al., 2009). In the Netherlands, not everyone starts to drive immediately after having reached the minimum age. From the same database, a similar trend line as in Figure 1

could be calculated for drivers that passed the driving test when they were: 21 years of age, between 23 and 27 years of age and between 30 and 40 years of age. The results are presented in Figure 2. Only the trend lines are shown.

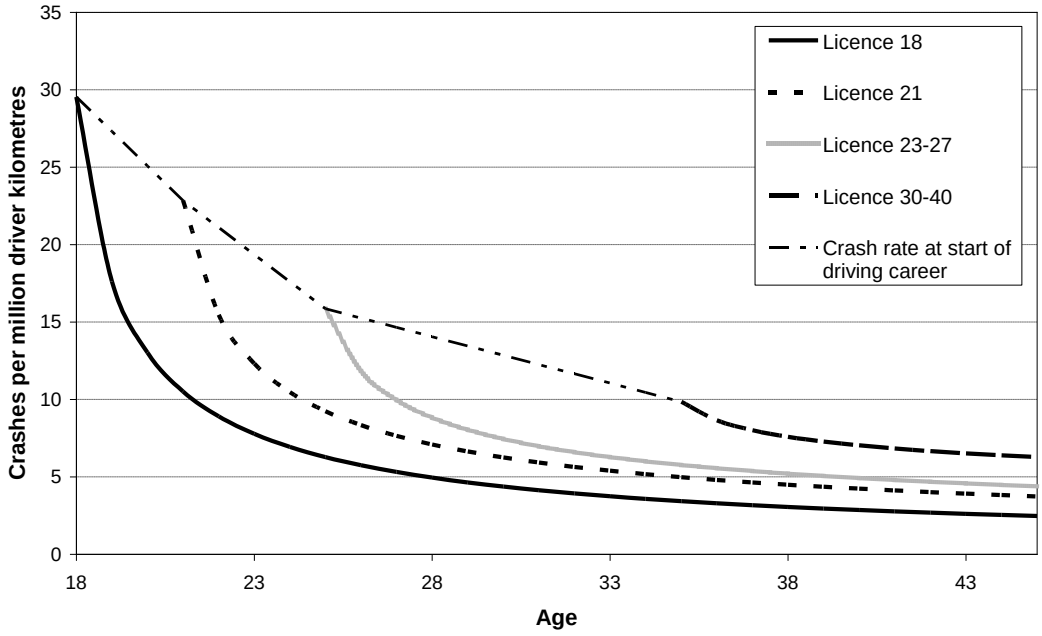

Figure 2: Crash rate of novice drivers after licensing of drivers that commenced driving early in life and drivers that commenced driving late in life. Only the trend lines are represented. Source: Vlakveld, 2011

Figure 2 suggests that decline in crash rate is caused both by the mere fact that people grow older (maturation of the brain, differences in lifestyle when adolescents become young adults) and the accumulation of driving experience. When one assumes that the age effect is represented by the line that connects the crash rates at the start of the driving career on the different ages, approximately 40% of the reduction of crash rate is caused by age and approximately 60% is caused by experience. Similar proportions were found in the UK and Sweden (Gregersen & Bjurulf, 1996; Maycock et al., 1991). However, one has to keep in mind that people are free to choose when to start with their driving career. Neither in the Dutch study nor in the studies in the UK and Sweden was random assignment possible. It could be that people who decide to start their driving career later in life are more cautious than people that start to drive early in life. Another confounding factor may be that people before they start to drive gain traffic experience in another role (e.g. as a passenger, as a moped rider or as a bicyclist). Differences in personality and traffic experience in another role may have been the cause of the relatively low crash rate at the very beginning of their driving career of drivers that start to drive later in life and not so much the fact that they were more mature. In their literature review on studies about the age effect and the experience effect, McCartt et al. (2009) conclude from studies that were mainly carried out the USA, that crash rates of 16 year old beginners are higher than the crash rates of 17 year old beginners. They therefore think that increasing the age for unsupervised driving from 16 years of age to 17 years of age will have a positive effect on road safety. Elvik, Høye, Vaa, and Sørensen (2009) conducted a meta-analysis on studies about licensure age. Ten studies were included. Table 3 shows the estimates of this analysis on the decline in percentages in crashes in the first year of solo driving.

Table 3: Estimates of the reduction in crashes in the first year of solo driving when the age for solo driving is raised by one year. Source: Elvik et al. (2009)

		Percentage change in the number of accidents	
Increase of drivers age at which solo driving is allowed	Types of accidents affected	Best estimate	95% Confidence interval
From 16 to 17 years	All accidents	-10	(-20; +5)
From 17 to 18 years	All accidents	-7	(-15; +1)
From 18 to 19 years	All accidents	-6	(-17; +4)
From 19 to 20 years	All accidents	-6	(-22; +13)
From 20 to 21 years	All accidents	-5	(-29; +27)

Note that the 95% confidence intervals in Table 3 all range from minus to plus. This indicates that none of the best estimates are statistically significant.

There are developmental differences in late adolescence and young adulthood between women and men. On average young women mature somewhat faster than young men with regard to risk taking (Lenroot & Giedd, 2010; McCormick & Mathews, 2007). That is, young men tend to take more risks than young women. In the Netherlands, young women need more driving lessons than young men in order to pass the driving test, whereas the crash rate (the number of serious crashes per distance driven) of 18 and 19 year old female drivers is approximately half of the crash rate of male drivers in that age group (Vlakveld, 2011).

3.5.2. The theory test

There are only very few studies about the validity of national theory tests. Not only are learners who have failed the theory test not allowed to drive, it is also almost impossible to include a control group when theory tests are mandatory tests for all learner drivers. In 1996, a theory test was introduced in Great Britain. Before that date learner drivers did not have to pass a theory test before taking the practical test. Simpson, Chinn, Stone, Elliot, and Knowles (2002) conducted a before and after study while compensating for known confounding factors that affected the key outcomes (crashes, attitudes and behaviours). They found that the introduction of the theory test resulted in a small but statistically significant improvement in attitudes and behaviours. However the crash rate of test passers did not decrease significantly in the 3.5 years after licensing. Elvik et al. (2009) conducted a meta-analysis about the effect the theory test had on the number of crashes for both novice riders (eight studies) and novice drivers (10 studies). Neither type of theory test was shown to lower the crash rate. Despite the lack of evidence for their direct effectiveness in lowering crash risk, it can still be argued as important that drivers and riders know the rules of the road. Moreover, it is likely that in the theory tests included in the meta-analyses of Elvik et al., some of which were from decades ago, only knowledge of traffic regulations and knowledge of road signs were tested. It is possible that there are other question types which could have an effect on crash rates; for instance some questions might go beyond knowledge and try to tap into 'insight', for example not only "Do you have right of way in this situation?" but also "Is it wise to take right of way in this situation although you have right of way?". Research is needed to verify this hypothesis.

3.5.3. The on-road driving test

Baughan and Simpson (1999) examined the reliability of the British practical driving test. Candidates that had never done the practical driving test before, but had prepared themselves and thought they were ready, did the test. 34% passed and 66% failed. However, the candidates did not receive the results of this test. Three days later they did the practical driving test again with another examiner who did not know they had done the test before. Of the candidates that passed the first test, 53% failed to pass the test for the second time and 47% passed the test again. Of those that failed to pass the test the first time, 76% failed again but 24% passed this second test. These results indicate that at least in 1999, the British practical driving test was not very reliable. However, the results are not as surprising as they may seem. A reliable on-road test is difficult to achieve because there can be differences in consensus between examiners about how safe or unsafe a certain action is. The assessment of the skills of a candidate is always a matter of interpretation. Assessment is in particular difficult to achieve because the traffic situations differ per candidate. A candidate can be so unfortunate that she or he encounters many different hazardous situations during the driving test whereas another candidate encounters only traffic situations that are easy to master.

The predictive validity of the practical driving test is difficult to measure because those who fail the test do not drive and there is no control group. It therefore is not possible to compare the crash rate for drivers who have passed the test with drivers who have failed the test. In almost all developed countries, the vast majority of learners will ultimately pass the test, although many candidates will need more than one attempt to pass. Despite this methodological problem, some attempts have been made to test validity of the driving test. Baughan and Sexton (2002) examined whether there was an association between the number of minor faults during the practical driving test in the UK and self-reported crash involvement in the first six months after having passed the driving test. They found that there was no association between the number of driving faults during the test and crash rate. However, in a second study which included controls for age, mileage, and night time driving Baughan, Sexton, Maycock, Simpson, Chin and Quimby (2006) found a small but lower crash rate in the first six months of solo driving for those with few minor faults compared to those with many minor faults. In a cohort study from the UK no association was found between the number of attempts that were required to pass the practical test and crash rate in the first years after having obtained the licence. However, for young female drivers there was an indication that the more practical tests were needed to pass this test the higher the crash rate was after licensure (Maycock & Forsyth, 1997). In the second cohort study that was conducted in the UK the results of the first cohort study of Maycock and Forsyth (1997) could not be repeated. Sexton and Grayson (2010a) found that first-time passers had 15% fewer 'active' accidents (essentially where the driver was at fault) per distance driven.

In Finland, Hatakka, Keskinen, Gregersen, Glad, and Hernetkoski (2002) found that the better male drivers performed in the practical test, the more they were involved in crashes and the more traffic offences they committed. The rather poor predictive validity of the practical test is not as surprising as it may seem. On-road practical tests generally require demonstration of adequate skills in car control, the mastering of basic traffic situations, and the skill to perform special manoeuvers (e.g. reversing into a parking space). However, research has shown that a lack of vehicle control skills, not being able to master regular traffic situations, and not being able to perform special manoeuvres are rarely the underlying causes of crashes in which young novice drivers are involved (Clarke, Ward, Bartle, & Truman, 2006; Curry, Hafetz, Kallan, Winston, & Durbin, 2011; McKnight & McKnight, 2003). Young novice drivers are overrepresented in single vehicle loss-of-control crashes (Laapotti & Keskinen, 1998), although it is general believed that this is not caused by the fact that they lack vehicle control skills but because they drive

too fast for the circumstances, or take other risks which make unrealistic demands on their (otherwise adequate) skills.

Besides predictive validity there is content validity. A test would be judged to have good content validity when candidates can show their skills in all road and traffic situations that are relevant for road safety (Baughan, 1998). This implies that the test drive should cover various road types and traffic situations. Driving examiners have indicated that they want to assess driving skills in various conditions (Baughan, Gregersen, Hendrix & Keskinen, 2005). There is some evidence for an impact of varied experience on road safety outcomes (Sexton & Grayson, 2010b), and the test is one way of stimulating this.

3.5.4. Hazard perception testing

Some countries (e.g., the UK, most states of Australia and the Netherlands) have incorporated a hazard perception test in their licensing system. In the UK and the Netherlands the hazard perception test is incorporated in the theory test. The UK introduced the test in 2002. This has resulted in a decline in the number of crashes in the first year after licensing (for certain on-road crash types expected to benefit from greater hazard perception skill) of 11.3% (Wells, Tong, Sexton, Grayson, & Jones, 2008). In the Australian state of Victoria, a hazard perception test was implemented in 1996. The pass/fail criterion of this test was very low and most candidates passed this test. Congdon (1999) found that fatal crash risk in the first years after full licensing was significantly higher for those that had low scores on the hazard perception test than those with high scores on the hazard perception test (similar findings are shown in Wells et al., 2008). Queensland in Australia has a graduated driver licensing system in which learners can progress from solo driving with many restrictions (the P1 licence) to solo driving with only a few restrictions (the P2 licence) when they pass a hazard perception test. This test is almost the same as the British hazard perception test; the only difference is that candidates have to point out the hazard on a touch screen instead of pressing a button to indicate that a hazard is present somewhere in the scene. Horswill, Hill, and Wetton (2015) found that those who failed the test were 25% more likely to be involved in a crash than those who passed the test. The results indicate that in contrast to the traditional theory test and on-road practical driving test, results on hazard perception tests are associated with crash rates of novice drivers.

3.6. Discussion of good practice

Based on the literature reviewed in this chapter and on the basis of the authors' judgement, five good practices were drafted. These good practices are shown below.

Good practices regarding driver testing	
1	As not all relevant competences for safe driving can be tested or are very difficult to test during the driving test (e.g. safe attitudes, risk acceptance), licensing systems should not be totally test driven. Therefore it is recommended to have compulsory theory lessons on subjects that cannot be tested or are very difficult to test but that are important for safe driving and eco driving (e.g. about distraction, peer pressure, driving while intoxicated, fatigue)
2	Hazard perception testing should be included in any licensing system, before solo driving begins
3	In combination with a graduated driver licensing system, the driving test can best be split up in different tests on different moments in time. For instance, a theory test before the learner phase starts (only accompanied driving is allowed), an on road-practical driving test before the intermediate phase with restrictions (e.g. not allowed to drive in the dark, not allowed to drive with peers) start, and a hazard perception test before the full licence phase without restrictions for novice drivers starts

4	Incorporate different road types (urban areas, motorways, rural roads) in the on-road driving test and preferably different circumstances (both driving during hours of daylight and during hours of darkness)
5	The driving task changes rapidly due to technical innovations (e.g. navigation aids, adaptive cruise control, lane keeping systems, autonomous driving on motorways). Drivers have to learn how they can safely use these systems and the skill to use these systems safely should be tested.

The first good practice suggestion is about acknowledging that not all relevant aspects for safe driving can be practically tested. Through education, training and driving culture (e.g. societal attitudes to unsafe driving behaviours such as drink driving) learners also have to develop safe attitudes and be able to resist impulses regarding unsafe actions, in situations that are not possible to test. Attitudes are very difficult to test during both a theory test and an on-road practical test. Nevertheless, theory tests can ensure that new drivers are aware of driving laws and rules and associated training can explain and justify the rules thereby increasing the perceived legitimacy of enforcement authorities. In order to train learners in safety-related aspects that cannot be tested mandatory theory lessons may be required (see also Section 6 on driver training)[11].

There is quite strong evidence that hazard perception tests can be valid (they predict crash involvement) and that hazard perception training is effective (see Section 6). Existing practice shows that so far only a few Member States have incorporated a hazard perception test in their licensing system.

Good practice three is about a synchronisation of tests and graduated driver licensing systems (see Section 4), and is based on the authors' judgement. This for instance could be a theory test before the start of the learner phase (the phase in which learners can only drive while accompanied by a dedicated older and more experienced driver), an on-road driving test in order to graduate from the learner phase to the intermediate phase with restrictions, and a hazard perception test in order to graduate from the intermediate phase with restrictions to the full licence phase.

Good practice four is about the validity of the on-road driving test. Finally, good practice five is about the rapid technological developments that change the driving task. Devices such as blind spot warning systems, adaptive cruise control, and lane departure warning systems not only help drivers with the driving task but they also can distract the driver. New drivers have to learn how to use these devices in a safety enhancing way, and this can be tested.

The mentioned good practices were put to stakeholders in a workshop in Brussels on September 15th in 2016.

Regarding the first good practice, one participant of the workshop was of the opinion that we should be not too pessimistic about the possibility to assess attitudes during the driving test. There is however no evidence that attitudes and motivation can be tested

[11] It should also be noted that the content of the test itself can be used to drive what is trained. This is also relevant to the good practice focused on the incorporation of different road types on the test; the reasoning is that if the test is likely to include a particular set of circumstances, then training will adapt to cover this. Unfortunately there is no existing evidence to directly link different specific requirements for training and testing to safety outcomes, with the possibility of minimum learning periods (Chapter 4) and Hazard Perception Testing and Training (see this chapter, and Chapter 6).

properly. Nevertheless attitudes and motivation can be discussed during the examiner's feedback after the test.

There was generally support for the incorporation of a hazard perception test in the licensing systems. A mentioned barrier was that it is difficult to develop a good hazard perception test. It may not be easy to develop a good hazard perception test but the tests that have been implemented in the UK and in Australia have shown that it is possible. Another point made was that there should be means to test hazard perception skills during the on road driving test; it should be noted however that achieving a standard set of hazards on-road is not plausible.

There were no comments regarding good practice three and four. With regard to good practice five, it was stated that in some countries use of navigation equipment already was part of the on-road driving test. It was also mentioned that there is a lot of variation in how devices function and that car manufacturers also have a responsibility to train drivers who buy their vehicles.

4. Graduated risk exposure for novice drivers in training and licensing (Category B)

4.1. Introduction

The broad rationale behind controlling exposure to risk for young and novice drivers is that there are known risk factors for this group which, with logical policies, can be controlled. The typical manner in which this is achieved is through graduated driver licensing (GDL)[12].

Broadly, young and novice drivers are at a heightened risk of crashing because of factors associated with both their youth and inexperience. All other things being equal, the younger a driver is when they begin solo driving the higher their likelihood of crashing. The reasons for this are typically driving- and lifestyle-related factors associated with youth (e.g. higher speed choice and risky overtaking, socialising – typically at night). Perhaps related to socialising, the carriage of passengers (especially peer-age passengers) is another important risk factor for young drivers; more passengers in the car are typically associated with greater likelihood of crashing (Preusser, Ferguson & Williams, 1998). These factors are all seen in young driver crash statistics. For example young drivers tend to be more likely to have crashes on single carriageway rural roads, crashes at night, and those involving excess speed (Clarke, Ward & Truman, 2002; Clarke et al., 2006); when passengers are present, such crashes can be devastating in terms of their injury burden.

The role of on-road experience in improving safety outcomes has been demonstrated in both the pre-solo driving and the early solo driving phases. For example Gregersen, Berg, Engström, Nolén, Nyberg and Rimmö (2000) showed that changes to the licensing system in Sweden that promoted greater on-road practice before solo driving led to a lower crash rate in those drivers who took advantage of the extra on road practice. Data are also available from Australia and Germany showing similar protective effects of systems that promote greater pre-solo driving on-road experience (Scott-Parker, Bates, Watson, King & Hyde, 2011; Schade & Heinzmann, 2013). The protective effect of post-test on-road experience has been known for many years (Wells et al., 2008; Mayhew, Simpson & Pak, 2003; McCart, Shabanova & Leaf, 2003; Maycock, 2002; Williams, 1999; Sagberg, 1998; Forsyth, Maycock & Sexton, 1995; Maycock et al., 1991).

The reason GDL systems have been successful in reducing young and novice driver crashes (Kinnear et al., 2013; Russell, Vandermeer & Hartling, 2011) is presumably that they target both age- and experience-related risk factors. In short, GDL systems attempt to do three things:

1. Encourage later licensure through minimum learning periods
2. Encourage greater on-road experience in the pre-solo-driving phase

[12] Note that where we use the term 'graduated driver licensing' or 'GDL' in this report, following Kinnear et al. (2013) we are referring to a licensing system that has one of more of a number of specific measures in place, typically including a minimum learning period, minimum amounts of on-road practice, restrictions when solo-driving begins on night time driving and the carrying of (typically peer-age) passengers, and lower limits on things like blood alcohol levels and penalty points that can be accrued. The term is distinct from 'graduated access to higher motorcycle categories' in the next chapter, which specifically relates to a motorcycle licensing system in which restrictions on the power of the machine ridden are gradually lifted. In principle, it is possible to have GDL measures in place for motorcyclists, in addition to any power restrictions that already exist in the Directive.

3. Manage exposure to the riskiest situations in early solo-driving, typically in a 'probationary period' lasting a few months or years, for example by not allowing unsupervised night time driving or carrying of teenage passengers, and by putting stricter limits on things such as alcohol levels permitted when driving.

The intended result of these measures is that drivers will be a little older and will have more on-road experience than would otherwise have been the case when they begin solo driving, and will gain even more on-road experience before they are allowed to drive solo in the riskiest situations.

While considering how GDL systems work, it is worth considering how they fit into the wider injury reduction paradigm. Reducing exposure to risk is widely established as a sensible strategy for injury reduction. Ways of reducing exposure to risk can be based on a variety of approaches; in road safety the taxonomy of 'education, enforcement, and engineering' (the 3E's) is typically used to categorise the approaches used. For example road safety information campaigns, safety interventions designed to change attitudes to risk, and driver training would generally fall under 'education'. Speed limits and drink drive laws would fall under 'enforcement'. Finally alcohol interlocks that prevent drink driving, and changes to vehicle or road design to lessen impact damage (e.g. collapsible steering columns, deformable road sign poles) fall under 'engineering'.

The 3E framework aligns nicely with wider injury reduction categorisations. A good example of this can be seen by considering the influential report 'Injury in America' (Committee on Trauma Research, Commission on Life Sciences, National Research Council, and the Institute of Medicine, 1985), in which it is suggested that there are three general strategies available to prevent injury (reproduced below from Page 7 of that report):

1. **Persuade** persons at risk of injury to alter their behaviour for increased self-protection—for example, to use seatbelts or install smoke detectors.
2. **Require** individual behaviour change by law or administrative rule—for example, by laws requiring seatbelt use or requiring the installation of smoke detectors in all new buildings.
3. **Provide automatic protection** by product and environmental design—for example, by the installation of seatbelts that automatically encompass occupants of motor vehicles or built-in sprinkler systems that automatically extinguish fires.

The authors of the 'Injury in America' report note that in general the provision of automatic protection is the most effective approach, followed by requiring a change in behaviour. Relying on persuasion is generally the least effective in terms of its direct impact on injury levels.

The correspondence between the 3E framework and above categorisation is that broadly education=persuade, enforcement=require, and engineering=provide automatic protection. Of course there are nuances which are not captured in this high level mapping (for example enforcement can be thought of as both the laws involved, and rigour with which they are applied by the enforcing authority) but we need not concern ourselves with these for now. The important point is that in addition to considering the risks to which we are trying to reduce exposure (in this case the key behaviours and risky driving situations we wish young and novice drivers to avoid) we can consider multiple methods to achieve this reduction within an injury reduction framework, and their relative levels of effectiveness.

GDL systems take, broadly, the 'require' approach in that they set limitations in law as to the kinds of driving in which young and novice drivers are allowed to engage without supervision, and put other requirements on drivers in terms of things like minimum learning periods and minimum levels of on-road practice. There are other mechanisms

that can be engaged in attempts to achieve the same outcomes, which are typically more aligned to the 'persuade' approach. These include things like parent-teen contracts which might be used to encourage parents to set limits on driving exposure with their teen drivers (Simons-Morton, Hartos, Leaf & Preusser, 2006), and telematics-based insurance products (for a review see Tong et al., 2015). These alternative approaches, while they show promise as something that can be done if a full GDL system is not an option, do not currently have anywhere near the same level of support from the evidence base as full GDL systems do (Pressley et al., 2016).

4.2. Aim

The work in this chapter sought to establish what current practice is in EU Member States regarding graduated risk exposure approaches. The review of scientific literature then focused on analysing the impact of schemes for graduated risk exposure for novice drivers (category B) especially with regard to road safety. The analysis was based on an review of literature on existing GDL systems that allow novice drivers of category B to be gradually exposed to risks, including pre-test learning phases, and restrictions that are imposed after passing the driving licence tests. Voluntary approaches and approaches based on education and technology were also considered, where appropriate (drawing heavily on the work of Pressley et al., 2016). Good practices identified were then considered in light of workshop discussions.

4.3. Methodology

The approach taken to the literature review on graduated access to risk for Category B drivers was slightly different to that of the others in the project, in that it was known that there was a recent systematic review covering the main topic of interest (Kinnear et al., 2013). Therefore the current review aimed to establish what a good practice system would look like based on the evidence reviewed in Kinnear et al. (2013), and any additional evidence uncovered through a search of literature since 2012 (the last year covered by Kinnear et al.).

The inclusion criteria for the review were as follows:

- All studies where a GDL scheme or similar has been evaluated against either a primary (crash rates of young/novice drivers) or secondary (overall crash rates, occupant injury rates or offence rates) outcome measure since 2012 (the coverage of the last major review by Kinnear et al., 2013). Also any consideration of a GDL scheme or similar in an EU context.

The search terms used for this review are shown in Table 15 in Appendix A. The online literature databases in which a search with these terms and strings was conducted were TRID, Pub Med and Science direct.

The search using these terms returned 26 potentially relevant references. A further two references were returned from the search terms for the review of graduated access to higher motorcycle categories (Section 5). Of these 28 references, 15 were deemed potentially relevant according to the inclusion criteria, and were scored according to the quality criteria outlined in Section 2.1, with all being deemed of sufficient quality for final review. The outcome of this scoring can be seen in Appendix B, in Table 21.

4.4. Existing practice

Table 4 and Table 5 show the existing practice in Member States for which data are available in Genschow et al. (2014), and from the survey undertaken as part of this project. Note that the following terms are used according to the following definitions, following the convention used in Genschow et al. (2014):

1. 'Supervised learning period' (Table 4) means the period before solo driving of any kind commences
2. 'Probationary period' or 'autonomous learning period' (Table 5) means a period during which solo driving is allowed, but with certain restrictions

Of interest is which features of such periods (for example minimum amount of time elapsed, specific restrictions) exist in each Member State. Note that in the few cases where data come from the survey (rather than from Genschow et al., 2014) the country name is in *italics* and ranges (rather than specific detailed answers) are given (e.g. 3-6 months rather than '3 months') since these were the options in the survey. If there are multiple options for licensing paths within a country, these are listed in the first column (for example in Belgium there are systems termed '18M' and '36M').

These data should not be taken as a definitive list of the precise arrangements in each Member State. What the data do show however is that although the majority of Member States have some kind of graduated system, none of them have the kind of 'full GDL' system which are common in jurisdictions outside of Europe (such as New Zealand, most US states, some Australian states, and Canada), and which are known to be effective at reducing young driver injuries and deaths (see Section 4.5).

The extent to which the data in Table 4 and Table 5 may represent the different 'preparedness' of Member States to strengthen their systems in the future will be considered in Section 4.6, when we also discuss workshop attendees' responses to the kinds of good practices that might be considered.

Table 4: Graduated access to risk components in the driving licence systems for licence B of Member States – supervised learning period

Country (with options where appropriate)	Minimum amount of time elapsed learning (months)	Minimum amount of hours/distance driving on-road
Austria	No data	-
Belgium 36M	3	-
Belgium 18M	-	-
Bulgaria	-	-
Croatia	-	35x45 minute lessons required, but it is not clear if there is a requirement for it to be on-road
Cyprus	-	-
Czech Republic	-	34x45 minute lessons required, but this can be a combination of off-road and on-road. Up to 10 lessons can be in a driving simulator
Denmark	-	16x45 minute lessons in real traffic, and also 4 lessons on closed practice ground, and 4 at road safety training centre
Estonia	-	32x25 minute lessons required, but it is not clear if there is a requirement for it to be on-road
Finland	-	30x20 minute lessons required, but no requirement to be on-road (simulator training also allowed)
France 'Driving School'	-	20x60 minute lessons, but it is not clear if there is a requirement for it to be on-road
France 'AAC'	12	3,000km, plus 20x60 minute lessons as in 'Driving School' route
Germany 'BF17'	-	12x45 minute lessons for 'special training drives' covering things like motorways and driving in the dark
Germany 'Driving School'	-	12x45 minute lessons for 'special training drives' covering things like motorways and driving in the dark
Great Britain	-	-
Greece	-	20x45 minute lessons – some on practice ground and some on real roads (not clear how much)
Hungary	No data	-
Ireland	6	12x60 minute lessons, but it is not clear if there is a requirement for it to be on-road
Italy	-	-
Latvia	-	14x60 minute lessons – some on practice ground and some on-road, with some focus on poor weather conditions
Lithuania	-	'20 course units' – some on practice ground and some on real roads
Luxembourg 'Accompanied Driving'	-	16x60 minute lessons – some on practice ground and some on-road – content should 'convey the demands of road traffic as fully as possible'

Country (with options where appropriate)	Minimum amount of time elapsed learning (months)	Minimum amount of hours/distance driving on-road
Luxembourg 'Driving School'	-	16x60 minute lessons – some on practice ground and some on-road – content should 'convey the demands of road traffic as fully as possible'
Malta	-	-
Netherlands	-	-
Poland	-	30x45 minute lessons, but it is not clear if there is a requirement for it to be on-road
Portugal	3-6 months	31-50 hours
Romania	No data	-
Slovakia	-	41x45 minute lessons – five can be in driving simulator
Slovenia	No data	-
Spain	-	-
Sweden	-	-

Table 5: Graduated access to risk components in the driving licence systems for licence B of Member States – probationary/autonomous learning period

Country (with options where appropriate)	Length of period (months)	Night time driving restrictions[a]	Passenger restrictions (maximum number)	Lower BAC limit mg/ml	Specific mobile phone restrictions	Engine-power restrictions	Marked vehicle?	Other restrictions
Austria	No data	-						
Belgium 36M	24	10pm-6am[1]	1[2]	-	-	-	Y	-
Belgium 18M	24	10pm-6am[1]	1[2]	-	-	-	Y	-
Bulgaria	-	-	-	-	-	-	-	-
Croatia	24	11pm-5am	-	0	-	75kW	-	Lower speed limit
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	-	-	-	-	-	-	-	-
Denmark	36	-	-	-	-	-	-	2 demerit points only (usually 3)
Estonia	24	-	-	-	-	-	Y	Lower speed limits
Finland	24[3]	-	-	-	-	-	-	Reduced offences allowed[4]
France 'Driving School'	36	-	-	-	-	-	Y	Lower speed limits Six credit points on demerits instead of 12 (loss of three leads to improvement course, loss of six to ban)
France 'AAC'	24	-	-	-	-	-	Y	Lower speed limits Six credit points on demerits instead of 12 (loss of three leads to improvement course, loss of six to ban)
Germany 'BF17'	24	-	-	0[5]	-	-	-	Stricter demerit points system
Germany 'Driving School'	24	-	-	0[5]	-	-	-	Stricter demerit points system
Great Britain	24	-	-	-	-	-	-	Six points (rather than usual 12) lead to ban and need to re-take test
Greece	24	-	-	0.02	-	-	Y	-
Hungary	No data							
Ireland	-	-	-	-	-	-	-	-
Italy	36	-	-	-	-	-	-	Lower speed limits, and double points deducted for traffic offences
Latvia	24	-	-	0.02	-	-	-	Stricter regulations within demerit points system

Country (with options where appropriate)	Length of period (months)	Night time driving restrictions[a]	Passenger restrictions (maximum number)	Lower BAC limit mg/ml	Specific mobile phone restrictions	Engine-power restrictions	Marked vehicle?	Other restrictions
Lithuania	24	-	-	-	-	-	Y	Lower speed limits
Luxembourg 'Accompanied Driving'	24	-	-	0.02	-	-	-	Stricter regulations within demerit points system, and mandatory driver safety training course
Luxembourg 'Driving School'	24	-	-	0.02	-	-	-	Stricter regulations within demerit points system, and mandatory driver safety training course
Malta	36	-	-	-	-	-	-	Stricter regulations within demerit points system
Netherlands	60	-	-	0.02	-	-	-	Strict regulations within a specific demerit points system
Poland	12	-	-	-	-	-	-	Stricter regulations within demerit points system (threshold for losing licence is 21 points instead of 24)
Portugal	36	-	-	0.02	-	-	-	-
Romania	No data							
Slovakia	24	-	-	-	-	-	-	Traffic offences are more likely to be sanctioned with a ban or withdrawal of licence
Slovenia	No data							
Spain	-	-	-	-	-	-	-	-
Sweden	24	-	-	0.02	-	-	-	-

a. Unless accompanied by an appropriate supervising driver (requirements vary by country)

1. Fridays, Saturdays, Sundays, and public holidays and the days before public holidays
2. Aged at least 24 and has Category B licence
3. Reduced to 18 months if a mandatory 'safe driving course' is taken within 18 months of passing test
4. 1st offence is written reprimand, and 2nd within year (or 3rd within two years) lead to personal meeting with police officer and possible bans and re-tests
5. Limit also applies to age 21

4.5. Effectiveness and impact on road safety

4.5.1. The Kinnear et al. (2013) review

Kinnear et al. (2013) undertook a review of the literature on graduated driver licensing (GDL) systems. Building on an earlier Cochrane systematic review (Russell, Vandermeer & Hartling, 2011) Kinnear et al. took a systematic approach to reviewing evidence for the effectiveness of GDL systems in the years since the previous work.

The broad conclusions reached in Kinnear et al. (2013), after reviewing wider literature on young and novice drivers, and all the evidence that could be found on GDL, were as follows:

- Young and novice drivers are at a heightened risk of crashing when they begin driving 'solo' due to factors associated with their youth and inexperience. Younger drivers, and less experienced drivers, are at greater risk.
- GDL is effective at reducing collisions and injuries for novice drivers of all ages
- The strongest systems, applied to all ages of novice driver, are the most effective
- The key components in effective systems are:
    - Minimum learning periods (to delay licensure and encourage on-road preparation). One to two years is recommended.
    - Minimum amounts of on-road preparation. At least 100-120 hours are recommended.
    - A 'probationary period' (ideally of one to two years) during which the following measures are in place:
        - Restrictions on night time driving unless accompanied by a suitable supervising driver.
        - Restrictions on carrying passengers (especially peer-age) unless accompanied by a suitable supervising driver. The ideal system does not allow any passengers.
        - Lower alcohol limits.

To anticipate the findings from the review in the current report, the findings above still stand. The evidence published since the Kinnear et al. review has added some interesting detail, but has done nothing to change the headline findings. In short "…the evidence for the effectiveness of GDL to reduce novice driver collisions is compelling" (Kinnear et al., 2013, p.47), when we are talking about the kinds of 'full GDL' systems described in the above bullet list.

Kinnear et al. also examined the likely range of effectiveness of strong GDL systems, and based on a number of studies they concluded that a realistic (but not *too* conservative) estimate for effectiveness in GB was 20%. Given the similarity in licensing ages across the EC Member States to that seen in GB, and the fact that there are no Member States which have what would be called strong GDL systems, this estimate seems like a sensible one to use as context for consideration of any good practice in this area.

4.5.2. Recent research

4.5.2.1. Evidence relating directly to GDL effectiveness

Since the Kinnear et al. (2013) review, there have been a small number of studies looking at approaches to achieving graduated access to risk for young and novice drivers

of Category B vehicles. Much of this literature has focused on further understanding how graduated driver licensing (GDL) systems work to reduce risk, as well as focusing on how such systems might be fine-tuned in the future. As we note above this research does not alter any of the key findings from Kinnear et al. (2013) about effectiveness.

An example of a recent overall analysis of the effects of GDL in the USA is the study of McCartt and Teoh (2015). These authors examined the crash rates of teenage drivers, and middle aged drivers, over the period from 1996 to 2012 (this period coincides with the implementation of GDL systems in US states). The authors were able to show that over this period fatal and police recorded crash rates per capita declined for both groups, but the fall was much sharper in teenage drivers (especially 16-17 year olds). When comparing 1996 and 2012 the proportion of crashes at night and with multiple passengers declined for teenage drivers (more so than for middle aged drivers), and the proportion of fatally injured teenage drivers who had been drinking alcohol declined (but changed little for middle aged drivers). In other words, the kinds of risk factors targeted by GDL systems being introduced in US states over that period were the ones that showed decline. Rates of driver errors or speeding among teenage drivers in fatal crashes did not change, lending more credibility to the suggestion that fatal crash types targeted by GDL laws were driving the improvements seen. The authors conclude that if states were to strengthen their GDL laws more improvements to safety are achievable.

McCartt and Teoh (2015) also point out that some risk factors remain to be targeted by GDL systems (e.g. speeding behaviour and driver errors) since these contributory factors did not change for teen drivers over the 1996-2012 period. Pressley, Addison, Dawson and Nelson (2015) arrive at similar conclusions. They examined data from the Fatality Analysis Reporting System (FARS) for 2007 to 2009, and showed that nearly one third of teen drivers involved in fatal crashes were GDL compliant, unimpaired, and wearing a seat belt; these drivers tended to have crashes to which factors such as speeding, lane errors, distraction and driving on slippery surfaces had contributed (all of these increased the odds of a fatality). Finally Simons-Morton et al. (2015) use data from the Naturalistic Teen Driving Study to argue that as GDL policy is advanced in the future, it should focus on what is termed 'kinematic risky driving' (broadly, harsh acceleration, braking and cornering), driver distraction from secondary tasks, and risky social norms. These conclusions were reached after studying changes in detailed driver behaviour in a small sample of teens with telematics devices fitted to their cars.

The recent focus in the research literature on factors that go beyond those normally covered by existing GDL laws seems also to be reflected in current practice. A publication from the Insurance Institute for Highway Safety and the Highways Loss Data Institute (IIHS/HLDI, 2015) notes that when looking at the progress of GDL in the USA, it is clear that states with the strongest laws have seen the biggest benefits, but also that since 2010 there has been a slowdown in the strengthening of GDL laws. The authors attribute this to the fact that states have been focused on some of the other behaviours and factors mentioned in the above paragraph (for example more palatable 'distracted driving' laws), despite the fact that the evidence base for such measures is much, much less convincing than that for GDL laws. Pressley et al. (2016) note that this is because the risk factors currently targeted by the strongest GDL systems (night time driving, carrying passengers, age and inexperience, drink driving) seem to be the ones with the most consistent links with collision risk.

Direct evidence has also continued to accumulate in the recent literature that the risk factors that are targeted by GDL systems are still highly relevant, highlighting the fact that although GDL systems do not solve every problem associated with young and newly qualified drivers, they do remain the single most effective intervention for this group.

Curry, Pfeiffer, Durbin and Elliott (2015b) for example examined the effect (on state recorded crashes) of licensing age, driving experience, and licence phase in the GDL system in New Jersey. Partly, this study was an attempt to uncouple age and driving experience in drivers within a GDL system (which had not been done before), and to look at whether the jump observed in crash rate between learner and intermediate licence phases is also evident at the jump between the intermediate and full licence phases. New Jersey is unusual in the USA in that it extends GDL restrictions to 18-20 year old drivers, and therefore can separate the different effects on crash rate of age, experience and licensing phase, for drivers aged 17-20. The first finding was that within the GDL system, independent effects on crash risk of age and experience were seen in the intermediate licensing stage. Drivers licensed at all ages showed a decline in risk over the first two years of driving, with those licensed at the youngest age (17 years) showing the steepest decline. The second main finding was that when drivers do transition to their full licence (they can do this from 18 years old in New Jersey), regardless of how many months after obtaining their intermediate licence they do this, their crash rate rises immediately and then falls again in line with the learning effect seen in other studies (e.g. Wells et al., 2008; Mayhew et al., 2003; McCart et al., 2003; Maycock, 2002; Williams, 1999; Sagberg, 1998; Forsyth et al., 1995; Maycock et al., 1991). Notably however, their level of risk remains below the level of risk in the initial solo driving in the intermediate stage, presumably due to the increased levels of on-road experience, and greater maturity, that they have when making this transition.

Ouimet Pradhan, Brooks-Russell, Ehsani, Berbiche and Simons-Morton (2015) provide a recent review of another important risk factor targeted by GDL systems (the carrying of passengers). These authors undertook a systematic review of epidemiological studies of crash risk in young drivers driving with passengers (compared with driving solo). There was a clear overall association of passengers and increased risk, whether only one passenger or two or more, relative to driving without passengers. The overall association suggested that continued restrictions on young drivers carrying passengers in GDL systems are recommended. Interestingly for the purposes of this review, Ouimet et al. suggest that some of the gaps in the literature that need to be filled include understanding the different effects of different ages and status of passengers (for example peer-age, siblings versus non-siblings), and that some of the findings from European countries (notably Sweden and Spain) have even suggested protective effects of some types of passengers, and carrying older passengers (35+ years) has been associated with a reduction in collision risk for teen drivers (Preusser et al., 1998). Nonetheless the overall findings from the literature support a starting point in which passenger restrictions form part of a GDL approach (as do the findings from McCartt and Teoh, 2015, and previous findings of protective effects from GDL systems more generally).

A final thing to note about GDL systems is that they often interact in some way with driver training and education approaches. This would be expected even for hypothetical 'ideal' systems (for example see the comprehensive approach suggested by Kinnear et al., 2015). While the GDL system sets boundaries for risk exposure and requirement for lengths of time at certain stages of licensing (e.g. the learning and probationary stages) there are usually education and training interventions that also occur as part of the system. An important consideration for GDL systems is the nature of this interaction. Specifically, Begg and Brookland (2015) note that 'time discounts' in the GDL system, achieved through participation in driver education and improvement courses, should be avoided, as they have been shown to lead to earlier licensing, and in some cases higher violation and crash rates in later solo driving.

4.5.2.2. 'Softer' approaches to achieving graduated exposure to risk

Researchers are also beginning to study approaches other than GDL to achieving graduated risk exposure for drivers of Category B vehicles. Such approaches can broadly

be separated into so-called 'parent-teen' contracts, and technology-based approaches (usually involving the use of 'black box' or telematics data recorders in teens' cars)[13].

'Parent-teen' contracts utilise the often close relationship between novice drivers and their parents or guardians, to encourage self-set limits on exposure to risk using similar risk factors as GDL systems. For example parents and teens might have an agreement on how soon after becoming licensed they are allowed to drive at night, or carry peer-age passengers, when unaccompanied. Pressley et al. (2016) provides a review of this approach, and concludes that it shows promise in improving parent supervisory behaviours during early driving, and in reducing teens' risky driving behaviours, but is currently unproven in terms of its impact on collision risk. Curry, Peek-Asa, Hamann and Mirman (2015a) reached similar conclusions in their review.

Approaches based on technology tend to focus more on driver behaviour variables than on reducing risk exposure *per se*, although some insurance products designed specifically for novice drivers do utilise night time curfews. Tong et al. (2015) have reviewed such approaches where they are delivered through motor vehicle insurance, and Pressley et al. (2016) reviewed the wider literature. In both cases it was concluded that such approaches, while demonstrating great promise, are as yet unproven.

A recent study looking at approaches that combine parental supervision and telematics is that of Creaser, Swanson and Morris (2015). It is interesting because it focuses specifically on one of the explicit intended outcomes of GDL systems (post-licence supervised driving). These authors studied three groups of drivers. One group had no support (the control group) and two others either had partial support with a telematics based system that coached them on various behaviour measures, or 'full support' where the in-vehicle system also alerted parents via texts and weekly emails. The findings were that amounts of supervised driving were highest in the full support group. In the partial support group, supervised driving was only higher than in the control group in vehicles that were not shared between the teen driver and the parent; in other words such systems can be used by parents to allow more freedom than would otherwise have been the case in shared vehicles.

When considering the evidence as a whole, it is concluded that GDL systems remain the only proven approach to achieving graduated risk exposure and injury reduction.

4.6. Discussion of good practice

Based on the literature reviewed in this chapter, the good practices in the following table were drafted, and discussed at the workshop.

[13] In fact, many parent-teen approaches also include telematics, and many approaches based on telematics also seek to involve parental supervision. The combination of both approaches to reduce exposure to risk post-licence, and to improve driving behaviour, seems to show the most promise.

Good practices regarding graduated exposure to risk for Category B drivers	
1	All novice drivers should be subject to a probationary period after licensure (ideally one to two years in length), during which the following restrictions should be in place: a. A ban on night time driving (unless accompanied by a suitable supervising driver). Typically the time period runs from 9-11pm to around 5-6am. The longer the time period, the greater the effect on safety outcomes. Some systems have exceptions for 'legitimate travel' (for example to a place of employment or education) but such exceptions are best avoided if possible. b. A ban on carrying peer-age passengers (unless accompanied by a suitable supervising driver). Systems typically allow from zero to two passengers to be carried, and some have exceptions for family members. As with night-time limitations, exceptions are best avoided if possible. c. A lower blood alcohol limit. Such limits can run from effectively 'zero'.
2	All learners should be subject to a minimum learning period. This should be as long as is possible to permit time for drivers to both mature, and to undertake extensive on-road preparation. One to two years is recommended.
3	All learners should be subject to a minimum prescribed amount of on-road driving practice during the learning period (either with a formal driving instructor, or with a 'lay' instructor such as a parent or guardian). The evidence suggests that around 120 hours of driving is desirable if it is to be protective of later crash risk.

The one measure that was given wide support was the one that seems already to be adopted by a number of Member States – a stricter alcohol limit for learners during the post-test probationary period.

In general, feedback regarding post-test restrictions (except lower alcohol limits) was negative, with respondents citing a large number of perceived barriers to implementation. Some barriers cited were general in nature (such as cost increases related to the increased regulatory burden, and enforcement difficulties) while others related to specific issues within Member States (for example in Member States where night time driving is taught, post-test night time restrictions would make little sense).

The same broad negative feedback was given to both the good practices proposed for the learning period (minimum period of time, minimum amounts of on-road practice). Barriers suggested included the costs incurred by learners, specific Member State issues (such as in Finland, compulsory education being a political barrier), and the way in which a target number of hours might be seen also as a 'maximum' (rather than just as a minimum).

Almost all of the barriers mentioned are common objections that have been cited previously due to their intuitive-sounding appeal, but which lack any real foundation in evidence (Kinnear et al., 2013). The moderator at the workshop (with some support from one or two of those present) noted that in all cases, such objections have been overcome in the multiple jurisdictions around the world (for example in Canada, Australia, the USA, and New Zealand) where strong GDL systems have been successfully implemented and achieved improvements in safety.

5. Graduated access to higher motorcycle categories

5.1. Introduction

The concept of graduated access to higher motorcycle categories emerged in the United Kingdom in the 1980s as a result of the Transport Act 1981. The act introduced various measures for reducing risk to riders of powered-two wheelers in the UK; one such measure was the reduction of the maximum engine size for learners from 250 to 125 cubic centimetres (cc).

Motorcyclists continue to be one of the most vulnerable road user groups in Europe and beyond. A study based on data from Great Britain found that motorcyclists are 76.32 times more likely to be killed than motor vehicle drivers (Rolison, Hewson, Hellier & Hurst, 2013). In 2008, PTW riders made up around 18% of all road collision fatalities in the EU-23 (Yannis, 2012). Motorcyclists are also overrepresented in road casualties generally. In the UK, riders are estimated to represent 19% of road casualties, but less than 1% of all road traffic (DfT, 2015); in New Zealand, riders represent approximately 13% and 9% of road deaths and injuries (respectively) despite only composing 3.5% of registered vehicles (NZ Ministry of Transport, 2011). These statistics are replicated in other countries around the world.

Much like young drivers, age and inexperience play a key role in casualties for this road user group (Schneider, Savolainen, Van Boxel & Beverley, 2012; Sexton et al., as cited in Mitsopolous-Rubens, Rudin-Brown, & Lenné, 2009). For example a study by Sexton et al. in the UK showed that a novice rider aged 60 (with one year experience) was 70% less likely to be involved in a crash than a 17 year old novice rider with the same experience. Age can also contribute to at-fault status, as an American study by Schneider and colleagues (2012) found young riders were more likely to be at-fault in the event of a collision. Young riders are also associated with riskier behaviours when on the road, for example, a study in 2014 with commercial riders in Nigeria showed that motorcyclists under the age of 25 were 16 times more likely to have poor road safety practices (e.g. road sign compliance and wearing a helmet) when compared with those aged 35+ years.

Graduated access to higher (powered) motorcycle categories is only a relatively small part of a more generalised graduated licensing system (GLS) for motorcyclists discussed in the literature. Although rarely implemented in full at present, this system could involve a set of restrictions that can be applied to riders at different stages of the learner period, and depending on the licence category they are operating under (A1, A2 or A[14]), could involve stricter restrictions on blood alcohol limits, requirements for minimum learning periods and practice time, as well as restrictions on the transport of pillion passengers. Similar to GDL for car drivers, increased safety for motorcyclists is more likely to be achieved through a complete programme of well-defined specifications for learner riders. Graduated access to higher powered bikes is likely to be an important element of this programme, and will be the initial focus of this chapter.

[14] According to the Directive, the categories can be described as: A1 – motorcycles with a cylinder capacity not exceeding 125 cc's, of power not exceeding 11kw and with a power/ weight ratio not exceeding 0.1 kW/kg. A2 – motorcycles of a power not exceeding 35 kW and with a power/ weight ratio not exceeding 0.2 kW/kg; A – an unrestricted licence allowing access to any power output.

5.2. Aim

The work in this chapter sought to establish what current practice is in EU Member States regarding graduated access to higher motorcycle categories as well as any planned changes to training, licensing or regulatory practices as a result of the Directive. The review of the scientific literature then analysed available studies of the impact of graduated access (also called progressive access) to riding motorcycles as introduced by Directive 2006/126/EC on road safety. Good practices identified were then considered in light of workshop discussions and the current evidence.

5.3. Methodology

The inclusion criteria for the review were as follows:

- All studies where a graduated or progressive access scheme, or similar, has been evaluated against either a primary (crash rates of motorcycle riders) or secondary (overall crash rates, occupant injury rates or offence rates) outcome measure since 2006.

The start year of 2006 was chosen as this was the year of the introduction of the Directive 2006/126/EC, even if it was not the year of implementation. Therefore 2006 represents a sensible start year since it is when Member States could definitely have begun studies that directly examined the factors and outcomes targeted by the Directive.

The search terms used for this review are detailed in Table 16 in Appendix A. The online literature databases in which a search with these terms and strings were conducted were TRID, Pub Med and Science direct.

The initial search returned 17 potentially relevant studies. Of these, 10 studies were deemed to meet the inclusion criteria and were requested for full-text review for quality scoring. Seven studies met the quality criteria requirements and have been included in the review. A further two studies (identified through the 'Graduated risk exposure to novice drivers' search) were also included. Table 22 in Appendix B shows the results of the quality scoring.

Two of the papers identified through the full-text review did not meet the quality criteria (due to the nature of the work undertaken), but were included as they directly discuss the issue of graduated access to motorcycle categories.

5.4. Existing practice

A recent report by the Federation of European Motorcyclists Association (FEMA) (Delhaye & Marot, 2015) provides the most detailed insight into Member State practices and priorities in light of the implementation of the 2006 Directive. The study reports on an engagement exercise undertaken with Member State representatives as well as the motorcycling community. The representatives were asked to discuss the benefits and challenges involved in the implementation of the Directive at a national level. One of the key points identified related to the need for increased harmonisations between Member States in the implementation of regulations for learner riders. Table 6 breaks down the reported minimum age requirements for access to different licence subcategories, and thus the large differences that exist in relation to minimum age requirements across Member States. The data in this table were obtained from the Member State survey detailed in Section 2.3.

Table 6: Minimum age for Category A, availability of direct access and existence of an official rider training curriculum, by Member state

Member State	Minimum age for A1 licence	Minimum age for A2 licence	Minimum age for A licence	Direct access available	Official rider training curriculum
Austria	16	18	20	Yes	Yes
Belgium	18	20	21	No	Yes
Bulgaria	*	*	*	*	*
Croatia	16	18	20	Yes	Yes
Cyprus	18	20	21	No	Yes
Czech Republic	*	*	*	*	*
Denmark	18	18	21	Yes	Yes
Estonia	16	18	21	No	Yes
Finland	16	18	21	Yes	Yes
France	16	18	20	No	Yes
Germany	16	21	21	No	Yes
Great Britain (all of United Kingdom)	17	19	21	Yes	Yes
Greece	18	20	21	Yes	Yes
Hungary	*	*	*	*	*
Ireland	16	18	20	Yes	Yes
Italy	16	18	20	No	No
Latvia	16	18	20	No	Yes
Lithuania	16	18	21	No	Yes
Luxembourg	16	18	20	No	No
Malta	18	20	21	Yes	No
Netherlands	18	18/20	21	Yes	No
Poland	16	18	21	No	Yes
Portugal	16	18	21	No	Yes
Romania	*	*	*	*	*
Slovakia	16	18	21	No	Yes
Slovenia	16	18	21	Yes	Yes
Spain	16	18	20	No	No
Sweden	16	18	20	Yes	Yes
Switzerland	18	18	21	Yes	No

* Represents Member State for which no response was obtained in the survey.

Table 6 also shows that not all Member States have chosen to implement an age-based exemption (i.e. direct access) for access to a full (unrestricted) licence. Respondents from Austria, Croatia, Greece, Sweden, Slovenia and the Netherlands reported that in these Member States riders can obtain direct access to an unrestricted (A) licence at the age of 24 years. Denmark was the Member State to report the lowest age for direct access at 21 years. Switzerland (though not a Member State) reported the highest age, at 25 years old for direct access to A category.

Most countries also reported having an official national rider training curriculum. As shown in Table 7 in most cases this curriculum includes requirements for supervised on-road training, complimented by a minimum number of hours of on-road practice and class-room based training. Again, approaches are variable.

Table 7: Pre-test requirements included in the national rider training curriculum, by Member State

	Official rider training curriculum includes the following pre-test requirements			
Member State	Supervised on-road training	Minimum number of hours practice on road	Class-room based training	Other requirements
Austria	Yes	Yes	Yes	
Belgium	Yes	Yes	No	
Bulgaria	*	*	*	*
Croatia	Yes	Yes	Yes	
Cyprus	No	No	No	Minimum number of hours practice in an open simulation area using the motorbike and supervised by a trainer
Czech Republic	*	*	*	*
Denmark	Yes	Yes	Yes	
Estonia	Yes	No	Yes	
Finland	Yes	Yes	Yes	
France	Yes	Yes	No	Twenty practical training hours (including five hours on simulator or off-road)
Germany	Yes	Yes	Yes	
Great Britain (all of United Kingdom)	Yes	Yes	Yes	
Greece	Yes	Yes	Yes	
Hungary	*	*	*	*
Ireland	Yes	No	Yes	Sixteen hours (category AM, A1) or 18 hours for Category A and A2 (Direct access)
Italy	No official curriculum reported			
Latvia	Yes	Yes	Yes	
Lithuania	Yes	Yes	Yes	
Luxembourg	No official curriculum reported			
Malta	No official curriculum reported			
Netherlands	No official curriculum reported			
Poland	Yes	Yes	Yes	
Portugal	Yes	Yes	Yes	
Romania	*	*	*	*
Slovakia	Yes	Yes	Yes	
Slovenia	Yes	Yes	Yes	
Spain	No official curriculum reported			
Sweden	Yes	No	Yes	Mandatory risk education applies (180+240 minutes).
Switzerland	No official curriculum reported			

* Represents Member State for which no response was obtained in the survey.

Survey respondents were also asked to specify any additional restrictions placed on learner riders in different subcategories, i.e. mopeds (AM), A1, A2 and A (Table 8). Most Member States represented in the survey had a 'no mobile phone use' policy for riders in all subcategories. Croatia and Lithuania also reported a zero or lower blood alcohol concentration (BAC) for riders of all subcategories and Slovenia was the only country to report restrictions on the number of pillion passengers for all rider subcategories.

Some potential safety measures for learners, such as restricting night-time riding and requiring riders to wear high visibility clothing were not reported in any of the Member States, not even for the youngest of riders. This could represent an area for improvement, particularly given the potential benefits of measures such as high-vis clothing (e.g. Helman, Weare, Palmer, & Fernández-Medina, 2012).

Table 8: Additional requirements placed on riders based on the licence subcategory (AM, A1, A2 and A), by Member State

Member state	Zero or lower BAC	Restrictions on pillion passengers	No night-time riding	No mobile phone use	Requirement to wear high visibility clothing
Austria	AM			AM, A1, A2, A (Unrestricted)	
Belgium	*	*	*	*	*
Bulgaria					
Croatia	AM, A1, A2, A (Unrestricted)			AM, A1, A2, A (Unrestricted)	
Cyprus					
Czech Republic	*	*	*	*	*
Denmark		AM		AM,A1, A2, A (Unrestricted)	
Estonia				AM, A1, A2, A (Unrestricted)	
Finland					
France				AM, A1, A2, A (Unrestricted)	
Germany				AM, A1, A2, A (Unrestricted)	
Great Britain (all of United Kingdom)		AM, A1			
Greece					
Hungary	*	*	*	*	*
Ireland					
Italy	AM, A1, A2				
Latvia				AM, A1, A2	
Lithuania	AM, A1, A2, A (Unrestricted)				
Luxembourg					
Malta				AM, A1, A2, A (Unrestricted)	
Netherlands					
Poland					
Portugal					
Romania	*	*	*	*	*
Slovakia					
Slovenia		AM, A1, A2, A (Unrestricted)			
Spain					
Sweden					
Switzerland	AM, A1, A2, A (Unrestricted)				

* Represents Member State for which no response was obtained in the survey.

Slovenia appears to be one of the countries with the highest level of safety measures implemented. The reason for this is discussed in a recent paper focusing on the approach that Slovenia has taken to reducing risk to PTWs (Sraml, Tollazzi & Rencelj, 2012). These approaches include increased roads policing (e.g. speed cameras and police presence at 'critical' road sections), changes to signage and road markings, and introduction of educational approaches.

According to Delhaye & Marot (2015), the highest powered motorcycles (501cc and over) are more frequently seen in Finland, Belgium, Estonia, The Netherlands and Sweden. According to survey respondents, these are some of the countries with the least amount precautionary safety measures in place (as shown in Table 8), though all but The Netherlands reported the existence of an official curriculum.

5.5. Effectiveness and impact on road safety

The only study identified that directly assessed the safety impact of restrictions on the power of motorcycles for riders was undertaken in 1982 by the Transport and Road Research Laboratory (known today as the Transport Research Laboratory). The study was undertaken as a response to the implementation of the Transport Act 1981 in the UK. One of the measures introduced by the Act was to reduce the maximum engine size of the motorcycle that a learner rider may ride to 125cc; the power output of the bike was also limited to 9kW for learners. Of all the measures implemented, the study by Broughton (1987) found that it was the restriction on engine capacity of motorcycles that had the clearest effect on casualty rates per vehicle driven. The author concluded that the transfer of inexperienced riders to less powerful bikes led to a reduction of an estimated one quarter in casualties among learner riders. This was believed to be independent of any reduction caused by a declining number of motorcyclists generally at the time.

Haworth and Rowden (2010) evaluated changes in motorcycle licensing after the introduction of stricter rules for learner riders in Queensland, Australia. The process included two major changes, one that came into force on 1st July 2007 and the key changes included a requirement for motorcyclists to have held a provisional or open car licence for at least 12 months prior as well as the introduction of a 3 year limit for the motorcycle learner licence (previously the learner licence did not expire, per se). The other change occurred from 1st July 2008 and included a requirement for all riders to hold a restricted (RE class) licence for a period of 12 months prior to progressing to an unrestricted licence. The RE licence also includes a restriction for the power output of bikes to be no more than 250cc. Although their evaluation did not include collisions as an outcome measure, licensing data can be used as a proxy for exposure. Generally speaking, reducing exposure to the risk can result in decreased risk (this is not considering the 'low mileage bias'[15]). The study evaluated licensing over three distinct periods, one previous to the introduction of both changes (Period A: 1 January 2006 to 30 June 2007), after the introduction of the first change (Period B: 1 July 2007 to 30 June 2008), and after the introduction of the second change (Period C: 1 July 2008 to 30 June 2009). The study found that a far lower percentage of inexperienced riders were licensed to ride a high capacity machine as a result of the change in the licensing system. While the authors did not investigate the effects of the changes on crash risk, limiting the exposure of novice riders to higher-powered bikes has the potential to positively impact the rates of collisions for this road user group, based on the findings of Broughton (1987).

[15] The 'low mileage bias' suggests that drivers who travel more kilometres tend to have lower crash rates per km driven, regardless of age (Langford, Methorst & Hakamies-Blomqvist, 2006).

The Queensland government in Australia has also worked on the development of thorough guidance on bike power restrictions under the learner and probationary period licensing system. This has been developed under the 'Learner approved motorcycles scheme' (LAM Scheme)[16] and provides learner riders with an index of approved motorcycle models for the class RE (learner, provisional, probationary and open licences). The Queensland government has also announced that starting October 2016, riders wishing to progress to a class R (unrestricted) motorcycle must have held the provisional (RE) licence for at least two years. The highest permitted engine capacity for RE class is 660ml. This programme has not been evaluated in terms of understanding its effect on encouraging uptake or motorcycle riding, or on collision risk, but represents a clear step forward in ensuring the appropriate information is made available to learners..

Finally, a study by Reeder and colleagues also found reductions (22%) in the number of hospitalisations due to motorcycle crashes in the youngest group, 15-19 year olds, as a result of the introduction of a comprehensive graduated rider licensing system in New Zealand (Reeder, Alsop, Langley & Wagenaar, 1999). The system includes restrictions for learners on engine size (250cc for learners), the transport of pillion passengers (none are allowed at this stage), and a night-time riding curfew. The study was undertaken in New Zealand and employed data from the New Zealand Health information Services (national public hospital data files for the years 1978 to 1994), which was used to examine the years before and after the graduated system was introduced in 1987.

5.5.1. Evidence that could support the effectiveness of graduated access to higher powered bikes

There is limited direct evidence in relation to the effects of graduated rider licensing systems, especially in terms of the direct effects on road safety as a result of graduated access to higher powered motorcycles. The existing literature can, however, provide some other indirect insights into the risks that learner and novice riders face, regardless of age. It can also provide some justification as to why achieving progressive access to higher powered motorcycles may result in increased safety outcomes, even without much direct evidence to this effect.

Two studies were identified that explicitly sought to understand the relationship between motorcycle power and crash risk. A study by Rolison et al. (2013) showed that the risk of fatality for motorcyclists was linked to the power output of the bike; this is, fatality rates were found to be higher for riders of high-powered motorcycles, regardless of age (Rolison et al., 2013). The study analysed motorcyclists and motor vehicle driver casualties (passengers were not included) resulting from a road traffic incident in Great Britain between 2002 and 2009. The UK's Department for Transport provided researchers with data on drivers' and motorcyclists' estimated number of trips per year.

Another study was undertaken by Mattsson & Summala using data from the Finnish in-depth road accident investigation teams (VALT). VALT investigates every collision occurring on Finnish roads and contains information on around 500 variables believed to have contributed to the collision. A total of 111 fatal collisions (which specified data on power-to-weight ratio of the bike) were included in the analysis, and riders were divided into two age groups: 21-30 year olds and 30+ years old. Analysis showed that the relative number of fatal crashes increased sharply with increasing power and power-to-weight ratio, regardless of age group (Mattsson & Sumala, 2010). This study was further supported by the analysis of VALT and survey data looking into fatal and non-fatal collisions (undertaken by the same research team; survey data assessed involvement in

[16] https://www.qld.gov.au/transport/licensing/motorcycles/learner-approved/

non-fatal collisions), which included over 2,000 Finnish riders of varying types (and power) of motorcycle. The study found that the risk of being involved in a fatal collision increased with increased engine power, again, regardless of age. The study did not find a statistically significant difference between power classes for non-fatal accidents, though the authors note that young users of higher-powered bikes (e.g. 75kw and over) were over-represented in the survey sample.

Christie (2014) also highlights data which indicates that high-powered motorcycles are overrepresented in crashes in Australia and elsewhere. The author notes that this is likely due to a combination of factors, including larger distances travelled, ability to travel at high speeds and the behaviour of the riders of this type of bike. The latter factor is also highlighted by Mattsson & Sumala (2010), who discuss the possible relationship between the power of the bike and the rider's characteristics. This is, the possibility that collisions involving high-powered motorcycles are due to the patterns of usage by the riders that choose to ride them (rather than as a direct result of the power of the bike). The authors cite work by Mayhew and Simpson who suggest that sensation-seeking individuals may be attracted to activities involving elevated risk (1989, as cited in Mattsson & Sumala, 2010). Higher powered bikes would allow access to such activities. It was beyond the scope of this review to understand the relationship between rider characteristics and the types of motorcycle they ride, although there is some evidence that riders fall into different categories which can be described in terms of their behaviours and attitudes toward risk (Christmas, Young, Cookson & Cuerden, 2009).

Although limited, the evidence above seems to indicate that there is likely to be a benefit from reducing exposure to higher-powered motorcycles, regardless of age. This is important as the Directive currently allows Member States to allow direct access to an unrestricted motorcycle licence for riders 24 years and older. It is also worth noting that progressive rider licensing systems allow the novice rider to mitigate risk by encouraging a stepped access to higher risk scenarios. At the start, riders may experience the most stringent limitations such as carrying pillion passengers (thus possibly adding distraction to an already cognitively overloaded novice rider) or riding during the late hours of the night (thus avoiding possible risk relating to poor visibility and/or fatigue). The reasoning behind such systems is that as the rider gains experience of different on-road scenarios, usually as a function of a pre-determined length of learner permit holding, he/ she becomes more able to perform the riding task effectively and safely.

Experience is important for obvious reasons, but a recent study by Simons-Morton & Ehsani (2016) uses learning theory to underpin the importance of practice in the driving context (their general arguments can be applied to riding). They summarise the general notion from the skill learning literature that learning is a complex task involving three stages of skill acquisition (cognitive, associative and autonomous). The autonomous stage is the pinnacle of the learning experience (i.e. when behaviours become controlled by autonomous processes, thus freeing up cognitive resources) and is achieved through the progressive application and internalisation of the learner's cognitive experiences; this is, through repetition and practice of behaviours. Learning to operate a motor vehicle is, therefore, a complex process that at the initial stages is likely to require all cognitive sources to be utilised. Thus, a system which spreads learning (including learning when licensed) over a longer time period is likely to be more beneficial.

The young driver literature, which is currently very well developed, has shown that supervised experience (in the form of pre-licensing practice) has a positive effect on safety outcomes after licensure. Work by Gregersen et al. (2000) and Sexton and Grayson (2010b) has shown that on-road experience in the learning phase is associated with a reduction in post-test collisions for car drivers. Experience is also a key factor reducing risk for motorcyclists, and as such it could be assumed that, similar to novice drivers, increased practice when at the learner stage could potentially help reduce

collisions once the rider has achieved an unrestricted licensing status. Ultimately, although the available evidence seems to suggest the existence of a relationship between the power output of a bike and increased crash risk, more robust evidence is required to underpin the relationship of bike power, increased crash risk and age of first licensure. This would allow us to understand whether riders who progress through the motorcycle licence sub-categories are at less risk than those who obtain direct access to an unrestricted licence once they are 24 years or older. This type of study would be an important step forward in providing further recommendations to improve safety for this vulnerable road user group. More evidence is also required to gain insight into the behavioural aspects that may (or may not) mediate the relationship between higher-powered bikes and crash risk. As some researchers have identified, there may be important factors that increase risk for riders, regardless of the type (or power) of bike they choose to ride. This distinction might be important as it may provide guidance to the best approaches that can be adopted to mitigate risk in this road user group.

A final consideration, based on Christie (2014) is that the age for being allowed access to motorcycling should be higher (possibly higher than it is for access to driving a car), given the greatly inflated risk of injury that riders face, and the fact that a longer learning period would provide opportunity for greater supervised practice as well as maturation. Although not strictly related to the power of machines ridden, this topic (although controversial, given its impact on the affordable mobility that motorcycles allow) is worthy of consideration.

5.6. Discussion of good practice

Based on the available evidence and the judgement of the report authors, both directly and indirectly assessing the possible safety effects of limiting access to higher-powered motorcycles, the following good practices were developed and discussed at the stakeholder workshop.

Good practices regarding progressive access to higher-powered motorcycles, and rider safety in the EU	
1	The minimum age of licensure should be higher than the minimum age for holding a car licence.
2	All learner riders should be subject to a minimum number of hours of supervised on-road practice, which should be logged and evidenced as part of the learner phase. This is mostly derived from the lessons learned from the GDL literature for car drivers; increasing experience at the learner stage is likely to result in decreased risk. Consideration should also be given to having a minimum learning period in order to support this minimum amount of supervised on-road practice.
3	Learner riders should not be permitted to undertake time-discounting schemes which reduce their time in the learner phase. These schemes have been developed to provide riders with enhanced skills and knowledge about riding safety but, as educational approaches are generally limited in their effectiveness they should never be a substitute for increased riding practice under conditions of low risk.
4	Age-based exemptions to the learner requirements should not be permitted. All learner riders should have to show a minimum level of experience on the particular bike type (power) as prescribed by the graduated licensing system (GLS). Currently, Directive2006/126/EC suggests that the requirement to hold an A2 licence for two years prior to being awarded an unrestricted licence could be waived for candidates over the age of 24. However, some research shows that risk may increase for riders of higher-powered motorcycles, regardless of their age, so such exemptions should be dropped.

The stakeholder workshop held for the purpose of this study (Section 2.2) identified push-back in relation to the introduction of increased age-based restrictions for riders;

particularly in relation to the suggestion that the age of rider licensing should be higher than that of driver licensing. This good practice was based on a well-developed discussion paper (Christie, 2014), but at present the evidence to support a move to such a system is limited and as such it is unlikely to have positive response at an EU level, based on feedback from the workshop. One more palatable option might be to have the licensing age for A1 and A2 motorcycles in line with that of car drivers.

The evidence relating to the good practice to establish and harmonise requirements for on-road practice is based mainly on research with young drivers. Although there is also evidence to suggest that the learning phase is important in developing the cognitive mechanisms necessary to be able to perform the task safely and effectively, supervised learning can help ensure learner riders employ their cognitive resources in key areas, such as handling the bike (instead of needing to focus on other elements such as way finding and route choice). Requirements to log this supervised practice is likely to contribute to the harmonisation of licensing practices across the EU.

Time-discounting schemes were currently not reported by survey respondents, and in the authors' opinions this should be considered good practice. If Member States were to adopt time-discounting schemes this could prevent learner riders from acquiring much needed supervised experience, particularly if the skills assessed as part of the scheme are not evidence-based. It also potentially leads to earlier licensure, which has been shown to be detrimental to safety in car licensing (Begg & Brookland, 2015; Mayhew, Simpson et al., 2013; Hirsch, Maag & Laberge-Nadeau (2007).

The good practice to remove the possibility of direct access to an unrestricted licence at a pre-established age is likely to meet strong push-back. Although the Directive allows for direct access at the age of 24 years and older, this is likely based on the principle that it is the youngest learners who are at increased risk (e.g. Schneider et al., 2012). Some evidence suggests that higher powered machines can lead to increased crash risk, regardless of age. However, in order to ensure positive reception and compliance, regulations should not be perceived as a barrier to overarching transport needs. While limiting exposure to risk (and therefore, limiting the amount and type of riding a learner can undertake) is the key purpose of such graduated systems, the engagement exercise reported by Delhaye & Marot (2015) showed that both Member State representatives and the motorcycling communities believed that the introduction of direct access to an unrestricted licence (category A) at age 24 years or older was a welcome addition to what was often viewed as a restrictive and expensive system (Delhaye & Marot, 2015).

Good practices that are taken forward should take the possible increased costs and complexity of the licensing process into account. As such, requirements at each stage of the progressive licensing system should be distinctive and justifiable; for example, by assessing particular (and evidence-based) domains of safe riding relevant to the enhanced power output or likely exposure to risky situations.

6. Driver training

6.1. Introduction

When mass motorisation is accomplished in a country, a majority of people usually try to obtain their driving licence as soon as they have reached the age at which the legal system allows them to drive. In developed nations, including all EU Member States, mass motorisation has been accomplished and this implies that most people take driving lessons in order to pass the driving test when they are still teenagers or young adults (OECD, 2006).

In developed countries traffic is the primary cause of death of persons between 15 and 24 years of age (OECD, 2006). For example in the Netherlands in 2014, 22% of all car drivers involved in severe crashes were drivers between 18 and 24 years of age whereas this group represented only 10% of all licence holders. This over-representation of young newly licensed drivers in severe vehicle crashes is found in all developed countries (OECD, 2006).

The crash risk is highest for the youngest drivers, and regardless at which age one starts to drive, it is the highest immediately after licensing systems allow newly licensed drivers to drive without a supervisor. This crash risk declines rapidly in the first months of solo driving but it takes years before a stable low level is reached (Foss, Martell, Goodwin, & O'Brien, 2011; Maycock et al., 1991; McCartt et al., 2009; Sagberg, 1998; Vlakveld, 2011).

The over representation of young novice drivers in vehicle crashes is caused by a lack of skills and age (McCartt et al., 2009). It is widely agreed that the lack of skills is mainly caused by a lack of experience and that lack of experience contributes more to crash risk than age (Gregersen et al., 2000; Maycock et al., 1991). Age effects are due to lifestyle factors and the not yet fully developed brain of adolescents (Blakemore & Choudhury, 2006; Casey et al., 2008; Gregersen & Berg, 1994; Keating, 2007).

Initial driver training is one of the main countermeasures intended to reduce the involvement of young novice drivers is severe crashes at the beginning of their driving career. Senserrick and Haworth (2005) define driver training as any kind of effort by teaching and learning aimed at increasing drivers' skills in traffic and motives to use these skills in safety-enhancing ways. There is a subtle difference between driver education and driver training. Whereas driver training is predominantly skill training, driver education is also about enhancing safe attitudes and improvement of the willingness to be a safe and responsible driver. However, while driver training usually refers to a specific approach to improving skills, training often also encompasses education (Keskinen & Hernetkoski, 2011).

Safe and responsible drivers not only possess skills and know the rules of the road, they also anticipate hazards and are aware of the risks these hazards can cause. They can predict how potential hazards may develop into acute threatening situations and are able to take actions to keep a safety margin that is large enough to avert a crash should the potential hazard materialize. They know their own limitations and only accept risks they can cope with. A responsible driver does not want to exceed her or his own abilities and experiences feelings of loss of control when exceeding her or his abilities. In order not to lose control, the safe and responsible driver balances the task demands and her or his capabilities (Fuller, 2000; 2001; 2005; 2007). This balancing of capabilities and task demands based on self-assessment and risk assessment is called calibration (Horrey, Lesch, Mitsopoulos-Rubens, & Lee, 2015).

In the past, driver training in order to prepare drivers for passing the driving test tended to focus only on skill training regarding vehicle control and mastering basic road and traffic situations. However, more recently, basic driver training also encompasses training of so called higher order skills such as hazard anticipation, risk awareness, self-awareness, and calibration.

6.2. Aim

The work in this chapter sought to establish what current practice is in EU Member States regarding driver (and where relevant rider) training. The review of the scientific literature then analysed available studies of the association between driver education and training and collision, behaviours and attitudes for newly qualified drivers. It also sought to consider what is known about the effectiveness of teaching methods in training such a coaching, instruction and error learning, where literature could be found. Good practices identified for consideration in workshop discussions.

6.3. Methodology

The inclusion criteria for the review were as follows:

- All studies where driver/rider training (pre-licence, formal basic training, informal basic training, post-licence training) have been evaluated against relevant outcome measures in newly licensed drivers between 1990 and 2016.

Table 17 in Appendix A shows the search terms and strings that were used for the literature review on training. The online literature databases in which a search with these terms and strings were conducted were the SCOPUS database of Elsevier (https://www.scopus.com/) and the SWOV-Library (http://library.swov.nl/).

This literature search resulted in 19 meta-analyses and overview studies on the effectiveness of initial driver training and higher order skill training (e.g. hazard perception training programmes and risk awareness training programmes), eight theoretical studies about driver education, five studies on pre-driver education (training programmes that are not intended to learn to drive but to prepare teenagers for their later role in live as a driver), 10 studies on driver training teaching methods, 10 studies on the role of driver training in licensing systems, six studies on post licence training (e.g. second phase training programmes), 14 studies on special aspects in driver training (e.g. supervised practice or training modules on drink driving), three studies especially for rider training, one study one study on training for licence C (lorries), 12 studies on cognitive based higher order skills training programmes (e.g. on hazard anticipation), 14 studies on motivational based higher order skill training programmes (e.g. about risk awareness, self-awareness and risk acceptance), 10 studies on interactive training modules (e.g. PC-based training and e-learning), 11 studies on simulator training, five studies on the goals of driver education, and finally, two studies on improvements the driver training curriculum.

Table 23 in Appendix B shows the results of the quality scoring.

6.4. Existing practice

A distinction can be made between formal driver training and informal driver training. Formal driver training is tuition that is provided by a qualified driving instructor. The on-road driving lessons and the theory lessons of a professional driving instructor are mostly systematic and structured. Informal learning occurs when a learner driver gains driving experience while he or she is supervised by an experienced driver (usually a parent). Some licensing systems of Member States allow that learner drivers only take informal

driver training in preparation of the driving test (e.g. Belgium (the 36M model), Finland, and the UK). It is more common for Member States to allow for a combination of formal and informal driver training in preparation of the driving test (e.g. Belgium (the M18 model), the UK, France (the 'conduite accompagnée' (supervised driving) (AAC) model), Sweden and Ireland[17]. In most Member States, learners can prepare themselves for the practical driving test only by taking driving lessons from a qualified driving instructor (e.g. Denmark, Germany, the Netherlands, the Czech Republic, and Greece). A new consideration in some Member States is the possibility of informal driver training after having passed the driving test, but before the driver has reached a certain age (Germany, and the Netherlands).

Another distinction can be made between theory training and on-road driver training. Traditionally, theory training is about traffic regulations and theory lessons are intended to help the candidate pass a knowledge test. Sometimes learners have to pass the knowledge test first before they can start formal or informal practical driver training (e.g. Belgium). Most of the time the theory is learned and the knowledge test is taken in the period during which learners have formal or informal practical driver training (e.g. France, and Germany), and sometimes the knowledge test takes place shortly before the practical driving test (e.g. Poland). Although theory lessons are about traffic regulations they can also cover topics such as first aid, automotive engineering, the dangers of risky driving behaviour and risky attitudes, interaction with vulnerable road users, and hazard perception testing (e.g. UK). Theory lessons can be mandatory and classroom based but they can also be voluntary and independent. Traditionally, for independent theory training text books have been the norm. However more recently, interactive theory training is possible (e.g. e-learning and computer based training).

Besides initial driver training that is intended to teach learners to control the vehicle and to master basic road and traffic situations, licensing systems can also incorporate training elements that are intended to enhance the so called higher order skills of leaner drivers. A distinction can be made between more cognitive-based higher order skill training such as hazard perception training and more motivational-based higher order skill training about risk awareness, self-awareness and the motivation to drive safely.

Table 9 presents an overview the training segments in the licensing systems of all EU Member States, except Romania. The table includes only the training segments that are intended for all learners. Most licensing systems also have special training programmes that are only intended for young offenders. These training programmes are not included in Table 9. Some Member States are mentioned twice. These are countries in which learners can choose between two licensing systems. In France, Germany, and the Netherlands, learners can start at a younger age learning to drive than in the traditional systems of these countries when they opt for a system that includes informal driver training. In Finland and Belgium learners can choose between a system based on only formal driver training and a system based on only informal driver training. The table is based on data from surveys carried out by Genschow et al. (2014), and unpublished data obtained by contacts in Serbia who undertook a similar exercise.

[17] Some Member States have dual licencing systems. In most Member States with dual systems learners can opt for accompanied driving with a so-called 'lay instructor' and start earlier, or no such accompanied driving and start later with learning to drive (e.g. in France, Germany, Sweden, and the Netherlands). In Finland learners can choose between formal driving instruction and informal driving instruction to prepare themselves for the driving test. In Belgium learners can choose between independent training with a provisional licence (36M) and formal driving instruction (18M).

Table 9: Training segments in the licensing systems of EU Member States

	Theory Training		Formal on-road driver training		Informal on-road driver training	Hazard Perception Training		Risk- and Self-Awareness Training	
	Mandatory/**F**ixed number of lessons/ **O**ptional	**B**efore on-road training/**D**uring on-road training	**M**andatory/**F**ixed number of lessons/ **O**ptional	**M**andatory/**F**ixed number of lessons/ **O**ptional	**B**efore driving test/**A**fter driving test	**M**andatory/**F**ixed number of lessons/ **O**ptional	**B**efore driving test/ During **P**rovisional licence phase	**M**andatory/**F**ixed number of lessons/ **O**ptional	**B**efore driving test/ During **P**rovisional licence stage
Austria	MF	D	MF	MF	B			MF	P
Belgium '36m'	O	B		O	B			O	P
Belgium '18m'	O	B	MF	O	B			O	P
Bulgaria	MF	B	MF						
Croatia	MF	B	MF						
Cyprus	O	B	O	O	B				
Czech Republic	MF	B	MF						
Denmark	MF	B	MF						
Estonia	MF	B	MF	O	B			MF	P
Finland 'driving school'	MF	B	MF					MF	P
Finland 'lay instructor'				M	B			MF	P
France ACC	O	B	MF	MF	B				
France Trad.	O	B	O						
Germany Ab17	MF	B	MF	O	A	M	B	O	P
Germany Trad.	MF	B	MF			M	B	O	P
Greece	MF	B	MF						
Hungary	MF	B	MF						
Ireland	O	B	MF	O	B				
Italy	O	D	O						
Latvia	MF	B	MF	O	B				
Lithuania	MF	B	MF	O	B				
Luxembourg	MF	D	MF	O	B			MF	P
Malta	O	B	O						
Netherlands Trad.	O	D	M			O	B	O	P
Netherlands to2drive	O	D	M	O	A	O	B	O	P
Poland	MF	B	MF						
Portugal	MF	B	MF	O	B				
Romania	?	?	?	?	?	?	?	?	?
Slovakia	MF	B	MF						
Slovenia	MF	B	MF					MF	P
Spain	O	D	O						
Sweden	O	D	O	O	B			MF	B
United Kingdom	O	D	O	O	B	O	B	O	P

Table 10 presents an overview of the role driver training has in relation to the driving test. Table 9 and Table 10 between them show that licensing systems within the EU differ considerably with regard to driver training.

Table 10: Schematic overview of the various relations between driver training and the driving test

System	Description	Examples[18]
1. No mandatory on road formal driver training	It is possible for learners to prepare themselves for the driving test without mandatory on road diver training from a professional driving instructor.	Belgium (36M), the UK, Sweden, and Finland have the option to pass the driving test without driving lessons. However, in Finland and Sweden a risk awareness training is mandatory
2. Traditional model	Mandatory formal driver training by a certified driving instructor. No informal training with lay instructor. After having passed the driving test, drivers can drive without supervision.	Denmark, the Czech Republic, Poland, Bulgaria, Romania, Portugal, Hungary, Greece, Slovakia, Malta
3. Test-led model	The test dictates the content of training. There is no national curriculum. What is not tested is mostly not trained by private driving schools.	the UK, the Netherlands, Sweden, Cyprus, France, Spain
4. Training-led model	A National curriculum with obligatory training modules, also modules that are important for road safety but that cannot be tested during the driving test.	Germany, Croatia, Belgium (18M)
5. 2-phase model	Mandatory post-licence training (in first year or two years after the test).	Finland, Luxembourg, Austria, Estonia, Slovenia, Latvia, Lithuania
6. Structured training + accompanied driving	Package of minimum driving school training + minimum mileage (with feedback sessions with instructor in between).	France (AAC), Austria
7. Post-test accompanied driving	Learner has to be accompanied by designated person when they have passed the driving test before they are 18 years of age. Solo driving is allowed for after 18 years of age.	Germany (Ab 17), the Netherlands (2toDrive)

6.5. Effectiveness and impact on road safety

In this section various types of driver training are evaluated for their link to road safety outcomes. Only types of driver training that are intended for all learner drivers are

[18] Some countries are mentioned twice in this column because they have a dual system.

discussed. So-called 'driver improvement training programmes' for offenders are not discussed. A section on pre-driver training is also included. Pre-driver training is not about learning to drive but is about preparing young people for their later role in life as a driver. Pre-driver training programmes are not mentioned in Table 9 because they are not included in licensing systems.

6.5.1. Initial professional driver training

Despite the idea having intuitive appeal, evaluation studies and meta-analyses have shown that formal initial driver training provided by a certified driving instructor generally does not result in lower crash rates after licensing than informal driver training provided by a lay instructor (e.g. a parent) (Beanland, Goode, Salmon, & Lenné, 2013; Blomberg & Fisher, 2012; Christie, 2001; Elvik et al., 2009; Lonero & Mayhew, 2010; Mayhew & Simpson, 2002; Peck, 2011). There are a small number of exceptions (e.g. Carstensen, 2002; Shell, Newman, Córdova-Cazar, & Heese, 2015), but the weight of evidence suggested no direct effect on safety of formal instruction.

Groeger and Banks (2007) note that there are good theoretical reasons to assume that although professional driving instruction improves driving skills, these skills do not transfer to real world when young drivers drive without supervision; Groeger and Banks suggest that the problem is in the mismatch of contexts between formal instruction and later, solo driving.

Another issue noted by Helman, Grayson and Parkes (2010) is that traditional driver training may focus on the wrong skills altogether. Traditionally, driver training is focused on vehicle handling and mastering common traffic situations. Learners must be able to control a vehicle and be able to apply the rules of the road before they are allowed to enter the driving population. However, many of the crashes involving novice drivers and riders are not caused by poor vehicle handling skills and the inability to master regular traffic situations. Crashes involving novice drivers are most of the time caused by lack of higher order skills such as poor hazard anticipation skills, inattention, poor calibration skills, peer pressure, and lack of motivation to be a safe and responsible driver (e.g. Clarke, Ward, & Truman, 2005; Curry et al., 2011; McKnight & McKnight, 2003).

6.5.2. Lay instruction

Evaluation studies in Section 4 discussed Graduated Driver Licensing (GDL) systems, and that evidence has shown that GDL with long learner phases in which learner drivers gain driving experience while driving with a lay instructor (also called supervisor or accompanied driving) are effective (Senserrick & Williams, 2015). During supervised practice only few accidents occur (Gregersen, Nyberg, & Berg, 2003) and to be effective, learners do not need to have passed the driving test first as is required in Germany and the Netherlands. The introduction of a long learner phase before the driving test in Sweden reduced the crash rate in the first two years of solo driving by 35% (Gregersen et al., 2000). However, a very similar introduction of a long period of accompanied driving in Norway had no effect on crash rate. Sagberg and Gregersen (2005) found that this may have been caused by the fact that in Sweden learners drove on average 3,800 km before the driving test while accompanied by a lay instructor, whereas in Norway this was only 1,150 km. It could be that a certain amount of lay instruction in varied conditions is required before supervised driving will have a positive effect on crash rate after licensing. It is also possible that a combination of formal training and informal training is effective. Shell et al. (2015) found that formal driver education within the learner phase of a GDL system resulted in a lower crash rate. However, a negative effect on crash rate occurs when learners receive a time discount on the required time of supervised driving as a reward for undertaking formal driver training (Begg & Brookland, 2015; Mayhew, Simpson, Desmond, & Williams, 2003).

6.5.3. Pre-driver education

Studies show that risky attitudes among 11–16 year old pre-drivers are similar to those of adult drivers in that they are riskier in males than females and are related to social deviance and sensation seeking (Rowe et al., 2016; Waylen & McKenna, 2008). Pre-driving attitudes also predict post-licence behaviour (Rowe, Maughan, Gregory, & Eley, 2013). When unsafe attitudes toward driving already exist well before young people learn to drive, it makes sense to try and positively influence these attitudes before the formal learning to drive process begins. Pre-driver education programmes are not part of the licensing system; the aim of these interventions is not to teach teens to drive but to raise awareness of the road environment and the complexity of driving among young people before they begin to learn (Senserrick, 2007). They are mainly about attitudes that promote safe driving, and can be part of a secondary school curriculum or 'standalone'. Although there is some evidence that pre-driver education improves safety attitudes (Mann & Lansdown, 2009), there are also numerous studies that show that these education programmes do not lead to any such changes, or can even lead to undesirable risky changes in attitudes (Glendon, McNally, Jarvis, Chalmers, & Salisbury, 2014; Poulter & McKenna, 2010).

6.5.4. Situation awareness and hazard perception training

Analyses of crash reports involving young novice drivers show that novice drivers do not always scan for possible hazards and find it hard to comprehend the intentions of other road users (Curry et al., 2011; McKnight & McKnight, 2003). Hazard Perception (HP) can be defined as situation awareness for dangerous situations in the road and traffic environment (Horswill & Mckenna, 2004). Several short training programmes for novice drivers have been developed to improve their hazard perception skills and their awareness of risks in traffic situations. These are mostly interactive PC-based or video-based training programmes or training programmes in which a simple driving simulator is used (Chapman, Underwood, & Roberts, 2002; Crundall, Andrews, van Loon, & Chapman, 2010; Fisher et al., 2002; Fisher, Pollatsek, & Pradhan, 2006; Isler, Starkey, & Williamson, 2009; McKenna & Crick, 1997; McKenna, Horswill, & Alexander, 2006; Pollatsek, Narayanaan, Pradhan, & Fisher, 2006; Pradhan, Pollatsek, Knodler, & Fisher, 2009; Regan, Triggs, & Godley, 2000; Vlakveld et al., 2011; Wang, Zhang, & Salvendy, 2010; Wetton, Hill, & Horswill, 2013). All these training programmes seem to improve the hazard perception skills of novice drivers (McDonald, Goodwin, Pradhan, Romoser, & Williams, 2015). A recent study found that a short interactive training programmes named Risk Awareness and Perception Training (RAPT) (Pradhan et al., 2009) was associated with a reduction in the number of crashes of young male drivers but not of young female drivers after licensing (Thomas, Rilea, Blomberg, Peck, & Korbelak, 2016).

6.5.5. Risk awareness and self-control training

Hazard perception training programmes try to improve the more cognitive higher order skills. There are also higher order training programmes for young drivers that try to improve attitudes and the motivation to drive safely (Gregersen, 1996). In Sweden a risk awareness training programme before the driving test is mandatory. Nyberg and Engström (1999) found that the effect on self-reported behaviour of these 'insight' training programmes was limited. Interestingly, Senserrick et al. (2009) found that a kind of insight training programme for young drivers on only road safety issues was not associated with a lower crash rate, whereas what was called a resilience training programme that was not only about road safety but also about other dangerous behaviours exhibited by young people (drugs and unsafe sex), was associated with a lower crash rate. Although part of a large cohort study (and therefore open to selection bias), Senserrick et al. (2009) do cite work in the US showing that similar approaches have been shown to impact on road violation rates in stronger trial designs, making them

promising as training interventions for young and novice drivers. For example, a school-based drug abuse programme showed that anti-drinking attitudes were related to later driving violations (Griffin, Botvin & Nichols, 2004). However, it is worth noting that some of this work in the US has been criticised on the grounds that the effects seen are dependent on the measures used (and presented) in evaluation trials (Gorman, 2005).

Another promising approach of this type of training programmes was developed in New Zealand (Isler, Starkey & Drew, 2008). This was the so called 'frontal lobe project' (Isler et al., 2008). The focus of this training programme was on personal and self-management skills rather than on driving skills. An evaluation of this programme with over 20,000 New Zealand young people who self-selected to participate in either a more skill oriented programme or this more risk awareness and self-awareness programme, showed that the risk awareness and self-awareness programme resulted in a statistically significant improvement in risk awareness, safer attitudes to close following and to dangerous overtaking and a decrease in driving related confidence. In contrast, the vehicle handling skill group showed no improvement in risk awareness, attitudes to risky driving or driver confidence, although they did show significant improvements in relation to their on-road direction control and speed choice (Isler, Starkey & Sheppard, 2011).

6.5.6. Skill training for emergency situations

Emergency situations are situations that require immediate action to regain control over the vehicle and/or that require immediate action to avoid a crash. There are training programmes for learner drivers that aim to enhance the skills to regain control in emergency situations such as skid training. Until the end of the 1980s, every novice driver in Norway was required to attend a course for driving on slippery roads. This mandatory training was in fact skid recovery training. This training was evaluated (Glad, 1988), and the crash data showed that novice drivers had more crashes and not fewer crashes after having attended the training. A similar adverse effect of a short mandatory skid recovery training programme for learner drivers was found in Finland (Katila, Keskinen, Hatakka & Laapotti, 2004). Mayhew and Simpson (2002) suggest that short special skill training programmes can have an adverse effect because situations that precipitate the need for emergency skills arise infrequently. Retention of motor skills that are used infrequently is poor and the skills may tend to erode and not be readily available or inappropriately applied in emergency situations one or two years later. However, learner drivers who have attended these training programmes may think that they still possess these skills and the fact that they have attended the training programme may have made them overconfident. For example, graduates of advanced skill courses will generally be less reluctant to drive in adverse conditions because they are confident that they can handle them.

6.5.7. Mandatory post licence training

Because of the adverse effects of skill training for emergency situations, post-licence training programmes have tended to become 'insight' oriented (Gregersen, 1996). The Finish post-licence training programme consists of a self-evaluation, a so-called feedback drive in real traffic with a driving instructor in order to evaluate the driving style of the novice driver, on-track training not intended to teach skills but to raise risk-awareness and self-awareness, and a group discussion. A similar and even more elaborate compulsory post-licence programme was introduced in Austria in 2003. The Finish post-licence training does not seem to have reduced self-reported crash rate considerably, whereas in Austria the introduction of the training does seem to have reduced the self-reported crash rate (Mynttinen, Gatscha, Koivukoski, Hakuli, & Keskinen, 2010). Besides the fact that evaluation studies of post-licence training programmes are inconclusive, they start at a moment in one's driving career when the crash risk is already rapidly declining. The crash rate for newly qualified drivers is at its highest directly after

licensure and starting to drive unaccompanied, and declines rapidly in the first months after solo driving has commenced (Foss et al., 2011; Maycock et al., 1991; McCartt, Shabanova, & Leaf, 2003; Sagberg, 1998). It takes years of driving experience before the crash rate no longer declines (Maycock et al., 1991; McCartt et al., 2009; Vlakveld, 2011). This implies that although some experience is required to reflect upon to make post-licence training effective, post-licence training should start as early after the start of solo driving as possible. The earlier effective post-licence training can be implemented following licensure and solo driving, the greater its contribution to improving safety.

6.5.8. Training devices

Traditionally, young people learn to drive in a car. Professional driving instructors usually use a car with a dual brake system for driver training. For learning the rules of the road and how to apply them, traditionally textbooks are used. These traditional approaches are changing. For learning to drive, in some countries driving lessons can partly be replaced by simulator lessons. In the Netherlands for example, approximately 150 rather simple driving simulators (simulators without a moving base that do not simulate the feeling that one is driving) are in use to teach learner drivers the most basic driving skills before they start to drive with a driving instructor on the open road. After an initial increase of the number of training simulators in the Netherlands, not many simulators for initial driver training were sold after 2008 (SWOV, 2010). Although simulators have existed since the 1960s, for a long time they remained too expensive to be used for training purposes. However, PCs have become ever more powerful, and cheaper. This means that the price of simple simulators (that is, simulators that do not imitate the feeling that one is driving) has reduced considerably.

The driving simulator has a number of educational advantages over the car, but only if they are used optimally. According to De Groot De Groot, De Winter, Mulder and Wieringa (2007) the advantages simulators offer in teaching are rarely fully utilised. Fuller (2007) notes that a driving simulator has the following training benefits:

- Faster exposure to a wide variety of traffic situations. Scenarios can be made in such a way that they offer many situations in a brief period of time. This makes the training more intensive. During lessons in real life traffic it is difficult to expose drivers to a wide variety of scenarios.

- Improved possibilities for feedback from different perspectives. It is impossible to learn without receiving feedback in one way or another. Driving simulators have the possibility to give visual feedback while a learner is driving. For example, the instructor can say that a learner is swerving and illustrate this by projecting a straight line onto the display. In addition, simulators make it possible to retrospectively show a recording of the learner's performance from a bird's eye perspective or from another road user's point of view. Furthermore, possibilities are being explored to measure gaze direction. After having gone through a scenario, the recording can be shown with the visual fields superimposed. The learner is then faced with the things she or he missed (e.g. hazards) because she or he was looking in the wrong direction

- Unlimited repetition of educational moments. For example, if an instructor in real traffic wants to practice merging onto a busy highway, they are dependent on this difficult situation occurring during the driving lesson. In a simulator the desired situation can be stage-managed and repeated again and again

- Computerised and objective assessment. In a driving simulator, a learner's performance can be measured very accurately and objectively. In a practical

learning environment one has to more or less rely on the driving instructor's 'clinical observations'

- Demonstration of manoeuvres. During a practical lesson the instructor tells the learner what to do. The instructor will rarely go behind the wheel to show how a certain manoeuvres should be performed. A simulator has the possibility to demonstrate manoeuvres first.

- Safe practice environment. Very few learners will have had practical lessons in, for example, dense fog. A simulator offers a safe practice environment for driving in dangerous conditions.

However, simulators also have some disadvantages. A simulator only imitates reality, and even in the most advanced high-end simulators that are much too expensive to be used in the basic driver training, the imitation of driving is far from perfect. Lack of reality may hamper transfer of training (Groeger & Banks, 2007). This means that what is learnt in a certain educational environment, in this case the environment presented by the simulator, will probably not be applied in an environment that is clearly different, in this case the open road. Another key problem is simulator sickness. Simulator sickness is a type of motion sickness that expresses itself in nausea (Stoner, Fisher, & Mollenhauer, 2011). However, experience has shown that simulator sickness is not so frequent among young people with little or no driving experience.

Whether the introduction of driving simulators in the Netherlands has resulted in a lower crash rate of novice drivers is not known. De Winter et al. (2009) found that the chance to pass the driving test was 4 to 5% higher for learners who first took simulator lessons before they started with lessons on the open road than learners who immediately started with driving lessons on the open road, but the effect of this on safety is not known.

Driving simulators are not only used to train the most basic driving skills but also to train higher order skills of novice drivers, in particular hazard perception skills (Vlakveld et al., 2011; Wang et al., 2010b). Whether simulator based hazard perception training also reduces crash rate has not been investigated yet. Not all simulator-based training programmes for young novice drivers improve higher order skills. In Israel, a more general simulator-based training programme for young novice drivers that was not exclusively about hazard anticipation, had no effects on the intentions to drive safely and did not improve traffic safety knowledge (Rosenbloom & Eldror, 2014).

Although driving simulators without a moving base have become cheaper, they are still expensive. Much cheaper are interactive computer based multimedia training programmes. These can be about hazard perception and risk awareness (e.g. Pradhan et al., 2009) but they can also be about the dangers of distraction (Pradhan et al., 2011). There are also more general computer based interactive training programmes for young novice drivers such as 'Driver Z' in the USA (Fisher et al., 2002), 'Drive Smart' in Australia (Regan et al., 2000) and the online intervention 'eDrive' in New Zealand (Isler & Starkey, 2012). All the mentioned interactive computer-based training programmes improved behaviour (better hazard anticipation, shorter durations of eyes of the road when engaged in a secondary task). Weiss, Petzoldt, Bannert, and Krems (2013) developed a paper version of a hazard perception and risk awareness training and an interactive multimedia computer version of the same training. Learners that completed the computer version detected hazards sooner and were less overconfident about their own skills than learners who had completed the pen and paper training. Although computer based interactive multimedia training programmes seem to be effective, their effect on crash rate has not been investigated yet, except for the already mentioned study of Thomas et al. (2016) that showed that the PC-based Risk Awareness and

Hazard Anticipation Programme (RAPT) was associated with a reduction in the crash rate of male young novice drivers but not of female young novice drivers. The gender difference suggests this finding may be nuanced and is worthy of further investigation.

An even newer development is 'serious gaming'. Serious games are computer, tablet or smart phone games that are intended to enable people to learn something by playing the game. Although the serious game entertains, its real purpose is to learn. Li and Tay (2014) developed a game about the rules of the road. It appeared that gamers learned the rules of the road by playing this game and that retention was high. Because there was no control group, no comparison could be made with the traditional textbook method of learning the rules of the road.

6.5.9. Training styles

Although formal initial driver training provided by an authorised driving instructor does not seem to result in a lower crash rate after licensing, professional driving instructors provide more feedback and point out more situations that can become dangerous than lay instructors do (Groeger & Brady, 2004). There is a tendency not to instruct but to coach learner drivers during formal driver training. A driving instructor mainly tells a learner what do and shows a learner how to do it. In contrast, a coach mainly asks a learner why the learner did it this or that way and asks what other solutions would have been possible. When driving instructors coach, feedback is primarily a means to get learners to reflect on what they are doing. However, when driving instructors instruct, feedback is mainly intended for correction (Bartl, 2010). Stanton, Walker, Young, Kazi, and Salmon (2007) found that a post-licence training programme based on the principles of coaching resulted in better skills, better attitudes and less external locus of control. Locus of control is the degree to which people believe that they have control over the outcome of events in their lives. Drivers who have been involved in a crash with a high level of internal locus of control will think that they could have avoided that crash, whereas drivers with a high level of external locus of control will blame the other road users that were involved in the crash.

Training programmes in which learner drivers are confronted with their own errors and mistakes without instruction, which is called error learning (Keith & Frese, 2008), may result in better skills development (Ivancic & Hesketh, 2000; Wang et al., 2010a). Despite these positive effects, Helman, McKenna, McWhirter, Lloyd, and Kinnear (2013) found no evidence of improved safety attitudes and behavioural intentions when learner drivers had attended a training programme based on coaching; although there did appear to be an overall programme effect in Helman et al. (2013) some differences between the treatment and control groups indicated a safety benefit, while others indicated a disbenefit. Coaching may not be a training method that fits all learner drivers. It requires that learners possess metacognitive skills and are able to reflect on their own actions (Keith & Frese, 2008). Probably not all learner drivers will possess the required metacognitive skills for coaching.

6.6. Discussion of good practice

Based on the literature review in this chapter and the judgement of the report authors, five good practices were drafted. These good practices are shown below.

Good practices regarding initial driver training	
1	A national curriculum that not only stipulates a minimum number of hours of formal and informal on-road driver training behind the wheel, but also stipulates a number of hours of theory lessons that are not only dedicated to the rules of the road, but are also about aspects that are difficult to test but are important for safe driving and riding such as responsible vehicle use, the dangers of driving while intoxicated (illicit drugs, alcohol), speeding, distraction, peer pressure, and ways to prevent indulgence into dangerous activities (i.e. resilience training).
2	Hazard perception/anticipation training that is incorporated in the basic driver training program. This can be trained using a variety of techniques, including e-learning and driving simulation.
3	A curriculum that takes into account new technological developments that affect the driving task such as driving with navigation devices, driving with adaptive cruise control (ACC), driving with lane departure warning systems and lane keeping systems, etc.
4	A learning pathway in which formal driver and rider training by certified driving instructors and informal driver training are combined and in which both reinforce each other
5	Abolishment of short training programs aimed at enhancing the skills to regain control in emergency situations such as skid training. The learned skills in such training programs erode quickly, and such training programs result in more risk taking due to overconfidence.

The rationale for the first good practice is that there are Member States with test-led systems. In countries with these licensing systems what is not tested during the driving test is not normally taught during driver training. Safe attitudes and the willingness to drive safely are very difficult to test or even cannot be tested at all. It is important that although they are not tested, issues such as distraction, the dangers of drink-driving, and peer pressure are addressed in one way or another during initial driver training. A national curriculum enables that these issues are addressed. Furthermore, supervised driving with a lay instructor is an effective method to reduce crash risk. A national curriculum can prescribe a minimum period of supervised driving in varied conditions.

With regard to the second good practice suggestion, hazard perception skills are important for safe driving. These skills can be trained and they can be tested. Research has also recently shown that hazard perception training reduces crash risk of young male drivers. Despite evidence of effectiveness, only in a few Member States are hazard perception skills explicitly trained and tested.

The third good practice suggestion is about the fact that the driving task is rapidly changing due to new technologies that support the driver but also can distract the driver. It is important that newly licensed drivers know how they can use these devices in a safety enhancing manner.

The fourth good practice suggestion is about the fact that formal driver training should support informal driver training. The effectiveness of traditional formal driving instruction that is intended to prepare learners for the driving test is questionable. However, there are some indications that higher order skill training in combination with supervised driving can be effective.

The last good practice suggestion is about the fact that short training programmes about skills that are rarely applied tend to be counterproductive and can lead to an increase in crash risk

The mentioned good practices were put to stakeholders in a workshop in Brussels on September 15th in 2016. The first good practice suggestion on a national curriculum

stipulating subjects and minimum hours of formal and informal training was not widely supported. Some stakeholders thought that this suggestion would imply harmonisation of licensing systems in the EU. Because of the huge differences in licensing systems and differences in cultural background between countries, these stakeholders deemed harmonisation of licensing systems neither feasible nor desirable. Another issue discussed was that learner drivers may interpret minimum hours as maximum hours. Instead of dictating minimum hours, workshop attendees suggested that more emphasis should be put on the quality of driving lessons. Costs were also mentioned as a barrier to obtaining more practice.

The incorporation of hazard perception training in initial driver training was widely supported by the stakeholders. It was acknowledged that hazard perception skills are important for safe driving. Attendees suggested that in addition to hazard perception skills being trained, risk awareness, self-awareness, and risk acceptance should also be trained. One stakeholder mentioned that hazard perception not only can be trained with the aid of interactive computers but can also be trained during on-road driving lessons.

The fact that the driving task changes due to technological developments was widely acknowledged, and people tended to agree that somehow this issue should be addressed during driving lessons. A barrier is the differences between systems that support the driver, for instance differences in Adaptive Cruise Control (ACC) systems. It was mentioned that car manufacturers also have a responsibility and that they should provide lessons in how to use their equipment in a safe and responsible manner.

The few stakeholders that commented on the good practice of combining formal and informal driver training tended to support it. Mentioned barriers were costs, lack of willingness of parents to be an accompanying driver, and difference of opinion what lay instructors think what their role is and professional instructors think what their role is.

Finally, with regard to the good practice of avoiding short skill courses, stakeholders neither agreed nor disagreed. Some stakeholders mentioned that these types of training can have adverse effect others believed that probably not skid training but training in emergency braking may be effective.

7. Driving instructor competences

7.1. Introduction

In all Member States only authorised driving instructors can provide formal driver training. EU directive 2006/126/EC on driving licences and driver testing does not prescribe the competences that driving instructors need to have in order to execute their profession. This implies that each Member State can decide which criteria driving instructors have to meet and the way competences of driving instructors are tested.

For experienced drivers, driving can seem almost as natural as walking. Although it is a task that most of the time experienced drivers execute effortlessly without much explicit information processing (e.g. Mader et al., 2009), it is in fact a very complex task that requires a lot of practice (Groeger, 2000). Drivers have to perform various motor tasks such as steering, braking, and gear shifting to keep their vehicle at an appropriate trajectory and speed. What the appropriate trajectory and speed are depends on the intentions of the driver, the road and traffic situation, the status of her or his own vehicle (e.g. the current speed) and her or his own personal status (e.g. attentive or not attentive). Drivers need to constantly scan the environment, recognise what is going on and predict how situations may develop into dangerous situations in which a crash is likely (e.g. Crundall, 2016). Based on these predictions, drivers make decisions and execute tasks that will enlarge their safety margin allowing them to take timely evasive actions should the predicted dangerous situations materialise (Groeger, 1999). It seems self-evident that learners need professional support when they acquire these complex skills. Interestingly the evidence does not support this (see Section 7.5). However, on-road professional driver training is one of the rare training circumstances that is intended for a large number of people in which one tutor (the driving instructor) teaches one pupil (the learner driver) at a time, meaning it is an important topic for consideration.

It is important to note that very little is known about the effect the quality of driving instructors has on the crash rates of newly licensed drivers. There may be an association between the quality of driving instructors and the crash rate of novice drivers but it is very difficult to prove this. It can be assumed that the quality of newly licensed drivers is partly determined by the quality of the driving test, although evidence for this is also very weak (see Chapter 3). The quality of the driving test does partly determine the content of driver training programmes, and the quality and content of driver training programmes in turn are partly determined by the quality of driving instructors.

The only topic about driving instructors that has been widely investigated in the literature is the question of whether there is difference between the crash rate of novice drivers who only have had driving lessons from 'lay instructors' (e.g. parents) and the crash rate of novice drivers who only have had driving lessons from authorised driving instructors (see Section 7.5).

7.2. Aim

This chapter provides an overview of the existing practices in Member States, a review of the literature about driving instructors, and a reflection of the discussion on this topic with stakeholders during a workshop in Brussels on September 15th in 2016.

7.3. Methodology

The inclusion criteria for the review were as follows:

- All studies on driving instructor competencies with crash rates and the behaviour of newly licensed drivers as outcome measures since 2000.

Table 18 in Appendix A shows the search terms and strings that were used for the literature review on driving instructors. The online literature databases in which a search with these terms and strings were conducted were the SCOPUS database of Elsevier (https://www.scopus.com/) and the SWOV-Library (http://library.swov.nl/).

Some studies were found about the kind of instructions and feedback driving instructors provide and how instruction and feedback change over time when learners gradually acquire skills (e.g. Boccara, Vidal-Gomel, Rogalski, & Delhomme, 2015; Groeger & Brady, 2004). Except for studies about differences in crash rates of novice drivers who only have had formal driver training from an authorized driving instructor and novice drivers who only have had informal driver from a lay instructor, no studies were found about the impact the quality of driving instructors has on driving behaviour or crash risk.

7.4. Existing practice

This section is based on data of surveys carried out by Genschow et al. (2014) and the survey that was conducted for this project. Table 11 presents an overview about which drivers are admitted to driving instructors training programmes, the duration of these programmes, and how it is ascertained that driving instructors keep up with new developments in driver training.

The age to be admitted to a driver training programme ranges from 18 (the Netherlands) to 25 (Romania and Slovakia). The number of years aspirant driving instructors have to be in possession of licence B before they can start with the training programme for driving instructors ranges from 0 years (the Netherlands) to 5 years (Romania). The level of general education an aspirant driving instructor needs to have completed to be admitted to the driving instructor training programme differs considerably between Member States.

In Great Britain, Malta, Ireland and Denmark there is no minimum level of general education, whereas in for instance in Finland and Sweden the requirement for becoming a driving instructor is about the same as that for becoming a teacher in primary schools or secondary schools. These two Scandinavian countries also have much longer training programmes than other Member States. In Norway (not a Member State) the basic driving instructor training programme is the longest and consists of 3,360 hours of tuition. In combination with additional modules (e.g. in driving school management) one can obtain a Bachelor degree or even a Master degree. The UK, the Netherlands, Malta, Ireland, and Cyprus do not prescribe minimum hours of tuition. In these countries driving instructor training programmes are solely test driven. Providers of commercial driving instructor training programmes are free to choose the number of hours of tuition they think that are required to pass the test of driving instructor.

Aspirant driving instructors have to pass tests in order to become an authorised driving instructor. Most of the time this is a knowledge test about traffic regulations, a knowledge test about teaching methods and pedagogy, an on road driving test to test the driving skills of the instructor, and an assessment of educational skills. The educational skills are generally assessed while the candidate driving instructor provides an on-road driving lesson with a real pupil. However, sometimes an examiner pretends to be a pupil.

Table 11: Training of driving instructors category B: Entry requirement, training duration, and quality assurance

	Entry requirements for the driving instructor training			The training	Post training requirements and quality assurance	
	Minimum entrance age training	Years of driving experience	Entrance level[1]	Minimum hours of training	Periodic mandatory ongoing training	Periodic quality checks of driving instructors or driving schools
Austria	21	3	2	390	No	No
Belgium	22	3	2	-	Yes	No
Bulgaria	23		3	-	-	-
Croatia	21	3	2	-	Yes	Yes
Cyprus	24	5	3	X[2]	-	-
Czech Republic	24	3	2	230	No	Yes
Denmark	21	3	1	-	-	-
Estonia	21	3	3	-	Yes	-
Finland	21	3	3	2700	No	-
France	22	3	2	630	No	Yes
Germany	23	3	2	770	Yes	Yes
Greece	21	3	3	1680	No	Yes
Hungary	22	2	3	460	Yes	Yes
Ireland	19	2	1	X[2]	No	-
Italy	21		2	150	Yes	-
Latvia	21	3	3	210	Yes	No
Lithuania	21	3	3	158	Yes	No
Luxembourg	20	2	2	-	No	No
Malta	19	1	1	X[2]	No	-
Netherlands	18	0	2	X[2]	Yes	Yes
Poland	21	3	3	190	Yes	-
Portugal	20	2	3	280	Yes	-
Romania	25	5	3	140	-	-
Slovakia	25	3	3	230	Yes	No
Slovenia	21	3	2	210	Yes	Yes
Spain	20	2	2	210	No	-
Sweden	21	3	3	2520	No	Yes
United Kingdom	21	4	1	X[2]	No	Yes

1. Entrance levels: 1 = No requirements or primary education only, 2 = Secondary school certificate, 3 = Higher vocational training.
2. Cyprus, Ireland, Malta, the Netherlands, and the United Kingdom have no minimum training duration. Candidate driving instructors have to pass the test for driving instructor. It is up to the providers of training programmes how many lessons are required to pass the test.

Considering that the core business of a driving instructor is teaching and not driving, it is surprising that according to the survey conducted by Genschow et al. (2014) Spain, Italy, Bulgaria, Latvia, and Lithuania do not have an on-road assessment of the educational skills of aspirant driving instructors, whereas the driving skills of these aspirant driving instructors are tested.

In approximately half of Member States teaching skills of driving instructors are periodically reassessed, but equally a substantial proportion of the Member States do not have regulations about reassessing the qualities of driving instructors once they work as

a driving instructor. The driving task changes due to technological developments (e.g. adaptive cruise control, blind spot warning systems, navigation systems, lane keeping systems). There are also developments in good practices about how to train driving skills. Because of these two developments

7.5. Effectiveness and impact on road safety

In Finland learner drivers can prepare themselves for the driving test by either taking only formal on-road driver training provided by an authorised driving instructor or by taking only informal driver training provided by a lay instructor (e.g. a parent). This possibility also exists in for instance the UK, Belgium and Sweden. However in these Member States learner drivers can also combine informal training and formal training. In Finland and the UK no statistically significant difference in crash rate was found in the first years after licensing between learners who only have had formal training and learners who only have had informal training in preparation for the driving test (Hatakka et al., 2003; Wells et al., 2008). Also in overview studies of evaluations outside the EU no difference is found between the crash rate of formal trained novice drivers and informal trained novice drivers (Beanland et al., 2013; Christie, 2001; Elvik et al., 2009). An important limitation of all the mentioned studies so far is that learners were free to choose between either only formal training or only informal training. It could be that there is a difference in personality traits or other individual difference variables between those who opt for only formal training and those who opt for only informal training and that these differences have an association with crash risk. To our knowledge in only one study regarding this subject were learners randomly assigned to either formal or informal training. This is the evaluation of the so called DeKalb County project in the USA that started in 1978 and ended in 1981. A total of 16,338 high school students were randomly assigned to three groups.

1. A training programme with theory classes, simulator training, and formal on-road driving lessons.
2. A regular high school training programme with some theory classes, only 3.5 hours formal driver education, and informal training from a lay instructor.
3. Only informal training from a lay instructor.

The results have been analysed several times (Lund, Williams & Zador, 1986; Peck, 2011; Stock, Weaver, Ray, Brink, & Sadof, 1983). When the negative effect of early licensing in group 1 was taken into account, there was no difference in crash rate in the first two years after licensing between the three groups (Peck, 2011). One has to keep in mind that the DeKalb County project is old and what was considered to be the best possible driver training programme approximately thirty-five years ago probably is not the best possible driver training programme that includes formal driver training of today. It would be interesting to conduct a randomised controlled trial in which a modern training programme that includes formal training provided by an authorised driving instructor and in which higher order skills such as hazard anticipation and risk awareness are addressed compared with only lay instruction.

7.6. Discussion of good practice

Although there is no indication that formal driver training provided by an authorised driving instructor results in lower crash rates than informal driver training provided by a lay instructor, we make the assumption that formal training that addresses higher order skills may result in a lower crash rate. In addition, we make the assumption that higher order skill training requires that the driving instructor knows about learning styles, teaching methods and psychology. On the basis of these assumptions, and the judgement of the report authors, the following good practices were drafted.

Good practices regarding the competences of driving instructors	
1	A minimum age and a minimum level of school education for driving instructors. In order to teach or to 'coach' higher order driving competences, aspirant driving instructor must be able to comprehend psychological theories and theories about education methods. This requires a minimum level of school education.
2	An entrance test when the minimum requirements are not met
3	A minimum level of driving experience, not being convicted for serious traffic offences, not being convicted for sexual harassment
4	Standardised training objectives and a minimum training period. The training objectives should not only cover driving competences but also educational competences
5	A practical test (e.g. driving lesson that is assessed) and a theory test. The theory test should not only cover the rules of the road but also education methods
6	Compulsory periodic training after being licensed as a driving instructor, and periodic quality checks

The mentioned good practices were put to stakeholders in the workshop. Some stakeholders remarked that due to differences in culture there are huge differences in the status of driving instructors in Member States and the training programmes used for them. It was also noted that because of these differences it will be almost impossible to harmonise standards. One stakeholder questioned the validity of the studies that showed that there is no difference in crash rates after licensing between those who only had formal driver training and those who had only informal driver training. Some stakeholders stated that despite of lack of evidence they still believe that formal driver training provided by a well-trained driving instructor is better than informal training provided by a lay instructor.

Stakeholders were divided in their opinion about the first good practice suggestion (a minimum level of general education). Two stakeholders mentioned that there is no evidence that driving instructors with a low level of general education are poor driving instructors. Others however mentioned that the entrance level should be as high as possible. The stakeholders doubted whether the second good practice suggestion (entrance test for those who do not have the required level of general education) was necessary. However in some European countries an entrance test can be taken in the absence of minimum requirements (e.g. The Netherlands). Everyone supported the third good practice suggestion (driving experience and no convictions for serious driving offences and not having committed sexual harassment). About the fourth good practice suggestion (training objectives to include teaching methods and psychology) there was some doubt as to whether it was possible to draft training objectives in detail because there are differences in opinion about what is safe and what is unsafe in all possible traffic situations. Some stakeholders agreed that training objectives should also cover subjects that were required for higher order skill training. With regard to tests (the fifth good practice suggestion), all stakeholders agreed that there should be tests after aspirant driving instructors have completed their training and that these tests should also include an assessment of the application of various teaching methods of the candidates. The last good practice is about periodic training and quality assurance. Most stakeholders were in favour of periodic training. Quality assurance was deemed necessary as well. However, one stakeholder remarked that it can be very costly when all driving schools have to be inspected regularly.

8. Requirements on medical fitness to drive

8.1. Introduction

Ageing of the population is occurring rapidly across most of the developing and developed world. The UN World Population Ageing Report (UN, 2015) noted that in Europe currently, 14% of the population are aged 80 years or older and this is expected to approach 30% by the year 2050. As shown in Figure 3, while Europe and North America currently lead the world in terms of the "oldest-old" proportions, other regions such as Oceania, Latin America and Asia are not that far behind and are expected to catch up in the coming years.

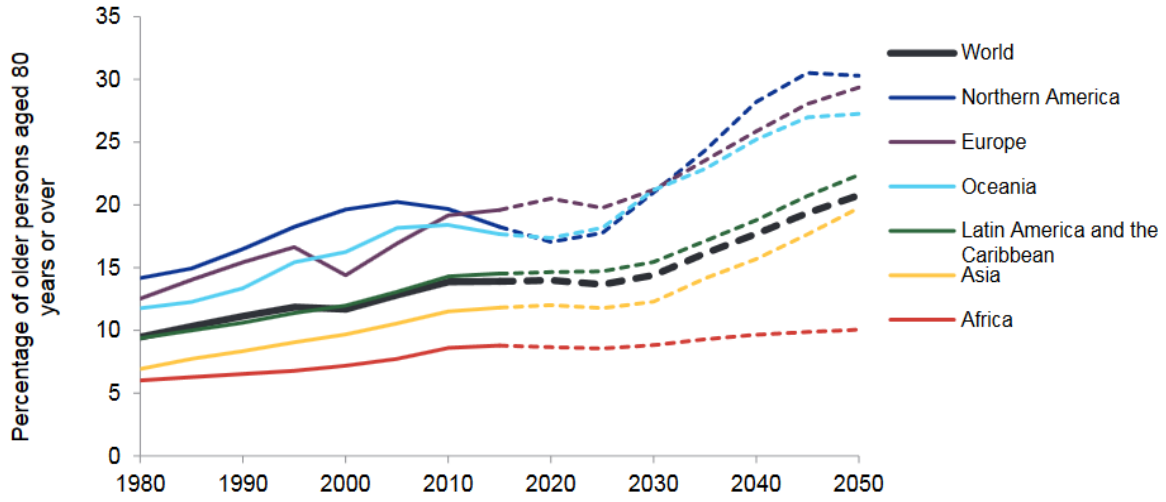

Figure 3: Percent of population aged 80 years or older by region (1980-2050) (Source: United Nations: World Population Ageing Report 2015)

Braver and Trempel (2004) suggest that older drivers, even with low average annual mileage, still pose an increased risk to occupants of other vehicles and to themselves and their passengers. Their increased risk of crashing is attributed to decreases in the functional abilities related to cognitive impairment (Dementia), other neurological or musculoskeletal disorders, other medical illnesses, vision problems, medications with side effects that can impact on driving, their level of cognition, and their physical abilities and medical fitness (Harada, Nateson, Love & Triebel, 2013). While there appears to be an apparent shift in cognitive skills among these age groups, ageing *per se* does seem likely to be associated with a potential increase in road crashes and injuries in the coming years.

8.2. Aim

The work in this chapter sought first to establish current practice in EU Member States regarding medical fitness to drive.

Then the review of literature set out to analyse the impact of an ageing society on the driver population, particularly regarding effects on road safety, and identify which medical conditions could be more prevalent with changes in the driver population. It aimed to assess to what extent medical unfitness to drive is a causational factor for road fatalities and serious injuries. Where possible, this was specifically associated with the relevant medical condition and associated risks (eyesight, cardiovascular, diabetes, drugs etc.). The review examined what mechanisms exist in order to ensure safe mobility in an

ageing society, including medical checks and refresher courses (excluding rehabilitation of drivers).

Finally, after good practices were identified and discussed at the workshop, recommendations were made for possible future EU initiatives (Section 9).

8.3. Methodology

The broad inclusion criteria were as follows:

- Studies on the relationship between medical fitness to drive and ageing, evaluated against both primary and secondary outcome measures over the last 10 years.

Given the much larger scope of this review than was the case for others in the project, a wide range of research questions were posed. These included:

- Is there published scientific information available on the role of medications and reduced fitness to drive?
- What are the formal processes and requirements in use across Member States for assessing older and medically unfit drivers?
- What regulations and guidelines are in use in Europe (and elsewhere, where relevant)?
- What is known about the adoption of self-regulatory behaviour and compensation, and the transition from driver to non-driver?
- What are the ways to assist self-regulation and this transition (e.g. education and training, medical checks, refresher courses, promotion of alternative travel modes) and are these effective?
- What are the benefits and disbenefits of various types of licensing systems (e.g. age-based mandatory testing versus none) with respect to medical fitness to drive?
- What is the role of medical practitioners / general practitioners (GPs) in the medical review process in Europe?
- What is known of GPs' involvement in referrals and mandatory reporting of at-risk drivers and are these effective?
- What knowledge do GPs have regarding assessing medical fitness to drive? Is there a need for guidelines?
- Do GPs need education or training in this area, and if so, do any such programs exist and have any been evaluated?
- What is the evidence that screening tests predict poor driving ability and crash risk?
- Which screening tests show promise and is there any evidence or evaluations available of their effectiveness?
- Are on-road tests for fitness to drive the most effective method and is there any evidence to support this?
- How are medical panels used, what is common practice and are they effective (including whether there is any evidence)?
- What is the role of occupational therapists (OT), what is common practice and are they utilised effectively?
- Is there a need for centres of expertise for medical assessments (with GPs, optometrists, psychologists, OTs, others)?

Table 19 in Appendix A shows the search terms that were applied regarding medical fitness to drive. The literature review mainly focussed on ageing and driving but many of the search terms were also relevant to medical conditions that were not age-related.

The online literature databases in which a search with these terms and strings was conducted were the ARRB ATRI & TRID databases and the Monash-Library database. Given that there were many hits from the search of these databases, only a brief search of the PUBMED database was undertaken. Studies included were those published between 1990 and 2016. As with the other reviews (see Section 2.1) the method of quality scoring sough to ensure that all studies accepted were scientific, (peer-reviewed preferred) with outcomes that supported good practice in the area, with adequate experimental control and exposure measures. In addition, major relevant project reports specific to the issue were also sought. Finally, research that included recommendations for areas requiring intervention and/or future research were especially useful for this review. The total number of articles retrieved from the search and rated by three panelists according to the quality criteria were 123 related to fitness to drive (67% accepted), 62 on substance impaired drivers (32% accepted), 35 on commercial drivers' fitness to drive (66% accepted), and 44 papers on varying topics from the TRDI/PUBMED database (73% accepted). Table 25 in Appendix B shows the quality scoring for this review.

While the main emphasis of the research was on passenger vehicles, aspects of commercial driving that overlapped with cars were included where relevant.

8.4. Existing practice

Table 12 presents an overview of the current state of licensing practices within the European Member States for licensing and medical assessment of potentially at risk drivers. The review on medical examination for driving licence applicants in Europe by Vandenberghe (2010) and the results of the survey undertaken in this project were used to compile this table.

The data show that the driver licensing systems within Europe differ considerably with regard to medical fitness to drive a passenger motor vehicle (category B). While the bulk of this information is now several years old, some checking of a random sample of the literature suggested that nothing much has changed in recent times.

The survey responses provide further detail on the degree of variation and good practice across the EU, and some detail on specific topics.

When asked if there are any guidelines for medical practitioners to assist them when confronted with a potentially at-risk patient, 73% of survey respondents responded 'yes'. When those who answered 'no' (27% of the sample, seven individuals) were asked if they thought there should be guidelines, all said 'yes'.

When asked about the GP procedures in their Member State for identification and action when confronted with a medically- or age-impaired client, additional comments (beyond those merely confirming the detail in Table 12) highlighted the detail of medical certificates and self-declaration forms for individuals to complete regarding their health.

Table 12: Driver Assessment procedures for some EU Member States
(Source: Vandenberghe (2010) and the results of the survey)

Member States	Age-based test req'd	Age for first retest	Holder legally bound to report ill-health	Medical check req'd for relicence	GP bound to report at-risk driver	GP initiate need for retest	Medical advisor assess req'd	Eye-test req'd for relicence	On-road test req'd for relicence	Conditional (restricted) Licence
Austria	yes	Every 10yrs	no	yes	no	yes	If req'd	yes	Unk.	Yes
Belgium	yes	50 (+5/3)	yes	yes	no	yes	If req'd	yes	Yes	Yes
Czech Republic	yes	50 (+1)	no	yes	yes	yes	If req'd	yes	Yes	Unk.
Denmark	yes	50 (+5-1)	no	yes	yes	yes	If req'd	yes	Unk.	Yes
Estonia	yes	50 (+5)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Finland	yes	50 (+5)	no	yes	yes	yes	If req'd	yes	Unk.	Unk.
France	yes	60 (+5/2)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Germany	yes	50 (+5/3)	no	yes	no	yes	Unk.	yes	Unk.	Unk.
Great Britain	yes	45 (+5/1)	yes	yes	yes	yes	no	yes	Yes	Unk.
Greece	yes	65 (+5/3)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Hungary	yes	45 (+3/2)	yes	yes	yes	yes	If req'd	yes	Unk.	Yes
Iceland	yes	65 (+5/4/1)	yes	yes	no	yes	police	yes	Unk.	Unk.
Ireland	yes	60 (+3/1)	yes	yes	no	yes	Unk.	yes	Unk.	Unk.
Latvia	yes	60 (+3)	no	yes	yes	yes	If req'd	yes	Unk.	Unk.
Luxembourg	yes	50 (+5/3)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Norway	yes	60 (+5/1)	yes	yes	yes	yes	If req'd	yes	Unk.	Unk.
Netherlands	yes	70 (+5)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Poland	yes	55 (+5/2/1)	yes	yes	yes	yes	If req'd	yes	Unk.	Unk.
Portugal	yes	40 (+5/3/2)	no	yes	yes	yes	If req'd	yes	Unk.	Unk.
Spain	yes	45 (+5/3/2)	no	yes	no	yes	If req'd	yes	Unk.	Unk.
Sweden	yes	45 (+10)	no	no	yes	yes	Unk.	yes	Unk.	Unk.
Switzerland	yes	45 (+10)	no	yes	no	yes	Unk.	yes	Unk.	Unk.

NOTE: Data were not available for all European states (members plus others) in this report

In a small number of Member States, it was noted that the medical fitness to drive procedure is conducted in a specialised centre, most often under the authority of the licensing authority. These centres have specialised experts and driving examiners/driving assessors. In contrast, one Member State indicated that 'there is a lack of certain procedures for assessing fitness to drive'.

There was a range of extra comments from survey respondents regarding the procedures and responsibilities of physicians and medical practitioners for identification and action when confronted with a medically impaired patient. In some Member States, the requirements and responsibilities of medical practitioners are low, with an obligation only to 'inform the patient', with the responsibility of the individual driver to inform the licensing authority. In one Member State, it was noted that 'the medical practitioner cannot report the patient – they can only do it if the patient agrees'.

In other Member States, medical practitioners have stricter requirements to refer the patient. In some Member States, the requirement is to send the patient to a specialised traffic medicine professional for further medical assessment. In others, the medical practitioner is required to refer the patient to the licensing authority.

Regarding the use of guidelines, most EU Member State respondents indicated that they were aware that guidelines existed, and all respondents agreed that guidelines were both useful and necessary to assist general practitioners in making decisions regarding medical fitness to drive.

When asked to describe the screening-tools used, responses were less clear, and few definitive descriptions of the assessments used were provided. Most respondents described the need for medical practitioners to provide medical certificates, checks, or referrals to the licensing authority, or declaration forms. There were no descriptions of specific assessment tools.

While the EU directive requires the licence to have validity for between 10 and 15 years, the validity period, in general, shortens for older drivers. Only in nine countries out of 27, was the periodicity the same (10 or 15 years) throughout all age groups. The remaining 18 policies showed great variation related to chronological age. Ages 60, 65 and 70 are typical turning points after which the periodicity shortens. The periodicity after 70 years of age is often 2-3 years. The periodicity is, however, usually not fixed in the sense that it can be shorter if there is a reason for it to be so (e.g. medical condition).

Not all, but most EU countries (21 out of 27) have driver screening (i.e. they require proof of fitness to drive in connection with licence renewal). This is usually a certificate issued by a physician, based on an examination performed by a general practitioner (GP). Variation exists, however; some countries require an assessment by medical specialists (such as a cardiologist or psychiatrist), and, in the UK, the authorities rely on drivers' self-reports. In countries without a requirement for mandatory proof for renewal, the drivers themselves, family members, or physicians are to report any illnesses or health related conditions that can have an impact on fitness to drive. Nevertheless, a clear majority of the countries with age-related fitness to drive assessments rely on fixed obligatory procedures at prescribed intervals, usually performed by GPs.

8.5. Effectiveness and impact on road safety

The licensing system is designed to permit adults to drive a vehicle on public roads, and most countries (and jurisdictions within countries) have a uniform driver licensing system. In addition to providing an entry into the licensed driver population and introducing new drivers to driving, the licensing system is structured to ensure that drivers comply with laws and regulations and remain safe throughout their driving career.

Further, the licensing system is the main method for jurisdictions to meet their obligations to ensure that all drivers are medically fit and able to drive independently, competently and safely. Driver health is an important consideration and drivers must meet certain medical standards to ensure their health status does not increase their crash risk.

The aim of determining fitness to drive is to achieve a balance between minimising any driving-related road safety risks for the individual and the community posed by the driver's permanent or long-term injury, illness or disability, and maintaining the driver's lifestyle and employment-related mobility independence. Assessing medical fitness to drive (MFTD) is a substantive issue in terms of road safety and wellbeing and autonomy of the driver. In most countries assessment is largely the responsibility of GPs and consultants in secondary care when appropriate, in consultation with the licensing authority. Comparative research on different systems of MFTD is at a relatively early stage, with a preliminary study suggesting significant differences in the way MFTD guidelines are prepared (Rapoport et al., 2015).

In most licensing guidelines, a distinction is drawn between licensing criteria for private and commercial licences. Due to the higher danger potential to the public and the environment that driving commercial vehicles encompasses (e.g., transporting dangerous goods, larger freight loads and passengers for hire, and the longer periods spent driving as well as the size and weight of the vehicle), drivers of these vehicles are required to undergo a more rigorous assessment prior to licensing. In comparison, the daily driving habits of a private licence holder may only involve driving to the shops or work and, hence, a less rigorous approach is indicated. While these differences are acknowledged, this review focuses on the effectiveness of processes for determining medical fitness to drive and identification of best-practice licensing procedures, screening and testing, as well as roles of health professionals in assessing fitness to drive.

Regardless of whether considering decisions for private or commercial drivers, it is essential that guidelines for assessing fitness to drive are in line with legislation relating to disability and human rights and do not unfairly discriminate against individuals with a disability. This underlines the importance of establishing guidelines that are informed by sound scientific evidence. We therefore do not make specific reference to distinctions between commercial and private licences, nor are specific conclusions drawn addressing fitness to drive of commercial drivers as opposed to private drivers.

8.5.1. Emerging trends on older adult transportation needs

The world's population is ageing. Many countries, especially European, North American, and Australasian countries are experiencing an increase in the absolute and proportional number of older adults in the community and this is expected to expand significantly over the coming three to four decades. Population ageing is a long-term trend which began several decades ago in Europe and is reflected in an increasing share of older persons coupled with a declining share of working-age persons in the total population. The share of the population aged 65 years and over is increasing in every EU Member State, European Free Trade Association country and candidate country (countries that are candidates for joining the EU). The increase within the last decade ranges from 5.2 percentage points in Malta and 4.0 percentage points in Finland, to lower than 1.0 percentage point in Luxembourg and Belgium. Between 2005 and 2015, an increase of 2.3 percentage points was observed for the EU-28 as a whole (see Figure 3). On the other hand, the share of the population aged less than 15 years in the EU-28 population decreased by 0.7 percentage points (Eurostat, 2016).

With a current ageing population throughout much of the developed world, there is an imminent need to understand the current transportation requirements of older adults,

and to ensure that good systems (such as licensing and education) are in place to support sustained safe mobility and healthy and active lives. Mobility is essential for older adults' independence, as well as ensuring good health and quality of life (generally considered to include dimensions such as physical health, psychological wellbeing, social networks and support, and life satisfaction and morale) by virtue of enabling continued access to essential services, activities, and other people (Metz, 2000; Oxley & Whelan, 2008; Ross, Schmidt & Ball, 2013; Webber, Porter & Menec, 2010).

For many older adults, especially in highly motorised countries including Europe, driving represents their most significant mode of transportation, in terms of mode share and distance travelled (OECD, 2001), and remaining an active driver is important for maintaining independence and well-being (Freeman, Gange, Munoz & West, 2006; Persson, 1993). Recent studies have demonstrated that the successive cohorts of older persons are increasingly car-reliant in their personal transportation and use cars in their everyday mobility (Hjorthol, Levin & Sirén, 2010; Infas, DLR, 2010a/b, Ottmann, 2010; Sirén & Haustein, 2013). The ability to drive allows one to work, socialise and maintain a feeling of self-confidence and independence. Driving cessation is associated with negative social and health consequences (Edwards, Perkins, Ross & Reynolds, 2009), a decrease in of out-of-home activity levels (Marottoli, de Leon, Glass, Williams, Cooney & Berkman, 2000), and worsening of depressive symptoms (Fonda, Wallace & Herzog, 2001). Older drivers who stop driving are five times more likely to enter long-term care facilities (Freeman et al., 2006) and are four to six times more likely to die over the subsequent three years (Edwards, Perkins, Ross & Reynolds, 2009).

It is predicted that the transport needs of current and future older road users will be significant given their expected growth in numbers and proportion of the overall population, as well as for their distinct social and demographic characteristics (Pruchno, 2012). Compared with previous cohorts, current and future older road users are more likely to be better educated and more affluent (Frey, 2010), be healthier (Chen & Millar, 2000), have longer life expectancies (Manton, 2008) and work for more of their senior years (Quinn, 2010). It is also predicted that current and future older road users will have distinctively different mobility characteristics to previous cohorts. For example, the baby boomer cohort was the first generation to be born into and live their whole lives in a society with modern mobility. Consequently, the private motor vehicle is likely to remain the principal mode of transport for current and future older road users who, it is predicted, will be more likely be licensed to drive, travel more frequently, travel greater distances, and will have higher expectations about maintaining personal mobility (OECD, 2001).

Worldwide, current figures show that older drivers are currently involved in few serious injury and fatal crashes in terms of absolute numbers and relative to numbers of young driver crashes. However, they represent one of the highest risk categories for crashes involving serious injury and death per number of drivers and per distance travelled. The literature provides good evidence that reduced fitness to drive is not the only issue surrounding the heightened crash and injury risk of older adults[19]. To summarise, older road users as a group are more likely than younger or middle-aged road users to be injured or killed due to their physical frailty, and it is this frailty that accounts for the majority of serious injury and fatal outcomes, once involved in a crash. Further, older drivers have a heightened casualty crash involvement per distance travelled (this is most likely to be since much of their travel is on complex urban roads). Last, older road users as a group are more likely to have some level of functional impairment and, at least intuitively, a reduction in some skills. In explaining older road users' heightened casualty

[19] http://www.roadsafetyfoundation.org/media/33073/modsfl-single-page-printable-version.pdf

crash involvement, the research suggests that the following factors have a particular role specific to older drivers:

- For almost all, physical frailty
- For many, a high level of urban driving
- For some, reduced fitness to drive.

8.5.2. Medical conditions

Much of the literature on older driver safety focuses on understanding the presence of medical conditions and resulting functional limitations that may affect an individual's ability to drive safely.

Driving is a complex task that requires appropriate skills and adequate higher executive, cognitive, and operational functions that mesh together appropriately (Fuller & Santos, 2002). Conditions which result in loss of or damage to these functions can seriously impair driving capability; motor vehicle crash rates increase modestly with a range of illnesses (Marshall, 2008; Charlton et al., 2010).

In terms of functional limitations, the literature has generally attributed older road users' risk mostly to their age-related sensory, cognitive, and physical impairments. While there are many individual differences in the ageing process, even relatively healthy older adults are likely to experience some level of functional decline in sensory, cognitive and physical abilities. These may include decline in visual acuity and/or contrast sensitivity, visual field loss, reduced dark adaptation and glare recovery, loss of auditory capacity, reduced perceptual performance, reductions in motion perception, a decline in attentional and/or cognitive processing ability, reduced memory functions, neuromuscular and strength loss, postural control, and gait changes, and slowed reaction time (Janke, 1994; Stelmach & Nahom, 1992). Of relevance to older road users is how the degradation of these skills relates to safe road use and whether they place older road users at an increased risk of crash-related injuries and/or death. Although there is some evidence that impaired functional abilities are associated with poorer driving, most studies do not support this.

For the assessment of a driver's fitness to drive, it is therefore more important to understand which medical conditions may serve as 'red flags' to better understand the resultant functional impairments that may affect the ability to drive safety, and initiate screening and/or assessment. However, it is noted by numerous researchers that current evidence for causal relationships between specific medical conditions and increased crash risk is limited (Charlton et al., 2010; Marshall, 2008; Vaa, 2003).

Notwithstanding this, the strength of evidence is increasingly drawing the conclusions that numerous medical conditions can affect one's functional ability to operate a motor vehicle. Moreover, there is evidence to suggest that the prevalence of chronic medical conditions increases with increasing age and the likelihood of having multiple medical conditions increases with advancing age (Naughton, Bennett & Feely, 2006). Naughton et al. (2006) found that 27 percent of people greater than age 70 had at least two significant chronic medical conditions and 86 percent of people in this age group received three or more medications for management of chronic disease.

Soderstrom and Joyce (2008) argued that conditions particularly associated with the ageing process that include cardiovascular disease, Alzheimer's disease, arthritis, and eye diseases (particularly cataracts, glaucoma, and later-stage macular degeneration) can affect safe driving.

Some of the more common disorders known to affect driving ability include visual impairment (Charlton et al., 2010), arthritis (Millar 1999), and conditions that may cause loss of consciousness, including seizure (Hansotia & Broste 1991), syncope (Distiller & Kramer 1996), sleep apnoea (Findley et al. 1988), and certain types of cardiovascular disease (McGwin et al. 2000; Medgyesi & Koch, 1995; Sagberg, 2006). These studies, collectively, have identified specific medical conditions of concern including diabetes mellitus, neurological disorders, epilepsy, dementia, vision disorders, psychiatric disorders, obstructive sleep apnoea, alcohol dependency, and cardiovascular disease.

In their landmark review of the effect of medications on older driver crash risk, Charlton et al. (2010) assessed the current state of knowledge regarding the size of the problem in Western countries, considering prevalence of specific medical conditions and the evidence for crash involvement and other measures of driver risk. The authors applied a risk rating (RR) system to all medical conditions of interest considering crash involvement. Based on the evidence from studies reviewed, eight conditions were found to have at least a moderately elevated risk of crash involvement compared with their relevant control group. Specifically, these were alcohol abuse, dementia, epilepsy, multiple sclerosis, psychiatric disorders (considered as a group), schizophrenia, sleep apnoea and cataracts. Many other conditions were examined and found to have inconclusive evidence or evidence for only a slight elevation of risk.

While much research has focused on specific medical conditions and their effects on driving performance and crash and injury risk, many older adults can suffer from multiple medical conditions. In a recent systematic review of the literature to identify the incremental risks for the effects of multiple chronic medical conditions on driving ability and crash risk, Marshall and Man-Son-Hing (2011) showed that the overall trend was for an increasing number of chronic medical conditions to be associated with higher crash risk and higher likelihood of driving cessation. On the other hand, although there is some evidence that impaired functional abilities are associated with poorer driving outcomes, most of the studies in the systematic review did not support this. No studies were identified that evaluated compensation techniques for drivers with multiple chronic medical conditions except for driving avoidance or self-restriction. Marshall and Man-Son-Hing (2011) went on to suggest that the interplay of multiple medical conditions may also contribute to crash risk; however, they did not specifically analyse this.

It should, however, be highlighted that clearly not all medical conditions affect injury risk in the road system to the same extent and not all individuals with the same condition will be affected in the same way (Charlton et al., 2010). Indeed, it is not necessarily the medical condition and/or medical complications *per se* that affect safe road use, but rather the functional impairments that may be associated with these conditions. In addition, the extent to which individuals may be able to adapt or compensate for their functional impairment while using the road will undoubtedly have some bearing on their likelihood of crash involvement.

8.5.3. Medication use

Prescribed and over-the-counter medications play a key role in the treatment of medical conditions, short-term illness and chronic disease. When appropriately prescribed, administered and monitored, medications are a cost-effective way to treat and reduce symptoms, prevent relapses of medical conditions, and restore health. Further, medications (including polypharmacy – the use of four or more medications by a patient) generally afford an improved lifestyle, health status, recovery from illness, independence and quality of life compared with living with the negative effects of a medical condition if left untreated.

Notwithstanding, the issues surrounding medication use are complex, particularly when understanding use of medication by older adults and how this may affect driving performance and crash and injury risk. The increased number of medications that older adults take, coupled with sometimes complex administration regimens for doses and times, increases the risk of mismanaging and poor adherence to taking medications (van den Bemt Egberts & Brouwers, 2000; Edlund, 2004, cited in MacLennan, Owsley, Rue & McGwin, 2009). Common errors include mixing over-the-counter medications and prescription medications, discontinuing prescriptions, taking the wrong dosages, using incorrect techniques, and consuming inappropriate foods with specific medications (Curry, Walker, Hogstel & Burns, 2005).

Rates of per-capita prescription and over-the-counter medication and dietary supplement use have increased considerably over the last few decades in many developed countries including Europe and the US, and particularly among older adults (Catlin, Cowan, Hartman, Heffler & National Health Expenditure Accounts Team, 2008; Hanlon, Fillenbaum, Ruby, Gray & Bohannon, 2001; Qato et al., 2008).

Further, older adults in the US are reported to be the largest per capita consumers of prescription medications and the most at risk for medication-related adverse events and poly-drug interactions (prescription and non-prescription). In the US, people aged 65 and older make up 12 percent of the population, but account for 34 percent of all prescription medication use and 30 percent of all over-the-counter medication use. In a comprehensive national survey of US non-institutionalised adults, Gurwitz (2004) reported that more than 90 percent of people 65 years or older use at least one medication per week, more than 40 percent of this population use five or more different medications per week, and 12 percent use 10 or more different medications per week.

It is noted that many studies examining the effect of medication use and driving performance are limited by small sample sizes and selection bias, and difficulty in controlling for confounding factors such as distinguishing the effects of the disease the medication is prescribed to treat from the effects of the medication itself. Moreover, it should be cautioned that an association between drugs and impaired driving does not necessarily imply causation, as other factors may be at play, such as chronic disease, acute emotional or physical stress, and performance bias or the related 'Hawthorne effect' (Janke, 1994; Hetland & Carr, 2014). Therefore, understanding the degree of reduced driving capability and increased risk caused by medication and drug use presents a major challenge for road safety experts.

Despite these variances and limitations, the overall conclusion from laboratory tests, simulator studies, on-road and off-road studies is that a substantial number of medications and drugs appear to impair performance in driving-related tasks, and are associated with increased crash risk.

Common effects of drugs on driving include inability to judge distance and speed, distortion of time, place and space, reduced co-ordination, hyperactivity, aggressiveness, paranoid psychosis and hallucinations, blurred vision, convulsions, dizziness and fainting, fatigue and memory loss.

Generally, the literature shows that psychoactive medicines may impair driving abilities owing to their action on the central nervous system (e.g. sedation in the morning following administration of a hypnotic), whereas other medicines may affect psychomotor functions by their action on physiological functions (e.g. hypoglycaemic seizures related to diabetic treatment) or because of centralised side effects (e.g. the depressant potential of carisoprodol on the central nervous system).

There is also evidence suggesting that older adults have heightened sensitivity to medications in general, but also to any medications that affect the central nervous system, leading to an increased likelihood with age of adverse reactions (Marottoli, 2002). Furthermore, older adults are more likely than younger adults to have pre-existing conditions that can increase both the frequency and severity of adverse effects (Hetland & Carr, 2014).

There is strong evidence that a substantial proportion of adults continue to drive while under the influence of certain prescription medications including psychotropic medications (especially benzodiazepines) and that these medications are associated with an increased crash involvement risk of 1.3 to 2.4 times (particularly crashes that are the responsibility of the driver under the influence) (Barbone et al., 1998; Engeland, Skurtveit & Mørland, 2007; Movig, Mathijssen, Nagel, Van Egmond, De Gier, Leufkens & Egberts, 2004; Orriols et al., 2009; Ravera, van Rein, De Gier & de Jonh-van den Berg, 2011; Smink et al. 2013; Rapoport et al., 2009). The co-ingestion of benzodiazepines and alcohol has been estimated to result in a 7.7-fold increase in crash risk (Dassanayake, Michie, Carter & Jones, 2010) and the risk of a road crash increases with dose and the use of more than one benzodiazepine (Smink, Egberts, Lusthof, Uges & de Gier, 2010, Rapoport et al., 2009; Orriols et al., 2009). More recent research from Sweden found that the risk of a driver aged 50 to 80 years being involved in an injurious crash increases progressively with the number of medications that they are prescribed (Monárrez-Espino, Laflamme, Elling, & Möller, 2013).

8.5.4. Managing older road user safety

The management of older road user safety requires careful consideration by governments, policy makers, and the community. The measures identified in the literature to address older road user safe mobility generally fall into three broad categories. These are behavioural and educational measures, infrastructure and road design improvements, and vehicle design improvements. With regard to behavioural interventions, the evidence suggests that interventions focused on i) encouraging safer road use habits particularly (but not only) through self-regulation, that is, assisting individuals to continue to drive for as long as it is safe to do so, making appropriate adjustments to their driving, and transitioning from driver to non-driver, coupled with ii) an appropriate licensing system to identify and assess drivers with reduced fitness to drive and support safe mobility, form 'best-practice'.

8.5.4.1. Self-regulation

One of the widely-held assumptions about older drivers is that there is a high level of self-regulation. That is, older drivers are thought to adjust their driving behaviour that adequately match their changing cognitive, sensory and motor capacities. In addition, self-regulation offers a potential way for older drivers to both manage their own safety on the road and maintain their mobility (Berry, 2011; D'Ambrosio et al., 2008; Okonkwo, Crowe, Wadley, & Ball, 2008; Stalvey & Owsley, 2000).

The abilities of older drivers to regulate their driving according to their own abilities, to continue driving only in a safe manner and cease driving when they feel they are no longer able to drive safely, are thought to be important skills in reducing the incidence and severity of crashes. Marshall and Man-Son-Hing (2011) concluded that the evidence supports the view that drivers with more chronic medical conditions tend to cease driving or engage in driving avoidance. The myriad combinations of diseases and disease severity present a level of complexity that complicates making informed decisions about driving with multiple chronic medical conditions.

While many drivers can and do self-regulate appropriately, the research also identified groups of older drivers who may not self-regulate to an appropriate level of their own accord. Research has found that, in general, older drivers travel fewer kilometres per year than younger drivers (Baldock & McLean, 2005; Collia, Sharp & Giesbrecht, 2003; Eberhard, 1996; Li, Braver & Chen, 2003; Lyman, Ferguson, Braver & Williams, 2002), but other research has found only low levels of avoidance of difficult driving situations by older drivers (Baldock, Thompson & Mathias, 2008; Stalvey & Owsley, 2000; Sullivan, Smith, Horswill, & Lurie-Beck, 2011). For example, Stalvey and Owsley (2000) interviewed drivers aged over 64 years who had been involved in a crash in the previous year and who had impaired visual abilities. They found that three-quarters of the participants reported "never" or "rarely" avoiding difficult driving situations. However, high proportions believed that impaired vision affected driving ability and that such impairments would be noticeable (91% & 89%, respectively). Despite this, substantial proportions also rated their vision as "excellent" or "good" and reported no difficulty with driving in challenging situations (70% & 82%, respectively). This suggests that the participants were not aware of their visual impairments and, consequently, were not self-regulating their driving to compensate for them.

For the most part, the literature refers to these behavioural changes as compensatory, implying that older drivers change their behaviour in response to a loss of function or as a counteracting measure for difficulties experienced. It should be noted here that it may not be entirely accurate to label such behavioural adaptations as 'compensation'. While these changes may reflect a behavioural adaptation to age-related changes in performance levels of certain important functions, there may be other possible explanations. For instance, the ageing individual's mature judgement, lifestyle choices, and personal preferences brought about by changes in circumstances may affect driving behaviour. Even younger drivers might avoid driving in darkness or during peak hours if not forced to by their circumstances. Other studies have found that older drivers may not be prompted to self-regulate their driving by declining health, cognition, and functional abilities that affect driving ability and increase crash risk (Baldock, Mathias, McLean & Berndt, 2006; Baldock et al., 2008; Okonkwo et al., 2008; Wong, Smith & Sullivan, 2012). In addition, it may also be the case that older drivers do not self-regulate appropriately, simply because they do not want to restrict their mobility and, therefore, their independence and activity level.

Given the importance of adoption of appropriate self-regulatory driving behaviour, it stands to reason that behavioural interventions should focus on this issue. Indeed, there are promising strategies that focus on improving the driving practices of older drivers through education and training programmes and resources. In addition, there is evidence suggesting that education can assist older drivers in compensating for the effects of the impairment identifying or promoting adaptive or self-regulatory strategies such as minimising the amount of driving done under conditions that impose a heavy perceptual and cognitive load (e.g. avoiding extensive driving or driving in unfamiliar areas: Kostyniuk, Streff & Eby, 1998; Persson, 1993). In addition, enlisting the cooperation of others to help share the driving load (e.g., having a passenger navigate or read the road signs: Kostyniuk et al., 1998; Persson, 1993), and exercising alternatives to reduce perceptual and cognitive load such as using less-travelled roads, can also be helpful.

8.5.4.2. Training and education programmes

Oxley, Langford, Koppel and Charlton (2012) examined the literature attesting to the effectiveness of older driver training and education programmes in producing safer road users. Table 13 provides a summary of identified publications that have evaluated a range of training and education programmes for older drivers, categorised into four groups of programmes that have as their main function, (i) the provision of knowledge about the general association between ageing, changes in functional performance and safe driving practices, (ii) the provision of practical driver training or behavioural skills

directly associated with driving, (iii) increased self-awareness of fitness to drive (with or without knowledge of compensatory driving practices), and (iv) improvements in functional areas considered to be necessary pre-conditions for safe driving.

To summarise, the review revealed that:

- Four of the six classroom-based education programmes were unable to show either driving or crash improvements, with a fifth evaluation showing an increase in crashes for some drivers
- All five programmes which provided practical driving training showed improvements in at least some driving skills
- Programmes which sought to increase older drivers' awareness had mixed results. The two related programmes from UMTRI had positive responses from participants, with driver ratings holding up against on-road performance. In contrast the two evaluations of *Roadwise Review* were unable to provide any validation evidence
- Two of the three evaluations of programmes which sought to improve pre-conditions for driving (physical activity, speed-of-processing and reasoning) showed either driving improvements or crash reductions, with one showing mixed results.

Overall, eleven programmes showed effectiveness at some level, including changes in driving performance and a reduction in at-fault crash levels. These findings are consistent with the conclusion reached by Korner-Bitensky, Kua, Desrosiers, von Zwek and Van Benthem (2009).

Table 13: Evaluation studies of older driver training and education programmes published 2000-early 2011.

Authors	Nature of participants	Age of key participants	Programme	Effectiveness
1. Education only				
Bédard et al. (2004)*	'Normal' active drivers	55 yrs+	55-Alive/Mature Driving	Ineffective – no driving improvements
Bao & Boyle (2009)	'Normal' active drivers	65 yrs+	55-Alive/Mature Driving	Effective – improved driving at intersections
Nasvadi & Vavrik (2007)*	'Normal' active drivers	55 yrs+	55-Alive/Mature Driving	Ineffective – increased crash rates for some participants
Owsley et al. (2003)*	Visually impaired, crash-involved drivers	60 yrs+	Tailored programme	Effective – self-reported improved safety attitudes, self-regulatory practices
Owsley et al. (2004)*	Visually impaired, crash-involved drivers	60 yrs+	Tailored programme	Ineffective – no crash reductions
Kelsey & Janke (2005)	Drivers with 'unclean' records	70 yrs+	Education publications and/or resources list	Ineffective – no crash, violation reductions (although increased driving, safety knowledge)
2. Practical driver training programmes				
Marottoli et al. (2007b)*	'Normal' active drivers	70 yrs+	55-Alive/Mature Driving + on-road training	Effective – improved driving knowledge, performance
Bédard et al. (2008)*	'Normal' active drivers	65 yrs+	55-Alive/Mature Driving + on-road training	Effective – improved driving knowledge, performance
Lavalliere et al. (2009)	'Normal' active drivers	?	55-Alive/Mature Driving + simulator training	Effective – improved driving performance
Romoser & Fisher (2009)	'Normal' active drivers	70 yrs+	'Active' simulator training, 'passive' education	Effective only for active group – improved simulator and driving performance at intersections

Horswill et al. (2010)	'Normal' active drivers	65 yrs+	Hazard perception training (video)	Effective – improved hazard perception
3. Self-awareness of fitness to drive				
Eby et al. (2003)*	'Normal' active drivers	65 yrs+	Self-awareness knowledge workbook	Effective – self-reported improved awareness; Valid – self-reported difficulties associated with driving performance
Molnar et al. (2010)	'Normal' active drivers	65 yrs+	Self-awareness and knowledge computer program	Effective – self-reported improved awareness; Valid – self-reported difficulties associated with driving performance
Scialfa et al. (2010)	'Normal' active drivers	50 yrs+	Roadwise Review	Not valid – no association between test performance and self-reported driving quality, at-fault collisions
Bédard et al. (2011)	'Normal' active drivers	50 yrs+	Roadwise Review	Not valid – no association between test performance and related clinical measures, driving performance
4. Pre-conditions for safer driving				
Marottoli et al. (2007a)*	Active drivers with specified physical impairments	70 yrs+	Daily exercise programme	Effective – better driving performance than a control group
Roenker et al. (2003)*	Visually impaired drivers	48 yrs+	Speed-of-processing or simulator training	Mixed results
Ball et al. (2010)	'Normal' active drivers	65 yrs+	Speed-of-processing, reasoning or memory training	Effective for speed-of-processing, reasoning training – reduced at-fault crash involvement

Note: "'normal' active drivers" in the main relates to convenience samples of active older drivers NOT selected on the basis of specified medical or performance criteria. However selection and other biases may have influenced the final samples.

8.5.5. The licensing process

The requirement for drivers to possess a current licence is a key foundation in most safe road transport system, and this necessitates drivers demonstrating their ability and motivation to drive competently and unimpaired. As noted previously, the licensing system is the main method for jurisdictions to meet their obligations to ensure that all drivers are medically fit and able to drive independently, competently and safely.

The most common strategy that has been used to manage the safety of older drivers has been to develop relicensing systems that differentiate between those older drivers who pose an excessive risk and should not continue to drive, and those who do not have an elevated risk of crashing. The medical review process is a key system component to identify drivers who have conditions that may place them at a heightened risk of crashes. At the same time, however, the system should not unfairly restrict the mobility of driver groups, particularly those with disabilities or ageing drivers. It is therefore imperative that the medical review process and its supporting systems (through physicians, pharmacists and other health professionals) is designed to ensure that the licensing criteria and assessment for all medical conditions and impairments, including use of prescription, over-the-counter medications and polypharmacy use, are sound and based on scientific evidence regarding effectiveness and predictive value for poor driving performance resulting in unacceptable crash risk.

8.5.5.1. Mandatory licence retesting

The requirement for older road users to demonstrate their continuing ability to drive has created much concern and discussion world-wide amongst road safety and ageing specialists and transportation and health authorities. Supporters of the practice of periodic mandatory licence retesting for older drivers argue that people in their later years wishing to retain a licence need to demonstrate they are fit and capable of driving without increased risk to other road users. Those who oppose age-based, periodic licence retests, base their claims on cost-effectiveness, discrimination, equity issues, vast individual differences in the ageing process, chronological age as a poor predictor of functional status, the inability of licence tests to discriminate those at risk, and the adequacy of self-regulation.

Relicensing practices for older drivers vary greatly between and within countries (Charlton, Koppel, Langford & Irving, 2009; Langford et al., 2009; Langford & Koppel, 2006). The usefulness and nature of mandatory age-based fitness-to-drive assessments have been questioned for several reasons, with insufficient evidence that there is any consistent demonstrable road safety benefit, and many concluding that age-based mandatory screening produces an overall negative safety effect (Charlton et al., 2009; Langford, Fitzharris, Koppel, & Newstead, 2004; Langford & Koppel, 2006; Sirén & Meng, 2012). This has been found by various studies that compare the crash rates of older drivers in jurisdictions that impose mandatory testing with those that do not.

Early European research by Hakamies-Blomqvist, Johansson and Lundberg (1996) examined the safety effects of the different licensing practices of Finland and Sweden. Regular medical assessments starting at age 70 are required for licence renewal in Finland, while Sweden has no age-based assessments. This study found that the crash rates per head of population of older drivers in Finland were not lower than those in Sweden, which suggested that there was no safety benefit from the practice of age-based medical screening of older drivers. Moreover, it was found that Finland had a higher fatality rate for older pedestrians. It was suggested that this may have resulted from an increased number of older drivers in Finland giving up their licences voluntarily, rather than undertaking the relicensing assessments, and relying on walking as their main mode of transportation. These older ex-drivers were then vulnerable as pedestrians because of their physical frailty. Therefore, it was concluded that Finland's relicensing

practices may actually have had an adverse safety implication for older road users (Hakamies-Blomqvist et al., 1996).

The Dutch road safety institute SWOV conducted a literature study to estimate the road safety effects of raising the minimum age from 70 to 75 for the medical examination for driver licences in the Netherlands (Vlakveld & Davidse, 2011). The review concluded that instead of raising the minimum age, the age-related medical examination should be completely abolished.

More recently, Sirén and Haustein (2015) investigated the evidence for and against having an age-based driver screening policy in place by conducting a systematic review of evaluation studies. They discovered little evidence of increased safety in countries with age-based licensing programmes. Following this, they mapped and compared the current driver licensing policies in EU countries to examine the variation between the countries, to investigate to what extent the European policies may be evidence-based, and to understand what implications the policies may have. Finally, they drew conclusions based on the literature and the policy mapping and provided policy recommendations.

Mitchell (2008) compared seven European countries with different driver licensing policies for older adult drivers. For those with the more relaxed relicensing procedures, he reported higher levels of licence holding but very little difference in crash rates compared with younger adult drivers. This was not the case though for the countries with more stringent relicensing procedures. He concluded that the countries with the more relaxed relicensing protocols provided a good balance between maintaining the mobility of older people without compromising road safety. He noted however, that the level of driving exposure and traffic may have some influence on these results. Similar findings are evident elsewhere.

At least seven North American and Canadian studies (Grabowski, Campbell & Morrisey, 2004; Lange & McKnight, 1996; Levy, Vernick & Howard, 1995; Nelson, Sachs & Chorba, 1992; Sharp & Johnson, 2005; Shipp, 1998; Tay, 2012) have compared crash rates in different states and provinces with different driver licence policies. Results are equivocal, with Grabowski et al. (2004) finding in general no link with crash rates (except for in-person renewal, which lowered crash rate), Tay (2012) finding that more stringent retesting led to higher crash rates, and Sharp and Johnson (2005), Nelson et al. (1992), and Shipp (1998) finding benefits of such retesting (the latter two references looked specifically at vision retesting).

An Australian study (Langford et al, 2004a) compared older (80+ years old) drivers' crash rates in the state of Victoria, where no age-based screening is used, with those in the state of New South Wales (NSW), where drivers have to undergo a medical assessment and a driving test at the age of 80 years. They observed no safety benefit for the seniors in NSW in this studyas crash rates on a per-licencebasis were the same (on a time-spent-driving basis, crash rates were even higher in NSW). Another Australian study (Langford et al., 2004b) compared older driver crash statistics in six Australian states with different licensing policies. The results showed that the older driver crash rates were the lowest in Victoria, the only state without age-based mandatory testing. Furthermore, Langford et al. (2008) studied the effects that screening policies for older drivers had on other road users' risk of being killed by an older driver. They found no demonstrable safety benefits from age-based mandatory screening programmes, in terms of either the total number of fatalities or the number of deaths of other road users. A more recent investigation of the effect of age-based testing among older Australians (Ross et al., 2011), comparing data from states with different mandatory age-based screening practices, found that older adults required to undergo age-based medical testing were between 1.5 and 2.2 times more likely to report not

driving. Moreover, the percentage of drivers with cognitive or visual impairments was similar in the states regardless of age-based testing policy.

8.5.6. Off-road screening process

In addition to examining the benefits and disbenefits of mass age-based assessment procedures, research has also focussed on the effectiveness of tools and measures designed to identify, screen and assess medical fitness to drive. There are several off-road tests of fitness to drive, serving as screening devices. Since the early 2000s, there has been significant discussion worldwide regarding the feasibility as well as the scientific validity and utility of performing functional capacity screening with older drivers. It is also noted that screening processes and their outcomes are only an initial assessment and serve as a trigger for other educational, counselling, referral, or diagnostic evaluation activities. These outcomes are not appropriate as grounds, in themselves, for any licensing decision or action.

There is variation in the methods used for screening assessment and which aspects of driver fitness are addressed, but the assessment in most cases is an examination of basic physical functionality including eyesight, hearing, and general health status. In some countries, visual acuity tests, or psychological or neurological items are included. In Sweden, where no proof of fitness to drive is required for relicensing, more focused driver assessments were carried out on demand (e.g. after a physician's report) by multidisciplinary teams in centres for traffic medicine (Levin, Ulleberg, Sirén & Hjorthal 2012).

While there is no disputing that drivers who are unsafe because of medical conditions should be identified, this identification is challenging, and often contentious given the negative consequences associated with driving cessation (Mullen & Bédard, 2009; Bédard et al., 2013). Establishing the cut-off point scores identifying a 'prevention threshold' and an 'intervention threshold' is obviously a key aspect of any driver screening programme, as well as assessing the appropriate functional domains and sensitivity and specificity of screening tools. Most of the most recent evidence points to few demonstrated positive effects from current screening tests and programmes. This knowledge gap outlines the need to develop valid and reliable driving assessment tools. It is also important that adoption of any assessment tools be supported by evidence of adequate benefits and minimal risks (Kitson & Straus, 2010; Bédard et al., 2013).

There are also suggestions that screening may influence the wrong subgroups, such as people who are more sensitive to social pressure and have a high feeling of subjective risk, but are safe drivers. This is consistent with findings of other studies (Langford et al., 2004a, 2004b; Sirén & Meng, 2012).

In 2002 in the US, NHTSA described a model programme encompassing procedures to detect functionally impaired drivers who pose an elevated risk to themselves and others; to support remediation of functional limitations if possible, to provide mobility counselling to inform and connect individuals with local alternative transportation options, and to educate the public and health professionals about the link between functional decline and driving safety, all within a larger context of helping to preserve and extend the mobility of older persons. An initial pilot study provided strong evidence that functional capacity screening, conducted quickly and efficiently in office settings, can yield scientifically valid predictions about the risk of driving impairment.

Four domains of perceptual-cognitive ability were highlighted: 1) directed visual search, 2) information processing speed for divided attention tasks, 3) the ability to visualise missing information in an image, and 4) working memory. Two physical functions also emerged as measurement priorities: 1) lower limb strength, and 2) head/neck mobility

(rotation). Furthermore, the study confirmed that certain, specific procedures have utility for performing functional screening and, in some cases, identified candidate cut-off points for pass-fail determinations using those procedures. While several North American studies have found some positive effects from driver screening, these effects are, in general, limited to single measures or only some age groups.

A study by Grabowski et al. (2004) investigated a number of factors including in-person renewal, vision tests, road tests and the frequency of licence renewal (which may vary in different states) as predictors of older driver safety. The results showed that the only predictor of lower crash rates was in-person renewal (as opposed to renewal by post), and that this effect was only observed for those aged 85 years and older. Additional tests, regardless of whether they were medical or tests of practical driving skills, had no effect on safety.

Increasingly, however, researchers are recognising that screening tests are too blunt to be used for licensing purposes on a simple pass/fail basis. For example, Viamonte, Ball and Kilgore (2006) used a sample from the screening procedure adopted in Maryland, USA, to investigate the costs and benefits associated with screening cognitive functions in drivers over the age of 75 years who presented for licence renewal. Calculations using different decision-making models were based on four of the best-performed screening measures from these earlier evaluations. Viamonte et al. (2006) concluded:

> *"…the current screening instruments do not discriminate future crash risk well enough in this primarily low-risk driving population to justify screening all drivers aged 75 years and older. … a near-perfect screening test would be required in order for screening to be a worthwhile option." (pp. 356-7)*

Hakamies-Blomqvist, Sirén & Davidse (2004) described general age-based screening of fitness to drive as a 'Jack-in-the box' safety measure, liable to pop up in specific situations but lacking any demonstrable safety benefits. They suggest that a major reason for this ineffectiveness is:

> "*While certain older drivers undoubtedly have higher risk of accident than others, and in some cases for age-related reasons (such as dementing illnesses whose incidence grows with age), it is difficult to find correlations between single functional measures and risk, and even the most carefully done studies … end up with correlations so low that they cannot be used as decision criteria" (p.59)*

Off-road screening tests of driving performance are generally used to 'rule out' or 'rule in' a given condition (McCarthy & Mann, 2006), with this decision usually made on a simple 'pass/fail' basis. For example, the Useful Field of View test (UFOV®) frequently uses 40 percent reduction in useful field of view as the pass/fail threshold. However, others have proposed a three-level classification of screening test performance, which is the equivalent of 'pass', 'fail' and 'uncertain' (e.g. Fildes et al., 2000). For the latter convention, screening tests are then followed by other, usually more sophisticated, assessment procedures aimed at providing a more categorical outcome.

Sirén and Meng (2012) compared the number of fatal crashes before and after a screening test for cognitive impairment was included in the existing screening procedure in Denmark in 2006. The authors did not find any safety benefits from the addition of cognitive screening to the procedure, but observed an increase in the number of fatalities in unprotected road users, possibly due to a modal shift from car driving to walking and cycling.

In their review of current literature on screening and on-road assessments, Dickerson, Brown Meuel, Ridenour and Cooper (2014) found that no single screening or assessment tool is the 'one and only' to use in determining fitness to drive (Baldock, Mathias,

McLean, & Berndt, 2007; Bédard, Weaver, Darzins, & Porter, 2008; Carr, Barco, Wallendorf, Snellgrove & Ott, 2011; Classen et al., 2011). The authors added that, because of the complexity of driving, it is unlikely that any single tool can address all the factors required to decide on older adults' driving abilities, with such diverse skills and medical conditions.

Avolio et al. (2013) summarised scientific findings concerning the relationship between neuropsychological and clinical screening tests and fitness to drive among people with chronic conditions. Studies were searched for driving ability evaluation by road test or simulator, clinical/neuropsychological examinations of participants with chronic diseases or permanent disablement impairing driving performance, primary outcomes as fatal/non-fatal traffic injuries and secondary outcomes as fitness to drive assessment.

Twenty-seven studies fulfilled the inclusion criteria. Some studies included more than one clinical condition. The illnesses investigated were Alzheimer's disease (AD) (n = 6), Parkinson's disease (PD) (n = 8), cardiovascular accident (n = 4), traumatic brain injuries (n = 3), Sleep apnoea (n = 2), Narcolepsy (n = 1), Multiple sclerosis (n = 1), Hepatic Encephalopathy (n = 1), and comorbidities (n = 3). No studies matched inclusion criteria about Myasthenia Gravis, Diabetes, renal diseases, hearing disorders and visual diseases. No studies referred to primary outcomes.

The selected studies provided mixed findings. The authors argued that it would be reasonable to argue that some clinical and neuropsychological tests may be effective in predicting fitness to drive even if contrasting results support that driving performance decreases as a function of clinical and neuropsychological decline in some chronic diseases. Nevertheless, and most importantly, they found no evidence that clinical and neuropsychological screening tests would lead to a reduction in motor vehicle crashes involving chronically disabled drivers.

By reviewing the scientific literature dealing with medical conditions and driving, Marino, de Belvis, Basso, Avolio, Pelone, Tanzariello and Ricciardi (2013) found a lack of systematic reviews on the relationship between screening tests and road safety in acute and chronic diseases. Given the importance of finding a way to differentiate safe from unsafe drivers, the authors sought to provide a snapshot on evidence-based instruments, and their validity and reliability for health professionals, (i.e. those physician and other health professionals who have statutory responsibilities to assess fitness to drive in subjects with acute and chronic diseases in order to release/renew the driver licence according to each national normative).

Avolio et al. (2013) noted that, while many studies focused on the contribution of neuropsychological and/or clinical screening tests in the driving ability evaluation of people with chronic diseases, none considered the number of on-road traffic injuries or mortality as outcome measures. They argued that, based on the studies that have been conducted, there is little evidence that any clinical and neuropsychological tests are effective in predicting fitness to drive. Nevertheless, there were some that showed some promise.

For example the Useful Field of View test (UFOV®) gave favourable results in predicting fitness to drive in two cases of Alzheimer's disease and Parkinson's disease (Amick et al., 2007; Rizzo et al., 1997, cited in Avolio et al. (2013)) but did not show any efficacy in two PD patient cases and one cardiovascular (Akinwuntan et al., 2006; Worringham et al., 2006; Devos et al., 2007; cited in Avolio et al. (2013).

The trail making test part A seemed to be useful for Alzheimer's disease and Parkinson's disease (Grace et al., 2005; Amick et al., 2007; Ott et al., 2008, cited in Avolio et al. (2013)), except in two papers (Fox et al., 1997; Worringham et al., 2006; cited in Avolio et al. (2013).

A simple Reaction Time test seemed useful in the evaluation of traumatic brain injuries but not in PD (Sommer et al., 2010; Devos et al., 2007; both cited in Avolio et al. (2013)).

Avolio et al. (2013) also noted that some common chronic conditions seem to have not been investigated yet in order to find a reliable screening test assessing driving ability (e.g. Myasthenia Gravis, Diabetes, renal diseases, hearing disorders and sight diseases). Most importantly, they found no evidence in support of, or against, the hypothesis that clinical and neuropsychological screening tests lead to a reduction in motor vehicle crashes involving chronically disabled drivers. Moreover, their review raised questions of major challenges in traffic injury prevention, that is, to develop valid and reliable screening tools, which can assist health professionals with making driving assessment referrals. They also argued that there is a serious need for research and effort from scientific bodies to develop tests with proven validity to identify high-risk drivers so that physicians can provide guidance to their patients regarding chronic and acute conditions, as well as to advise medical advisory boards working with licensing offices. They recommended that these tests ought to consider the impact on primary outcomes (e.g. mortality, disability), validate potential neuropsychological screening measures and road test procedures against real world driving practices, be focused on cost-effectiveness, be sustainable for health organisations and be acceptable to drivers, even with issues concerning the doctor–patient relationship.

In summary, there is no evidence that a general age-based system and currently available screening assessments have substantial safety benefits. Indeed, there is evidence of broader negative health and mobility impacts of mandatory age-based testing. The few existing studies from Europe conclude that aged-based licence renewal was associated with negative safety effects for older people.

Similarly, while it is argued that it is necessary to identify at-risk drivers, and there are some positive effects found for single measures, namely vision testing, in-person renewal and restricted driving (all in the North American context, and mostly for the oldest age groups), the evidence suggests that current broad and multi-faceted screening assessments are not effective in reducing crash and injury risk. However, because of the complex nature of physical and mental impairments and their relationship to safe driving, it would be strongly recommended that a medical screening process for each condition ought to be detailed, shared and established in all countries (Marshall, Man-Son-Hing, Wilson, Byszewski & Stiell, 2007).

8.5.7. On-road driving assessments

Despite the notion that comprehensive on-road driving assessments in combination with multiple off-road assessments are the ‘gold standard’ for determining medical fitness to drive (Dickerson, 2013; Langford et al., 2008; Wheatley & Di Stefano, 2008), there is surprisingly little evidence attesting to their effectiveness in identifying and assessing medically at-risk drivers, nor is there clear evidence regarding overall safety benefits in terms of improving driver performance or reducing crash and injury risk.

Moreover, the challenge is that on-road assessment is costly because it is usually part of a comprehensive driving evaluation (i.e. it has both a clinical and an on-road component) and involves risk. In addition, only a limited number of practitioners have the expertise, specialised equipment, or licence to perform an on-road assessment (Dickerson, 2013).

In many countries and jurisdictions, some form of on-road driving assessment is included in the fitness to drive licensing procedure. On-road assessments are most often conducted by trained driver assessor Occupational Therapists (OTs) who complete a

comprehensive assessment of clients to ascertain their functional status, ability to drive safely and their ability to participate in driver rehabilitation and re-training (Korner-Bitensky, Bitensky, Sofer, Man-Son-Hing & Gelinas, 2006).

Dickerson et al. (2014) recently summarised and critically appraised the current literature on clinical assessment and performance-based assessments for determining fitness to drive, focusing on validity on the basis of the outcome of on-road assessments, crashes, or driving cessation for older adults. The evidence demonstrated that a single tool measuring cognition, vision, perception, or physical ability individually is not sufficient to determine fitness to drive. Although some tools have stronger evidence than others, this review supports the use of different and focused assessment tools together for specific medical conditions. The results also indicated that on-road assessment remains the gold standard for driving evaluation; however there was emerging evidence for observation of complex instrumental tasks of daily living and driving simulation which support further investigation with these tools.

Dickerson et al. (2014) also noted that the evidence is clear that evaluation of higher level cognitive skills (e.g. executive function) is critical for determining fitness to drive, which is why on-road assessments remain important for evaluation. Unfortunately, while on-road tests often use standardised routes, they are not truly standardised (i.e. the same route can differ significantly because of traffic, weather, or time of day). Regardless of the inconsistencies, the on-road assessment provides important observations of the driver in a dynamic context and gauges a driver's ability to scan the environment, anticipate the actions of others, and prioritise and multi-task actions to arrive at a selected destination.

Di Stefano and MacDonald (2010) examined OT driver assessors' opinions on improving on-road driver assessment procedures. Their findings showed that there was clear in-principle support for use of pre-specified test routes when assessing drivers who wish to gain or retain an unrestricted licence, consistent with the views of many researchers (e.g. Duchek, Hunt, Ball, Buckles & Morris, 1998; Justiss, Mann, Stav & Velozo, 2006; Kay, Bundy, Clemson & Jolly, 2008; Kowalski & Tuokko, 2007; all cited in Di Stefano & MacDonald, 2010). However, there was agreement that, in some circumstances, the use of pre-specified test routes is not feasible, and it is therefore important to specify a standard set of core requirements for all routes used in an assessment, regardless of whether they are pre-developed, standard routes (Di Stefano & MacDonald, 2010). It was also agreed that test duration should be a minimum of 40 to 50 min, and the procedure should entail an initial period of familiarisation, a core set of mandatory manoeuvers and other test items, and additional client-specific items should be included when necessary.

Further, Di Stefano and MacDonald (2010) noted that while the core set of mandatory manoeuvers and route design criteria currently specified in the Victorian Driver OT Competency Standards (Australia) was seen as acceptable and mostly practicable, there is scope for improvement. The authors suggested that, to enhance these standards, additional items specific to different assessment contexts (e.g. urban or rural environments) could be considered as optional, additional items for use when appropriate.

In summary, Di Stefano and MacDonald argue that practising OT driver assessors strongly support amendments to their on-road assessment procedures to increase standardisation, reliability, and validity, in accord with research-based evidence and practice guidelines in the United States and Canada, as well as in Australia. There was agreement regarding a minimum set of standard core requirements applicable to all tests, with fixed routes and predetermined assessment points important for standard assessments. However, some flexibility must be retained for local area tests in relation

to route, procedure, and test items; trials of these and proposed new test features are needed.

Similarly, Jones Dickerson, Flaten, Belmashkan and Betz (2016) assessed driver rehabilitation specialists' opinions on older driver evaluations including current systems and barriers and facilitators of use in the US. The findings identified a true commitment by trained specialists in assisting older drivers but also addressable barriers to the development of an ideal on-road assessment system. Ideally, assessment specialists would have enhanced training and qualifications and be part of a larger multidisciplinary team, using standardised screening assessments to identify those at risk for further assessment and evaluation.

In Australia, considerable research has been undertaken to develop valid and reliable off-road assessments, protocols and standardising the process of conducting on-road assessments. Two Australian off-road assessments have documented reliability and validity. The OT-DORA Battery (Occupational Therapy – Off-Road Assessment Battery) (Unsworth, Pallant, Russell, Odell & Coulson, 2011) is a comprehensive battery taking approximately 90 minutes which includes a full client history and need for driving as well as assessing a client's sensory, physical and cognitive skills for driving. Drive Safe, Drive Aware (Kay, Bundy & Cheal, 2009) examines a client's cognitive skills for driving and the client's determination of their own driving skills. The assessment takes 30 minutes to administer.

In Queensland, Australia, an occupational therapy on-road driving assessment with a self-navigation component administered using a standardised format, using objective scoring protocols has been shown to be a valid and reliable measure of driving ability and predictive of subsequent crash risk for older community-dwelling drivers (Wood et al., 2008). While this may seem at odds with earlier findings, it should be stressed that OT assessments tend to be the most rugged and successful tests of fitness to drive, albeit also the most expensive.

8.5.8. The medical review process

The mechanism to detect and intervene with functionally impaired drivers depends critically upon the success of outreach efforts to encourage referrals to the licensing authority, and upon having medical review processes in place within a State's Department of Motor Vehicles and/or through its Medical Advisory Board (MAB) to conduct case reviews and reach determinations of medical fitness to drive that are valid, efficient, and perceived to be fair by the driving public. It will be important for these processes to be in place to accommodate the projected surge in the proportion of older licensed drivers in the coming years (Transanalytics, 2011).

8.5.8.1. Role of Medical Practitioners

Medically at-risk drivers come to the attention of licensing authorities through referrals from a variety of sources, including physicians, law enforcement, and the court system; in most jurisdictions referrals are also accepted from family, friends, and other concerned citizens. Common reasons for referral of older drivers include getting lost, crashes, 'fender benders', and 'near misses' associated with erratic driving and confusion.

While most GPs accept that it is the patient's responsibility to report any medical conditions to the driver licensing authority, most believe that reporting of unsafe drivers to the driver licensing authority would impact negatively on the doctor–patient relationship, a concern common throughout the literature (Marshall & Gilbert, 1999; Molnar, Byszewski, Marshall & Man-Son-Hing, 2005; Menard et al., 2006). A Canadian study of GPs (where mandatory reporting is widespread) reports that 75 percent of GPs

feel that reporting a patient as an unsafe driver places them in a conflict of interest and negatively impacts on their relationship (Jang et al., 2007) while in another Australian study, 54 percent of GPs expressed worry about losing patients, specifically older patients, in the event of involvement in cancellation of the driver licence (Lipski, 2002). As pressure from the patient or family members is a significant issue, this is likely to be an important aspect of training in traffic medicine.

In a 2012 Australian study, 46% of GPs felt they had been unduly pressured by patients (Sims, Rouse-Watson, Schattner, Beveridge & Jones, 2012). However, most GPs surveyed by Sims et al. (2012) had not experienced patients leaving the practice because of their assessment, contrary to Jones and colleagues who reported that 23 percent of GPs reported patients leaving their practice over licence revocation following the GPs assessment. This is something worthy of follow-up to be sure that medical practitioners continue to willingly agree to be the first point of call for licence retesting.

Meuser, Carr, Irmiter, Schwartzberg and Ulfarsson (2015) examined the issues surrounding referral of drivers with dementia to licensing authorities and argued that physicians and family members may understand cognitive symptoms differently. They argued that, while few family members may report drivers with dementia, they may be in the best position to recognise when medical-functional deficits impact on driving safety, and physicians and driver licensing authorities would do well to take their observations into account with respect to older driver fitness to drive. Despite a growing understanding of the disease, many primary care physicians lack expertise in diagnosing Alzheimer's disease and may assign a diagnosis of dementia. Others also argue that family input is important across the spectrum of dementia care. Family members are perhaps in the best position to observe progressive changes in cognition and function in persons with dementia, including deficient driving skills (Perkinson et al., 2005; Uc et al., 2004; Meuser, 2008; cited in Meuser, Carr, Irmitter, Schwartzberg & Ulfarsson 2010).

Silverstein & Barton (2010) noted that currently, reporting is voluntary in Massachusetts and no immunity exists for GPs. This immunity could be from legal action taken either by the state in cases where a GP could have reported a crash-involved driver but did not, or by the driver in cases where they disagree with the GP's assessment. The situation in Massachusetts is unlike more than half of all states that do have some form of mandatory reporting and provide some form of immunity. Through interviews with key stakeholders, the authors reported that stakeholders believed Massachusetts was ready for a change in licensing and renewal practices and in the medical review of impaired drivers. Except for continued support for voluntary reporting practices, a majority of the respondents disagreed with most of the current practices discussed in the interviews. Recommendations included granting immunity to physicians, strengthening the role, function, and composition of the MAB, developing clear guidelines and standards to report impaired drivers, and training for licensing authority counter personnel.

Although health care professionals, particularly GPs, are legally obligated in many countries and jurisdictions to report patients who may be medically unfit to drive, it is noted that there is little reliable scientific data upon which they can base their decisions at the individual level. Indeed, Eby and Molnar (2010) argued that better methods of identifying drivers who are at an increased risk need to be established.

8.5.8.2. Medical Practitioner Training Needs

Assessing medical fitness to drive is a substantive issue in terms of road safety and wellbeing and autonomy of the driver. The medical profession (including physicians, pharmacists and supporting health specialists) play a critical role in the assessment of medical fitness to drive. Generally, they are responsible for the assessment of a driver's medical fitness to drive using relevant medical standards, advising the person regarding

the impact of the medical conditions on the ability to drive, referrals into the licensing medical review process, and recommending restrictions and ongoing monitoring.

Most physicians report that they do not receive adequate training in assessing driving fitness and lack the necessary tools and knowledge to appropriately evaluate fitness to drive within a clinical setting, although they would be keen for focussed education (Kelly, Warke & Steele, 1999; Marshall & Gilbert, 1999; Jang et al., 2007; Moorhouse & Hamilton, 2014). A number of studies, most notably from Ireland, Canada and Australia, show that some physicians lack confidence in performing driving assessments and are often not aware of the regulations (Marshall & Gilbert, 1999; Lipski, 2002; Molnar et al., 2005; Menard et al., 2006; Jang et al., 2007). Thus, there is a clear need for further training and resources in supporting physicians in determining medical fitness to drive.

Indeed, there is evidence that many GPs and other health professionals are in favour of expanding continuing education in traffic medicine using medical literature (journals, books, etc.), educational events with clarification of legal obligations, face-to-face learning, and online activity (Pfaffli, Thali & Eggert, 2012; Sims et al., 2012; Kahvedžić et al., 2014; Omer et al., 2013). A well designed continuing education intervention – such as the evidence based, multi-media curriculum developed by the American Medical Association to promote basic competence – can improve attitudes, confidence and clinical practice of health professionals (Meuser et al., 2010).

Since 2012, the National Programme Office for Traffic Medicine at the Royal College of Physicians of Ireland has been involved in several traffic medicine educational initiatives aimed at enhancing the vital skills needed by medical postgraduate students, trainees, and doctors. This includes a blend of study days, master classes, clinical updates, hot topic days, and a large open online Modular Object-Oriented Dynamic Learning Environment (MOODLE) course (Royal College of Physicians of Ireland, 2014), all designed to provide insights into specific traffic medicine topics in relation to the standards outlined in the national guidelines. The guidelines that they produce (most recently revised in April 2016) are accompanied by an educational programme, to provide advice and support in this area (Road Safety Authority, 2016).

A postal questionnaire survey on medical fitness to drive training was sent to approximately 3,000 GPs and hospital doctors in Ireland in 2012–2013. In addition, a series of articles detailing the development of the guidelines was published in the Irish GP journal Forum (Cummins 2012, 2013a, 2013b). The office is enhancing its postgraduate education programme in traffic medicine by developing a certificate/diploma in traffic medicine. Preliminary evaluations suggest that these activities have resulted in a high degree of awareness among GPs of new MFTD guidelines; there are high levels of satisfaction with the utility of the guidelines, and increased confidence in assessing MFTD.

Kahvedžić et al. (2015) investigated current attitudes, resources, and practices of approximately 500 GPs registered with the Irish College of General Practitioners towards evaluating medical fitness to drive prior to the publication of the comprehensive national guidelines. The findings of the survey revealed that most GPs were confident (58%) or very confident (11%) in assessing medical fitness to drive. However, they were evenly divided as to whether GPs or practitioners specially trained for assessing medical fitness to drive should be primarily responsible (48%, 51%, respectively). Many (71%) expressed concern regarding the liability of such assessments. A significant minority reported pressure from patients and/or their families to reconsider decisions on medical fitness to drive.

When seeking guidance for assessing medical fitness to drive, the majority were found to either use existing guidelines or refer to a consultant opinion (69%, 66%, respectively). The authors concluded that, although Irish GPs report high levels of confidence in

assessing medical fitness to drive, as a group they express ambivalence about who should be primarily responsible for such assessments. This would indicate that some would consider deferring to a consultant opinion or at least recognise limitations of their skill set in this area. Further exploration is needed to determine which aspects of medical fitness to drive should be included in information and training for GPs, and to help address concerns regarding liability and patient/family communication issues.

These findings indicate areas for development of training programmes in medical fitness to drive in Irish general practice and support the publication of 'Sláinte agus Tiomáint' guidelines as a source of reference and guidance. Relevant aspects include clarification of legal liability and ways to reduce concerns over this (including routine use of up-to-date guidelines), negotiation of patient and family pressure, and clarification of processes and procedures. The lessons learned in both studying the educational needs and programme development are also relevant for a wide range of medical specialties, and can help to shape elements of traffic medicine in undergraduate curricula.

In his commentary on the role of GPs in medical review and continuing medical education, Dow (2009) noted that informed physicians report drivers with medical problems that may affect driver fitness when they are aware that the licensing agency's decisions are based principally upon valid functional evaluations. Discretionary reporting may be as effective as mandatory reporting when physicians are knowledgeable about the road safety implications of medical conditions. Dow also noted that most health care professionals have had little or no exposure to the medical aspects of road safety and are often more concerned with protecting their relationship with the patient than the larger societal considerations of road safety. He argued that this leads to most medical professionals not considering the broader road safety implications of a medical condition when they evaluate their patient unless they have been referred following a road safety problem. Thus, it matters little if the reporting system in place in the jurisdiction is mandatory or discretionary if the physician is not aware of what should be reported.

In Canada, the Continuing Medical Education (CME) programme, established in 2005, has proven popular with physicians, and has resulted in a threefold increase in reporting by physicians. A major factor in the quality and quantity of physician reports was the introduction of a new medical report form that places more emphasis on the functional effects of medical conditions and guides the physician in identifying potential problems through the use of hints that highlight the principal concerns for the Société de l'assurance automobile du Québec (SAAQ). The form no longer requires physicians to state that the patient is fit to drive; instead, it asks whether further testing is required (Dow, 2009).

Dow (2009) also noted that the programme encourages the early identification of potential problems permitting the physician to begin discussing the problem. The physician and his or her patient can thus prepare for driver cessation with careful planning, making the event less traumatic for all concerned.

Moorhouse and Hamilton (2014) noted that there are currently no in-office cognitive tests with validated cut-off scores for predicting fitness to drive with dementia. They reported on the impact of a provincial web-based resource (www.notifbutwhen.ca) to assist GPs in assessing fitness to drive amongst dementia patients. The resource includes a summary of the evidence regarding driving safety with dementia, in-office driving assessments and national guidelines regarding driving safety in dementia, as well as referral forms for local driving assessment agencies, an algorithm for determining when on-road assessment may be needed, a step-by-step guide to the process of driving cessation once concerns are raised to the provincial Registry of Motor Vehicles, and printable information sheets and checklists for caregivers. The resource and awareness campaign have shown moderate effectiveness in addressing specific barriers to

assessment (e.g. caregiver resistance, lack of resources). Future efforts will address additional barriers, such as lack of comfort in decision-making.

In addition to GPs, education and outreach activities directed to other health professionals, including OTs are critical. Occupational therapy is recognised as an additional profession that best addresses the screening and evaluation needs of the medically at-risk client (Carr et al., 2011), and service expansion is needed to meet the needs of the growing number of at-risk older adults. Further, Dickerson et al. (2014) argued that addressing community mobility should be a routine component of occupational therapy services. While they noted that education of students regarding driving as a means of community mobility is one of the Accreditation Council on Occupational Therapy Education's (2012) educational standards, educational modules or courses on this standard should include the process and tools with the best evidence used by occupational therapists when determining fitness to drive, especially when available for specific diagnostic categories.

8.5.8.3. Medical Advisory Boards

Medical Advisory Boards (MABs) are generally established within licensing authorities and have the responsibility of ultimately determining fitness to drive and licensure. There are various forms of MAB throughout Europe and elsewhere, however there are few evaluations regarding the effectiveness of these systems, and therefore little evidence of 'best-practice'.

In the US, the State of Maryland has been considered one of the 'best-performing' jurisdictions in terms of managing the safe mobility of older drivers through the licensing system. Soderstrom and Joyce (2008) explain that the MAB does not have executive authority. It cannot issue a licence, nor can it suspend or revoke a licence. It can only provide an advisory opinion to the licensing authority, on which the administration can base its regulatory action. In this way, the MAB functions very much like an expert witness at a trial; its opinion will inform the outcome but not determine it.

Maryland, which does not require physician reporting, provides immunity (for example from legal recourse) to physicians who report in good faith. First, the medical evaluation is 'driver-centric' rather than 'condition-centric'. This is a holistic approach, which is not practised in many jurisdictions. Rather than focusing on the presence of any single (or even multiple) condition(s), the MAB views the overall health status of the driver and considers the ramifications of that status on functional capacity to drive safely in the context of that driver's apparent behaviours. Second, everyone is considered on a case-by-case basis with the overall goal of maintaining the privilege to drive for as long as the person is deemed medically safe. Third, recommendations developed by the medical advisory board are based on practising the 'craft' of medicine informed by the best available scientific evidence.

Eleven administrative case review nurses and four administrative case reviewers assemble the essential elements needed for a medical review. Additional materials may include police request for re-examination reports, Motor Vehicle Administration (MVA) field investigation reports, driver occupational therapy reports consisting of clinical and behind the wheel evaluations, as well as other materials. Nurses present their cases one-on-one to a medical advisory board physician, like a resident physician presenting a patient to an attending physician. An important element that the nurse brings to the review process is information that has been gleaned from conversations with clients and their families, such as their driving needs/expectations and their ability and willingness to self-regulate. This information helps to fashion case-by-case recommendations and advice to the MVA administrator.

A review of the above reveals the Maryland MVA's unique resources including a well-established medical advisory board, a Driver Wellness Division with nurse case reviewers that refers cases to the MAB on behalf of the MVA and multiple referral sources. An important resource available to MVA clients is the state's OT driving rehabilitation specialists (Wang et al., 2003). The MVA hosts quarterly meetings with key clinicians to develop consistency in evaluation, remediation, and clinical reports.

In addition, Transanalytics (2011) describes the medical review programme in the state of Virginia. This programme comprises of a MAB and an in-house Department of Motor Vehicles (DMV) Medical Review Department. The MAB, established in 1968, consists of seven licensed physicians who are currently practising medicine in Virginia. The governor appoints board members for four-year terms. The functions of the board are to advise the DMV on medical criteria and vision standards for licensing, to review and advise the DMV on individual cases (as requested by the Medical Review Department, or when a driver contests the medical review action), and to assist on legislative proposals. The DMV Medical Review Department currently consists of 10 nurses and one office manager (also a nurse) who order medical and vision reports and skills and knowledge testing, and evaluate medical fitness to drive for drivers referred into their department by physicians, law enforcement officers, the courts, concerned family members, and DMV staff.

Silverstein and Barton (2010) examined opinions amongst key stakeholders regarding MAB composition and function, and argued that expansion of the board to include other allied health professionals, specifically driver rehabilitation specialists and occupational therapists, should be considered. In addition, beyond policy advising, respondents advocated for the MAB to have a more direct role in reviewing cases, such as they do in Maryland. Finally, many suggested that the MAB meet on a more regular basis.

8.5.9. Guidelines and regulations

Guidelines, standards, and regulations for assessing medical fitness to drive have been established in many countries and are regularly updated to ensure they are accurate and reflect current practices. While setting up such documents commonly involves extensive consultation across a wide range of stakeholders including regulators, employers, health professionals and licensing authorities with the aim to provide the most appropriate, informative and useful guides for GPs and other health professionals, there are mixed opinions on their effectiveness and suggestions for enhancements.

A common theme throughout the literature is that GPs are not always aware of the standards set out in their national guidelines and, as a result, frequently report a lack of confidence when assessing MFTD (Jang et al., 2007; Lipski, 2002; Marshall & Gilbert, 1999; Menard et al,. 2006; Molnar et al., 2005; Pfaffli et al., 2012; Sims et al., 2012). Encouragingly, Kahvedžić et al. (2015) noted that the routine implementation of medical fitness to drive guidelines has been associated with a 45 percent reduction in crashes among drivers with medical conditions relevant to driving, suggesting good awareness of guidelines. In contrast, others suggest there is poor use of guidelines and poor understanding of content. For example, despite 70 percent of GPs in an Australian study acknowledging that they had received the Australian national guidelines, in general they displayed poor knowledge of their content (Shanahan et al. 2007). This is in agreement with another Australian study that showed that 38% of GPs contact the driver licensing authority for information about medical guidelines when assessing MFTD (Sims et al. 2012).

A second issue is specific direction or guidelines for specific conditions. Marshall and Man-Son-Hing (2011) argue that Expert Opinion Physician guidelines for determining medical fitness to drive do not provide specific comment or direction for the patient with

multiple chronic medical conditions (American Medical Association 2003; Canadian Medical Association 2000; Drivers Medical Group, DVLA 2006). Holland, Handley & Feetam, (2003) suggested in their report that "severity of all combined effects" be used rather than specific diagnostic group categories. They suggest that it is the overall functional abilities of the driver that will most likely influence his or her driving ability.

8.6. Discussion of good practice

Based on the literature review and the user survey findings, six good practices were identified for medically at-risk and/or older drivers, detailed in the table below.

Good practices regarding driver assessment	
1	A European-wide consistent screening process is required to ensure a common approach for assessing at-risk drivers across the Member States.
2	In addition to the screening process, a validated off-road assessment tool is also needed to minimise the number of potentially at-risk drivers on the road placing themselves, their assessors and the general public at some added risk of collision.
3	Medical practitioners (GP) are clearly a critical part of the identification of older and medically vulnerable at-risk drivers. Many stress the lack of and need for guidelines to assist them in their assessment.
4	In addition, GPs commonly seek assistance with this task and the need for education programmes for GPs to assist them is clearly warranted.
5	There is evidence that some drivers are able to make a rational decision about their own abilities to continue driving, yet may in fact take themselves off the road unnecessarily. Materials to aide their decision in arriving at such a decision would also be very helpful.
6	Some Member States currently provide restricted licences that allow ageing and medically at-risk drivers to drive under certain circumstances. This helps those who may be at slight risk to continue to drive in remote areas where public transport is limited.

8.6.1. Screening process

General screening of the whole population of at-risk drivers is not justified from an effectiveness and/or a cost-benefit perspective. Premature loss of a driver licence has many negative outcomes for older and medical unfit drivers about their safety, mobility, and health. Nevertheless, there is clearly a need for a constant, effective, and transparent assessment process for those drivers that may be unsafe and require assessment in the Directive. Such a process and associated support is important, given that to take away a driver's licence is only justified if it can clearly identify unsafe drivers. As most of the current procedures in Europe vary across countries, there is a need for a more standard process across the Member States.

Participants at the workshop agreed that it was not appropriate to screen all older drivers (or those with potentially risky medical conditions) regularly but rather focus on those judged to be at-risk. Referral mechanisms should include the person's GP, the family themselves and possibly the police. There was agreement of the need for a harmonised system across the Member States. However, the focus should always be on the person keeping their licence if possible, rather than taking it away. This was a consistent view across all the workshop participants. It was acknowledged though that individual state preference may be a barrier to ensuring a broad European approach.

8.6.2. Validated assessment protocol

To assist in the screening process, there is a need for a suitable validated screening process including effective medical and functional assessment tools for someone suspected of being an unfit driver. Current practice ranges from (i) a full-blown (expensive) comprehensive assessment involving screening tests, on-road driving, and a detailed review of each case by a qualified medical panel and possibly, an occupational therapist assessment, to (ii) simply relying on a GP's judgement, often under pressure and with little evidence-based support. The former obviously has higher validity but can be expensive while the latter is often subjective and not always based on sound knowledge and best practice.

There was strong agreement at the workshop for a validated assessment protocol in Europe with very few examples of such a system in Europe. Several participants noted the lack of solid scientific evidence in this area and stated that a validated assessment tool should be a separate project itself. It was claimed that the health of professional drivers was in fact worse than that of private motorists and hence a validated assessment instrument would benefit these drivers as well. It was noted that any barriers to developing the protocol would seem to be more methodological than practical and there was strong consensus on the need for further research in this area.

8.6.3. General Practitioner's guidelines

It is common practice (and very important) that the medical community play an important initial role in identifying those who may be at-risk in terms of their fitness to drive. A doctor's assessment is primarily used by licensing authorities as a first step in this assessment process. GPs are well placed to help identify at-risk patients based on their medical and functional conditions. The review showed though that many GPs report uneasiness in performing this task with little formal guidance and need clear information on what to look for and 'red flags' in terms of conditions and thresholds.

There was overall agreement on the need for this. As most Member States rely on the GP as the first point of reference for someone suffering medical or functional conditions that potentially put them at risk, the participants agreed that GPs need to be fully briefed on international good practice to help them make a rational and more informed judgement when it comes to the ability to drive a motor vehicle. The call for guidelines has been voiced in many countries around the world and generally supported by GPs themselves. The group failed to identify any potential barriers in developing such guidelines.

8.6.4. Education programmes for GPs

As noted above, many GPs generally don't like to take on this role as a faulty judgement can sometimes destroy the doctor-patient relationship and trust. Most have appealed for supporting information to give them a transparent and effective basis for making this judgement. As well as evidence-based guidelines noted above, the group felt that an educational programme such as the one currently in operation in the UK would benefit all GPs in the thrust for a more transparent and scientifically-based system for fitness to drive. While GPs should not be tarnished with what is essentially an agency role, regular training would help to support them. Perhaps the biggest barrier to such a programme is the availability of GPs to attend the course, given their workload, meaning that some inducement might be needed in terms of continuing professional development points for attendance and/or web-based courses to minimise the need for travel.

8.6.5. Self-regulation materials

In many cases, issues with fitness to drive can be identified by the driver concerned or by other members of the community (e.g. families and friends). Reports in the literature showed that a cognizant individual with a high-risk medical or functional disability requires guidance in terms of their decision-making as to whether they should or should not continue to drive. Many of these reports, however, are rarely evaluated in terms of their effectiveness and good practice. In addition, such documents need to provide additional information on alternative forms of mobility, prior to driving cessation. This is necessary to ensure that the individual is still able to maintain their mobility.

The workshop participants fully agreed with this proposal. Some Member States already have some materials and campaigns to help raise public awareness and recognise the need for more public discussion about this issue. Participants noted the need for the information to be phrased in a positive way so as not to unnecessarily alarm drivers. It would be relatively easy to assemble a European-wide booklet and supporting marketing given what seems to be already available within Europe and internationally to enable an individual to judge for themselves if they pose a risk and what they can do to minimise this. The biggest impediment however, may be the fact that those who are likely to be most at-risk are generally not able to be easily convinced of the need, given their neurological or musculoskeletal disorders, other medical illnesses, vision problems, or medications. Nevertheless, the professionals who are required to make these judgements, claim that it does work.

8.6.6. Restricted licences

Several countries offer restricted licences for those approaching an at-risk condition but who have a strong need for private mobility[20]. This ranges from those living in remote areas, requiring ready access for basic uses (health, shopping, socialisation, etc.) or those with temporary medical conditions. These licences often involved distance, night-time or time-of-day restrictions, or vehicle modification conditions and are regularly assessed in terms of continuing to drive.

Some Member States allow restricted licences for short periods but with little evaluation and/or the need for retesting. Participants saw the value in allowing restricted licences but with a more regimented approach. Where a person suffers a temporary health condition, a restricted licence might be in order to allow the individual some mobility under constrained conditions, but there should also be a process for the person to get their full licence back if their health improves. It was pointed out that restricted licences can have negative effects if such a driver thinks they are able to drive safely under all conditions when in fact they are not. The benefits and disbenefits of this approach need to be thoroughly debated and researched, if restricted licences are to be seriously considered across Europe.

[20] Codes 61 to 69 in the Directive list a range of conditional licence categories. See Chapter 9 for a recommendation on how these codes might be used more widely by Member States, and possibly expanded in the future.

9. Recommendations

In this section, we make recommendations for actions by the EC for each topic studied, based on the work reported in the earlier sections of this report.

It should be noted that the good practices stated in the previous chapters are considered, on the basis of the evidence, to be the desirable end goals from a road-safety perspective. Taking into account the feedback from stakeholders at the workshop in this project, the recommendations below have been tailored to reflect the extent to which Member States appear to be ready (or not) for implementation.

In cases in which stakeholders indicated no major obstacles to implementation, recommendations suggest that the EC should take action to facilitate implementation; the key mechanism for achieving this should be (in the absence of updating the main text of the Directive 2006/126/EC) a review and update of the technical annexes in the Directive. Where there are other mechanisms (either in addition to or instead of updates to the annexes) this is noted alongside each recommendation.

In cases in which many barriers to implementation were noted, recommendations take a more pragmatic approach in pointing to the next steps necessary to progress policy in a positive direction.

9.1. Driver testing

Based on the mentioned good practices and the opinion of the stakeholders, the following recommendations[21] are made:

1. The EC should promote the inclusion of a hazard perception test in the licensing system of all Member States. Edits to Annex II of the directive are clearly desirable in this case, but the support and evidence for this approach is such that we recommend that the EC promote it regardless, even in the absence of changes to the annex. See also Recommendation 11.

Good practice: Hazard Perception testing in Great Britain
Hazard perception testing was researched thoroughly throughout the 1980s and 1990s. A useful overall summary of the research undertaken in GB and around the world is provided by Grayson and Sexton (2002). An important early finding was that in order to be useful as a test instrument, a hazard perception test needs to be able to discriminate between high- and low-risk road user groups. It should be possible to show that people who score badly on the test are at greater risk of having a collision on-road than people who score well. Another important feature is that the test should measure a driver's ability to anticipate hazards on the road ahead, rather than simply their 'reaction time'. Although many of the valid tests that have been developed rely on some time-based measure of performance, this is typically related to 'spotting hazards early as they develop' rather than 'responding quickly when a hazard is fully developed'. Great Britain introduced the hazard perception test into the theory test in November 2002. This has resulted in a decline in the number of crashes in the first year after licensing of 11.3% (for certain on-road crash types expected to benefit from greater hazard perception

[21] Note that where recommendations are for further research or evaluation, this is noted.

skill) (Wells, Tong, Sexton, Grayson, & Jones, 2008).

Current developments include further development of the test bank using 3D computer animation, which has the benefit of flexibility over the longer term (for example creating hazards using modern-looking vehicles, rather than relying on older-looking filmed stimuli). Some details of such work in GB can be seen at the following link: https://www.gov.uk/government/news/hazard-perception-clips-get-a-modern-makeover

2. Directive 2006/126/EC includes learning objectives about knowledge of safe attitudes and the willingness to drive safely (Annex II). However, knowledge as such is not enough to change driving behaviour. Therefore, Member States should consider including lessons in basic driver training programs that stimulate risk awareness, low risk acceptance, self-awareness, not to drink and drive, not to get distracted, and so-on.
3. The EC should aim to raise awareness among Member States that the driving task is rapidly changing due to new technologies (e.g. navigation systems, adaptive cruise control, lane keeping systems, inattention warning systems, semi-autonomous driving systems), and that safe and adequate use of these systems needs to be learned during basic driver training, and if possible be tested[22]. One route which might be considered to achieving this is through engagement with relevant stakeholder organisations such as CIECA.
4. Directive 2006/126/EC stipulates that wherever practical, the on-road driving test should include all major road types. However, Directive 2006/126/EC does not stipulate the time of day. Preferably, candidates should be tested both while driving in daylight and while driving during hours of darkness. This is difficult to organize and will increase the costs of the driving test. Therefore, Member States should require that part of the formal driving lessons and part of the hours of accompanied driving are driven during hours of darkness.
5. The driving test is not only an instrument for selection (those who do not meet the standards are not allowed to drive on public roads) it is also a method to assure that learners take driving lessons. There for, the EC should enhance those training objectives that are mentioned in Annex II of Directive 2006/126/EC that can be tested and for which an association with road safety or environmentally friendly driving has been found (i.e. those skills, competencies and experiences during driver training that have been shown to benefit safety or environmentally friendly driving).

9.2. Graduated risk exposure for novice drivers in training and licensing (Category B)

The generally negative responses to the good practices related to a Graduated Driver Licensing (GDL) system were almost all ones that are typically raised and have been discussed elsewhere in the literature (see Kinnear et al., 2013). When we consider that strong GDL systems are in place in a number of countries around the world, and that such systems have been shown conclusively to reduce young driver collisions and

[22] How systems such as adaptive cruise control (ACC), blind spot detection systems, and lane keeping systems should be used in a responsible and safe manner can differ from vehicle type to vehicle type. Therefore car manufacturers also have a responsibility to train drivers in using these novel technologies.

injuries, even with less-than-perfect compliance[23], such barriers to implementation cannot be considered as insurmountable.

In the opinion of the report authors, the strength of the evidence base on the effectiveness of the GDL components proposed makes it important that the adoption of such a strong GDL system across Europe is seen as a priority. However, it is also understood that such change cannot happen overnight. Therefore, as with other topic areas covered in this project, we propose the following mix of tangible, but pragmatic recommendations:

6. Member States should consider implementing strong GDL systems with minimum learning periods, minimum requirements for on-road practice before solo driving commences (120 hours is desirable, see Kinnear et al., 2013) and post-test restrictions on night-time driving and the carrying of peer-age passengers. Lower alcohol limits for newly qualified drivers are also desirable if they are not included already in a Member State.

Good practice: Strong graduated driver licensing

The term 'graduated driver licensing' (GDL) has come to mean a range of things, but there is broad agreement in the literature as to what a strong (and therefore effective) system should look like. Kinnear et al. (2013) suggest that the strongest and most effective systems have at least the following components:

5. A minimum period of time spent learning (at least one year is proposed)
6. A minimum amount of on-road practice during this period (120 hours is proposed as a minimum)
7. A probationary period (ideally one to two years) after solo driving begins, during which there are restrictions on night-time driving and the carrying of passengers, unless accompanied by an appropriately experienced supervising driver
8. A lower alcohol limit should also be in place during this probationary period

Some further detail on the effectiveness of various components of GDL systems can be found in: Senserrick, T., & Williams, A. F. (2015). Summary of literature of the effective components of graduated driver licensing systems (Vol. AP-R476-15). Sydney: Ausroads Ltd.

The following website also has a good deal of detail regarding effective systems in the USA. While the 'crash calculator' outputs probably cannot be generalised in absolute terms to other jurisdictions, they are useful in illustrating what has been shown to be effective in the USA:

http://www.iihs.org/iihs/topics/laws/gdl_calculator?topicName=teenagers

7. The EC should see the adoption of a strong GDL system across Europe as a priority. For the first step in this recommendation, the EC should consider promoting research

[23] It is known that there is some level of non-compliance with GDL restrictions, but such systems are still shown to work. The same argument can be applied to speed limits; we know that at least some drivers break the speed limit, at least some of the time, however we still have speed limits and they still work.

within the Horizon 2020 programme, or if necessary forming another funded research programme, to promote research into two things:

a. (Research) An assessment of the likely casualty savings that would be realised in each Member State, if a GDL system, such as that suggested by Kinnear et al. (2013), were implemented. This research should also consider the likely impact of individual components (with varying 'strengths' of restrictions considered). An example of this for regions in the UK was reported by Kinnear, Lloyd, Scoons and Helman (2014).

b. (Research) An assessment of how such systems have been implemented in other countries such as New Zealand and Australia, including an understanding of the steps necessary to convince the public, and political and other stakeholders as to the merits of GDL systems and their individual components.

Such work would seek to 'lay the foundations' for at least some incremental strengthening of licensing systems across Europe in the hope that, as has been observed in other jurisdictions, post-implementation improvements in acceptability from stakeholders (in the light of observed casualty savings) would permit further strengthening of systems over time.

9.3. Graduated access to higher motorcycle categories

The literature on young and novice motorcyclists is scarce. Just as for learner drivers however, age and inexperience are key risk factors for motorcyclists and, as such, much can be learned from the driver training literature which is currently very extensive. In light of this, and building on the assumption that age and exposure should be primary concerns in relation to riders, four recommendations are provided.

8. It is recommended that Member States consider increasing the number of on-road supervised training hours that learner riders receive, and ensuring that these are logged and monitored across Member States.

9. Currently, access to an 'A' licence for those riders under 24 requires 2 years' experience on an A2 licence. It is recommended that Member States maintain this stepped process, since it makes it more likely that younger riders have some experience on road before solo riding of larger bikes[24].

10. (Research) It is recommended that the EC undertake research to:

    a. Evaluate the potential benefits and disbenefits (in terms of at least safety and mobility) that would result from the future implementation of a minimum age of licensure for riders that is higher than it is now (for example in line with, or potentially higher, than that for car drivers).

    b. Assess the safety effects of progressive access to higher-powered motorcycles, compared with direct access to an unrestricted category (A)

    c. Understand if rider characteristics influence choices to ride higher-powered bikes and if these relate to increased risk, and use this knowledge to inform the development of rider training approaches

[24] No Member States currently report such systems, but future-proofing is recommended to maintain current practice.

9.4. Driver training

Taking into account the results of the literature review and what was discussed during the workshop, the following recommendations are proposed:

11. All Member States should include hazard perception training in basic driver training programmes. See also Recommendation 1.

12. Because safe attitudes and the motivation to drive safely cannot be tested properly during the driving test (see Recommendation 2), Member States should require that driver training programs include lessons about risk awareness, risk acceptance, self-awareness, the dangers of drink driving, distraction, and so-on.

Good-practice: Mandatory post-licence training in Austria

A good example is the mandatory post licence training in Austria. After having passed the driving test, novice drivers have to attend three separate training programs during the first year of solo driving. This was introduced in 2003. The first training program is a so-called 'feedback drive'. This drive is not about skills but about driving style. During the drive the novice driver gets feedback about his/her driving style and gets tips for improvement. The second training program is on a training ground (test track). This is not an anti-skid course but a method of confronting the novice driver with his or her limitations; the novice driver experiences how easy it is to lose control and learns that he or she should avoid circumstances in which control can easily be lost. The third training program is a group discussion followed by a second feedback drive. The group discussion is chaired by a psychologist. A number of risk situations are discussed and the underlying factors of this risk taking, such as overestimating one's skills, and one's responsibilities in traffic. A similar mandatory post licence training program but without a group discussion had only a marginal effect on crash rate in Finland (Keskinen et al., 1999). However, the extended program with a group discussion and a second feedback drive in Austria resulted in fewer self-reported traffic offences and accidents (Myntinnen et al, 2010).

13. Member States should seek to find ways to increase the amount of supervised on-road driving that learner drivers undertake before solo driving commences. Research suggest that on average 3000 km or 120 hours of supervised driving (see good practice below) is required to reduce crash risk during the first years of solo driving.

Good practice: Greater amounts of on-road experience

Graduated Driver Licencing (GDL) systems in the USA, Canada, Australia and New Zealand start with a supervised driving phase. During this phase the learner driver gains driving experience while being supervised by a lay instructor (usually a parent). There is some evidence that approximately 120 hours of supervised driving within such a system lowers the crash rate in the first years of solo driving (for an overview of research on this topic, see Senserrick & Williams, 2015). Sagberg & Gregersen (2005) found that on average learners drove 3,800 km while being supervised by a lay instructor in Sweden, compared with only 1,150km in Norway. In Sweden, supervised driving resulted in a lower crash rate in the first years after licencing while in Norway it did not, suggesting that greater amounts of on-road practice are more protective.

14. Because research shows that short training programs to enhance the skills to regain vehicle control in emergency situations such as skid recovery training, do not reduce crash risk and sometimes can even increase crash risk 9, Member States should discourage to include short training programs that are merely aimed at enhancing vehicle control skills in emergency situations that only rarely occure, in basic driver training programs.

Given the mixed responses from stakeholders regarding the latter two topics, a communication-based approach would seem to provide the best balance between acceptability and an assertion that these good practice approaches are being pursued.

9.5. Driving instructor competencies

No studies could be found about the effect the quality of driving instructors has on driving behaviour and the crash risk of newly licensed drivers. The overview of the training programmes for driving instructors and the minimum requirements for becoming a driving instructor shows that they differ considerably between Member States. Considering the lack of studies and the mixed opinions of stakeholders, the following recommendations are proposed:

15. (Research) Member States should promote research to investigate whether the quality of driving instructors has an effect on behaviour, especially with regard to higher order driving skills.

16. If such research indicates that the higher order driving skills of formally trained drivers (those trained by a professional driving instructor) are better than those of informally trained drivers (those who have relied on practice whilst supervised by a so-called 'lay instructor' such as a parent), Member States should then consider improvement of training programmes of professional driving instructors, to ensure that any advantage of professional tuition is maximised.

17. Given the self-evident need for driving instructors who respect learners, Member States should take precautions that driving instructors have not been convicted for sexual harassment and have not committed serious traffic offences (if such measures are not already in place).

18. (Research) Member States should consider evaluation studies into the effects of refresher training/CPD of driving instructors on road safety outcomes for young and novice drivers.

19. Member States should see to it that the theory test and the practical test for driving instructors include the testing of knowledge educational methods and the skill to apply these methods.

Good practice: Learner-centred approaches

First and foremost, more research is required on the effect the quality of driving instructors has on the crash rate of newly licenced drivers. However, we do know that most crashes by novice drivers are caused not so much by a lack of basic driving skills but are caused by the lack of higher order skills (e.g. hazard anticipation, risk awareness, and self-awareness). There is some evidence, (although more research is required), that learner-centred methods such as coaching are more appropriate for acquiring higher order skills than just instruction. This suggests that driving instructors should be capable of applying learner-centred methods. A good example of learner-centred or 'coaching' methods is seen in Bartl, (2010).

20. Member States should take provisions for mandatory periodic life-long on going vocational training and periodic assessment of proficiencies.

9.6. Requirements on medical fitness to drive

From the review, it is apparent that medical fitness to drive is a critical aspect of maintaining and reducing road trauma in Europe, and is especially relevant given the projected increases in the number of older drivers as the population ages. Best practice evidence shows that a person's ability to drive should be based on functional deficit, rather than age or medical condition. The following recommendations are made:

21. It is recommended that a standardised screening process be considered across all Member States when assessing a driver's fitness to drive for a Class B driving licence. The process should be based on international best practice and ideally, consistent across all jurisdictions.

Good practice: Standardised screening process

A standardised screening process ensures that there is a consistent approach to assessing medical fitness to drive across Member States, optimising safe driving and reducing opportunities of licensing malpractice in Europe.

Current best practice suggests the following: (i) referral by a General Practitioner to a specific traffic medicine centre, (ii) assessment of fitness to drive using validated off-road screening tools with acceptable sensitivity and specificity measures, (iii) referral to expert medical advisory boards for final assessment by expert medical advisors, and (iv) an appropriate appeal process by the individual for disputed claims.

Best practice models currently operate in Sweden, Canada, parts of the USA, and Australia, although the lack of a validated off-road screening tool has led to use of on-road assessments that have questionable validity and are potentially dangerous for clients and assessors.

22. It is recommended that, while a consistent screening tool or protocol should ideally be applied across all Member States, international best practice suggests that these judgements should at the very least be made using the same functional criteria.

23. It is recommended that the existing practice across all Member States of General Practitioners (GPs) being the primary point of call for initiating an assessment of a person's fitness to drive (as shown in Table 12) be continued. The development and

implementation of consistent guidelines by Member States for all GPs is strongly recommended based on international best practice.

24. It is recommended that evidence-based education programs, shown to be effective and accepted by GPs, be promoted, and adopted across all Member States for consistency in assessing a person's fitness to drive. Appropriate incentives for GPs to participate in this area should be evaluated.

Good practice: Education programmes for general practitioners

General Practitioners are for the most part willing to be the primary point of call for initiating an assessment of a person's fitness to drive. However, they often acknowledge the lack of details on specific assessment criteria to use and some feel uneasy about making the assessment, especially around key unsafe driver functions. It is recommended therefore, that educational programs for GPs be established to assist in this process.

Best practice examples of such educational programs for general practitioners can be found in Ireland and Canada in Continuing Medical Education (CME) programs involving master classes, clinical updates, case studies, and online courses, designed to provide vital skills in specific traffic medicine topics related to standards in national guidelines and practices.

25. It is recommended that the EC consider development and promotion of materials to support successful self-regulation and transition to reduced driving and driving cessation. These materials should be made freely available to all Member States, to assist individuals in undertaking assessment of their own fitness to drive.

Good practice: Self-Regulation Materials

While it is a difficult task for people with questionable fitness to drive to decide to stop driving at an appropriate time, especially those with severe dementia, nevertheless many elderly and medically challenged drivers do seek out information on self-assessing their own driving abilities. Family members of these individuals also require such materials to help them in deciding whether to initiate an assessment process.

There are best practice examples of brochures, test procedures and online courses that could be made available or used to assist individuals and family members in this process. These include classroom education courses that provide criteria and strategies for safe driving and transition to non-driving, online self-assessment tools, hazard perception assessments (Australia and USA), test-track training courses with individual feedback on driving performance (Canada and Australia), and brochures outlining safe and unsafe medical and functional abilities with recommended thresholds (Australia).

26. Codes 61 to 69 in the Directive 2006/126/EC list a range of Limited Use Codes for conditional licences which may be of benefit for those with a range of medical conditions. The EC should recommend that Member States make wider use of such conditional licences where possible (see good practice below).

Good practice: Conditional and restricted licences

Conditional or restricted licences are currently used in at least 3-European countries (Austria, Belgium, and Hungary) as shown in Table 12. Other countries such as Australia and Canada also have adopted restricted or conditional licences for those shown to be marginally at risk but who require personal mobility for basic medical and social activities.

Restricted and/or conditional licences come with a minimum likelihood of an increase in crash exposure and risk (only marginal if applied in low traffic conditions). Authorities need to balance this increase in crash risk with health and social needs of the individual and should be regularly reviewed (commonly yearly). There is always the risk, too, that an individual needing their car for important mobility may drive unlicensed if their licence is stopped entirely.

27. (Research) It is recommended that further research be commissioned in three key areas, which will provide much needed evidence to support the implementation of a consistent approach in the assessment of a person's fitness to drive namely:

    a. Undertake research to develop an effective and transparent screening protocol for possible use across Europe in testing the functional capabilities of someone suspected of being an unfit driver of a Class B vehicle.

    b. Undertake research to develop evidence-based guidelines for GPs across all Member States to use in assessing a person's fitness to drive.

    c. Undertake research to develop and evaluate educational programs for GPs that are both effective and accepted by medical practitioners.

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Appendix A. Search terms for literature reviews

Table 14: Search terms for review on driving tests

In case of test for motorcyclists "driv*" was replaced by "rid*".

Table 15: Search terms for review on graduated risk exposure for novice drivers in training and licensing (Category B)

Graduated driver licen* OR GDL OR structured licen* OR licence restrict* OR license restrict* OR night restrict* OR probationary period OR passenger restrict* OR alcohol restrict* OR supervis* OR accompan* OR practi*	AND	Component OR compliance OR consequence OR crash OR collision OR accident OR effect* OR evidence OR safety OR behaviour OR attitudes OR evaluat* OR age OR risk OR novice driv* OR young driv* OR teen driv* OR teenage driv* OR new driv* OR young adult driv* OR learner driv* OR teenaged driv* OR adolescent driv*

Table 16: Search terms for review on graduated access to higher motorcycle categories

Graduated access* OR progressive access* OR restrict* OR graduated driver licen* OR GDL OR structured licen* OR licence restrict* OR license restrict*	AND	Motorcycle OR motorbike OR PTW OR powered two-wheel* OR powered two wheel OR powered 2-wheel* OR powered 2 wheel*

Table 17: Search terms for review on driver training

In case of rider training "driv*" was replaced by "rid*".

Table 18: Search terms for review on driving instructor competencies

driv* AND instructor* AND competence*, driv* AND professional AND train* OR education, driv* AND lay instructor, driv*AND lay instruction, driv* instructor* AND training program, driv* instructor*AND requirements

In case of test for motorcyclists "driv*" was replaced by "rid*".

Table 19: Search terms for review on requirements for medical fitness to drive

Licence OR Licensed OR Licensing OR Licensure Structured licen* OR licence restrict* Medical review Fitness to drive	AND	Restrictions OR conditions OR suspension OR cancellation OR revocation OR withdrawal OR mandatory reporting OR driver testing OR driver regulation OR age-based testing OR commercial drivers OR private drivers Assessment OR ageing OR chronic illness OR disability OR medicine OR medication OR polypharmacy OR illicit drugs or medical examination OR medical report

Appendix B. Quality scoring tables for literature reviews

Table 20: Literature scoring outcomes for review on driving tests

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Baughan et al. 2006	Novice driver safety and the British practical driving test	B	B	A
Baughan & Simpson, 1999	Consistency of driving performance at the time of the L-test	B	B	A
Clarke et al. 2006	Young driver accidents in the UK	A	C	B
Congdon 1999	VicRoads hazard perception test, can it predict accidents?	A	B	A
Curry et al. 2011	Prevalence of teen driver errors leading to serious motor vehicle crashes	A	C	B
Elvik et al. 2009[1]	Handbook of road safety measures	A, B	A, B, C	A, B
Gregersen & Bjurulf, 1996	Young novice drivers	C	B	C
Hatakka et al. 2002	From control of the vehicle to personal self-control	B	B	A
Horswill et al. 2015	Can a video-based hazard perception test used for driver licensing predict crash involvement?	B	A	A
Laapotti & Keskinen 1998	Differences in fatal loss-of-control accidents between young male and female drivers	A	B	A
Maycock & Forsyth 1997	Cohort study of learner and novice drivers Part 4	B	B	A
Maycock et al. 1991	The accident liability of car drivers	B	B	A
McCartt et al. 2009	Effects of age and experience on young driver crashes	B	B	C
McKnight & McKnight 2003	Young novice drivers: careless or clueless?	A	C	B
Sexton & Grayson 2010a	The accident history of and behaviours of new drivers	B	B	A
Simpson et al. 2002	Monitoring and evaluation of safety measures for new drivers	B	B	A
Vlakveld 2011	Hazard perception of novice drivers	B	B	A
Wells et al. 2008	Cohort II: A study of learner and new drivers.	B	B	A

1. The Handbook of Elvik et al. 2009 contains meta-analyses. In each of these meta-analyses several studies are included of which the quality differs.

Table 21: Literature scoring outcomes for review on graduated risk exposure for novice drivers in training and licensing (Category B)

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Begg and Brookland 2015	Participation in driver education/ training courses during GDL	B	B	A
Creaser et al. 2015	The Role of parent feedback and vehicle status	C	A	A
Curry et al. 2015b	Young driver crash rates by licencing age	A	B	A
Curry et al. 2015c	Young driver licencing: examination	B	B	A
Curry et al. 2016a	Effectiveness of parent-focused interventions	C	C	C
Hassan 2016	Investigation of the self-reported aberrant driving behaviour of young male saudi drivers	A	C	A
Insurance Institute for Highway Safety 2015	GDL: an easy win (Status Report)	C	C	C
Lee et al. 2015	Techniques for reducing speeding beyond licensure	C	C	C
McCartt & Teoh 2015	Tracking progress in teenage driver crash risk in the USA	A	B	A
Ouimet et al. 2015	Young drivers and their passengers	A	A	A
Pressley et al. 2015	Graduated driver license compliant teens	A	C	A
Scott-Parker 2015	The psychosocial purpose of driving and its relationship with the risky driving behaviour	B	C	A
Simons-Morton et al. 2015	Naturalistic teenage driving study	A	B	A
Simons-Morton et al. 2016	Are perceptions about driving risk and driving skill	B	C	A
Taubman et al. 2015	Parents' and peers' contribution to risky driving	B	A	A

Table 22: Literature scoring outcomes for review on graduated access to higher motorcycle categories

Author(s)	Abbreviated title	Outcome measure(s)	Controls	Analysis
Brown et al. 2015	The Austroads in-depth study of motorcycle crashes in NSW	A	A	A
Christie 2014	A discussion paper on elements of graduated licensing systems	Context	Context	Context
de Rome et al. 2010	Survey of novice moto riders and their riding experience before licencing	C	C	B
Haworth et al. 2010	A preliminary examination of the effects of changes in motorcycle licensing in Queensland	B	C	B
Lennard et al. 2009	Journal of the Australasian College of Road Safety	C	C	C
Mitsopoulos-Rubens et al. 2009	Graduated licensing for motorcyclists: Rationale, effectiveness, challenges and opportunities for the	Context	Context	Context
Rolison et al. 2013	Risk of high-powered motorcycles among younger adults	A	C	A
Sagberg & Bjornskau 2012	Graduated licencing in Norway	A	D	D
Senserrick et al. 2015	Development of Victoria's new Motorcycle Graduated Licensing System	E	C	C
Olumide & Owoaje 2015	Young age as a predictor of poor road safety practices	B	C	A
Sakashita et al. 2015	Development and Evaluation of an On-ride Motorcycle Coaching Program	D	A	C

Table 23: Literature scoring outcomes for review on driver training

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Bartl 2010	EU coaching project HERMES; Final report	B	B	C
Beanland et al. 2013[1]	Is there a case for driver training? A review of the efficacy of pre- and post-licence driver training	A B	A B	C
Begg & Brookland 2015	Participation in driver education/training courses during graduated driver licensing	A	B	A
Blomberg & Fisher 2012[1]	A fresh look at driver education in America	A B	A B	C
Carstensen 2002	The effect on accident risk of a change in driver education in Denmark	A	B	A
Chapman et al. 2002	Visual search patterns in trained and untrained novice drivers	B	A	A
Christie 2001[1]	The effectiveness of driver training as a road safety measure	A B	A B	C
Clarke et al. 2005	Voluntary risk taking and skill deficits in young driver accidents in the UK	A	C	A
Crundall et al. 2010	Commentary training improves responsiveness to hazards in a driving simulator	B	A	A
Curry et al. 2011	Prevalence of teen driver errors leading to serious motor vehicle crashes	A	C	A
De Winter et al. 2009	Relationships between driving simulator performance and driving test results	A	B	A
Elvik et al. 2009[2]	Handbook of road safety measures	A B	A B	A
Fisher et al. 2002	Use of a fixed-base driving simulator to evaluate the effects of experience and PC-based risk awareness training on drivers' decisions	B	A	A
Fisher et al. 2006	Can novice drivers be trained to scan for information that will reduce their likelihood of a crash?	B	A	A
Glendon et al. 2014	Evaluating a novice driver and pre-driver road safety intervention	C	A	A
Gorman 2005	The centrality of critical rational reasoning in science	C	C	C

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Gregersen 1996	Young drivers' overestimation of their own skill--an experiment on the relation between training strategy and skill	C	A	A
Gregersen et al. 2003	Accident involvement among learner drivers	A	C	A
Gregresen et al. 2000	Sixteen years age limit for learner drivers in Sweden—an evaluation of safety effects	A	B	A
Griffin et al. 2004	Long-Term Follow-Up Effects of a School-Based Drug Abuse Prevention Program on Adolescent Risky Driving	B	B	B
Groeger & Banks 2007	Anticipating the content and circumstances of skill transfer: unrealistic expectations of driver training	C	C	C
Groeger & Brady 2004	Differential effects of formal and informal driver training	B	A	A
Helman et al. 2010	How can we produce safer new drivers?	C	C	C
Helman et al. 2013	Evaluation of a new learning to drive syllabus and process in GB	B	A	A
Horswill & McKenna 2004	Drivers' hazard perception ability: situation awareness on the road	B	C	C
Isler & Starkey 2012	Driver Education and Training as evidence-based road safety Interventions	A	A	A
Isler et al. 2008	The frontal lobe project	B	A	A
Isler et al. 2009	Video-based road commentary training improves hazard perception of young drivers in a dual task	B	A	A
Isler et al. 2011	Effects of higher-order driving skill training on young, inexperienced drivers' on-road driving performance	B	A	A
Ivancic & Hesketh 2000	Learning from errors in a driving simulation: effects on driving skill and self-confidence	B	A	A
Katila et al. 2004	Does increased confidence among novice drivers imply a decrease in safety?: The effects of skid training on slippery road accidents	A	B	A
Li & Tay 2014	Improving drivers' knowledge of road rules using digital games	C	A	A

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Lonero & Mayhew 2010[1]	Teen driver safety; Large-scale evaluation of driver education review of the literature	A B	A B	C
Mann & Lansdown 2009	Pre-driving adolescent attitudes: Can they change?	C	A	A
Mayhew & Simpson 2002[1]	The safety value of driver education and training	A B	A B	C
Mayhew et al. 2003	Specific and Long-Term Effects of Nova Scotia's Graduated Licensing Program	A	B	A
McDonald et al. 2015[1]	A Review of Hazard Anticipation Training Programs for Young Drivers	B	C	C
McKenna & Crick 1997	Developments in hazard perception; Prepared for road safety division of DETR	B	A	A
McKenna et al. 2006	Does anticipation training affect drivers' risk taking?	B	A	A
McKnight & McKnight 2003	Young novice drivers: careless or clueless?	A	C	A
Mynttinen et al. 2010	Two-phase driver education models applied in Finland and in Austria – Do we have evidence to support the two phase models?	A	B	A
Nyberg & Engström 1999	"Insight": an evaluation: an interview survey into driving test pupils' perception of the "Insight" training concept	C	A	A
Peck 2011	Do driver training programs reduce crashes and traffic violations? — A critical examination of the literature	A	A	A
Pollatsek et al. 2006	Using eye movements to evaluate a PC-based risk awareness and perception training program on a driving simulator	B	A	A
Poulter & McKenna 2010	Evaluating the effectiveness of a road safety education intervention for pre-driver	C	A	A
Pradhan et al. 2009	Can younger drivers be trained to scan for information that will reduce their risk…?	B	A	A
Pradhan et al. 2011	The effects of focused attention training on the duration of novice drivers' glances inside the vehicle	A	A	A

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Regan et al. 2000	Simulator-based evaluation of the DriveSmart novice driver CD-Rom training product	B	A	A
Rosenbloom & Eldror 2014	Effectiveness evaluation of simulative workshops for newly licensed drivers	B	B	A
Rowe et al. 2013	The development of risky attitudes from pre-driving to fully-qualified driving	B	A	A
Rowe et al. 2016	Identifying beliefs underlying pre-drivers' intentions to take risks	C	A	A
Sagberg & Gregersen 2005	Effects of lowering the age limit for driver training	A	B	A
Senserrick & Williams 2015[1]	Summary of literature of the effective components of graduated driver licensing systems	A B	A B	C
Senserrick 2007[1]	Recent developments in young driver education, training and licensing in Australia	A B	A B	C
Senserrick et al. 2009	Young driver education programs that build resilience have potential to reduce road crashes	A	B	A
Shell et al. 2015	Driver education and teen crashes and traffic violations in the first two years of driving	A	B	A
Stanton et al. 2007	Changing drivers' minds: the evaluation of an advanced driver coaching system	B	A	A
Thomas et al. 2016	Evaluation of the safety benefits of the risk awareness and perception training program for novice teen drivers	A	A	A
Vlakveld et al. 2011	Do crashes and near crashes in simulator-based training enhance novice drivers' visual search for latent hazards?	B	A	A
Wang et al. 2010b	Effects of a simulation-based training intervention on novice drivers' hazard handling performance	B	A	A
Wang et al. 2010a	A comparative study of two hazard handling training methods for novice drivers	B	A	A
Waylen & McKenna 2008	Risky attitudes towards road use in pre-drivers	C	A	A

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Weiss et al. 2013	Calibration as side effect? Computer-based learning in driver education and the adequacy of driving-task-related self-assessments	A	A	A
Wetton & Horswill 2013	Are what happens next exercises and self-generated commentaries useful additions to hazard perception training for novice drivers?	B	A	A

1. Literature review

2. Meta-analysis

Table 24: Literature scoring outcomes for review on driving instructor competencies

Author(s)	Abbreviated Title	Outcome measure(s)	Controls	Analysis
Beanland et al. 2013[1]	Is there a case for driver training? A review of the efficacy of pre- and post-licence driver training	A B	A B	A B
Boccara et al. 2015	A longitudinal study of driving instructor guidance from an activity-oriented perspective	C	A	A
Christie 2001[1]	The effectiveness of driver training as a road safety measure: a review of the literature	A B	A B	A B
Elvik et al. 2009[2]	Handbook of road safety measures	A B	A B	A B
Groeger & Clegg 2007	Systematic changes in the rate of instruction during driver training	C	C	A
Hatakka et al. 2003	Basic driver training: New Models; Final report of the EU-project on driver training 'BASIC'	A	B	A
Lund et al. 1986	High school driver education: Further evaluation of the Dekalb County study	A	A	A
Peck 2011	Do driver training programs reduce crashes and traffic violations? — A critical examination of the literature	A	A	A
Stock et al. 1983	Evaluation of safe performance secondary school driver education curriculum project, Final Report	A	A	A
Wells et al. 2008	Cohort II: A study of learner and new drivers	A	B	A

1. Literature review

2. Meta-analysis

Table 25: Literature scoring outcomes for review on requirements on medical fitness to drive

Author(s)	Abbreviated title	Outcome measure(s)	Controls	Analysis
Avolio et al. 2013	Factors influencing quality of life for disabled and nondisabled elderly population	B	B	A
Bédard et al. 2008	Predicting driving performance in older adults	A	B	B
Charlton et al. 2010	Influence of chronic illness on crash involvement	A	A	A
D'Ambrosio et al. 2008	Gender differences in self-regulation	B	C	B
Dickerson et al. 2014	Assessment tools predicting fitness to drive on older adults	A	C	B
Di Stefano & MacDonald 2010	Australian occupational therapy driver assessors' opinions	B	B	B
Dow 2009	Evaluation of driver fitness	A	B	A
Eberhard 1996	Safe mobility for senior citizens	B	B	B
Eby & Molnar 2010	Driving fitness and cognitive impairment	B	B	A
Engeland et al. 2007	Risk of road traffic accidents associated with prescription drugs	C	B	C
Fildes et al. 2000	Model Licence Re-Assessment Procedure	A	B	B
Fonda et al. 2001	Changes in driving patterns and worsening depressive symptoms	B	C	C
Grabowski et al. 2004	Elderly licensure laws and motor vehicle fatalities	C	B	C
Hakamies-Blomqvist et al. 1996	Medical screening of older drivers as a traffic safety measure	B	C	B
Hetland & Carr 2014	Medications and impaired driving	B	B	B

Author(s)	Abbreviated title	Outcome measure(s)	Controls	Analysis
Kahvedžić et al. 2015	GP attitudes and practices in medical fitness to drive in Ireland	A	C	B
Korner-Bitensky et al. 2009	Older driver retraining	A	B	A
Langford et al. 2004a	Effectiveness of mandatory license testing for older drivers	B	A	A
Langford & Koppel 2006	Mandatory age-based assessment of older drivers	B	C	B
Levin et al. 2012	Enhance mobility among older people in Scandinavia	C	B	B
MacLennan et al. 2009	Older adults' knowledge about medications	C	C	C
Marottoli 2002	Health issues for older road users	A	B	A
Marshall & Man-Son-Hing 2011	Multiple chronic medical conditions & driving risk	A	B	A
Meuser et al. 2010	Older driver curriculum for health professionals	B	C	B
Monárrez-Espino et al. 2013	Medications and road traffic crashes in senior Swedish drivers	C	B	B
Naughton et al. 2006	Prescribing for chronic conditions among an elderly population	C	C	B
OECD 2001	Mobility needs and safety issues	A	B	A
Orriols et al. 2009	Impact of medicinal drugs on traffic safety	B	B	B
Oxley et al. 2012	Training program for older drivers	B	C	B
Road Safety Authority (Ireland) 2010	Medical Aspects of Driver Licensing	context	context	context

Author(s)	Abbreviated title	Outcome measure(s)	Controls	Analysis
Ross et al. 2011	Age-based testing for driver's license renewal	B	C	B
Royal College of Physicians of Ireland 2014	Europe's first Certificate in Traffic Medicine	context	context	context
Silverstein & Barton 2010	Medical review of impaired drivers and fitness to drive	B	C	B
Sims et al. 2012	Assessment dilemma for GPs	C	D	C
Sirén & Haustein 2015	Driving licences and medical screening in old age	A	B	B
Soderstrom & Joyce 2008	Medical review of fitness to drive in older drivers	C	C	B
Tay 2012	Ageing driver licencing requirements and traffic safety	C	D	D
Unsworth et al. 2011	Interrater reliability of the Road Law and Road Craft test	B	B	B
Vaa 2003	Impairment, diseases, age and their relative risks of accident involvement	B	C	C
Vandenberghe 2010	Medical Examination for Driving Licence	context	context	context
Viamonte et al. 2006	Risk-Reduction Strategies Targeted at Older Drivers	B	B	A
Wood et al. 2008	Predicting older driver safety under in-traffic road conditions	B	A	B

Appendix C. Online survey of Member States

Training, Testing and Medical Fitness - Survey

1. Introduction page

Thank you for your interest in the study on driving licence training, testing and medical fitness to drive. The purpose of this study is to provide the European Commission (EC) with an evidence-based overview of the effectiveness of approaches to training, testing and licensing for drivers and riders, including their medical fitness to drive. The aim is to provide the basis for the EC to more accurately assess the value of possible future EU-initiatives. The following questionnaire seeks to gain further insight into your country's practices in relation to driver/rider licensing and training, particularly in relation to the effects of Directive 2006/126/EC. The work is being carried out by the Transport Research Laboratory (UK), SWOV (Netherlands), BASt (Germany) and Loughborough University (UK). The data collected through this survey will be included in a report and recommendations to the EC. By completing the following questionnaire, you are agreeing to TRL using your anonymised responses in any reporting and/ or presentations that are delivered as part of this project to the EC. The data will be stored and secured according to TRL's data protection policy, and in line with the Data Protection Act (1998). Please confirm that you have read and understood the information stated here and that you are willingly taking part in the following questionnaire:

☐ Yes - I confirm I have read and understood the information about the study and agree to take part in the questionnaire

☐ No - Having read the information provided, I do not wish to take part in the questionnaire (this will take you to the finish page)

2. About you and your country

Which country are you answering on behalf of? ☐

What is your name and job title? ☐

What is your email address? (This is for us to verify who has answered the survey)
☐

3. EC Directive

Are you aware of the Directive 2006/126/EC of the European Parliament and of the council on driving licences?

☐ Yes

☐ No

4. Graduated risk exposure for novice driver in training and licencing (Category B)

The section that follows contains questions about learner driver licencing (Category B) in your country. We would like to know more about the current practices, regulations and the impact that Directive 2006/126/EC may have had on these. Do you have some knowledge or understanding of Category B (car drivers) licencing in your country?

 Yes - I have at least some knowledge of Category B licencing practices in my country.

 No - I have no knowledge of Category B licencing practices in my country.

Which of the following measures are in place for category B drivers in your country? (Please select all that apply)

 A minimum length of learning period

 A minimum number of on-road hours of supervised practice (with professional instructor or parent/guardian/other supervising driver) during learning

 Some kind of post-test probationary period

 None of the above

 Other (please specify): [ ]

How long is the minimum learning period for category B drivers? (Please select the option that applies).

 < 3 months

 3-6 months

 7-12 months

 Between 1-2 years

 More than 2 years

What is the minimum number of on-road hours of supervised practice for category B drivers? (Please select the option that applies)

 < 10 hours

 11-30 hours

 31-50 hours

 51-70 hours

 71-90 hours

 91-120 hours

 121 hours or more

8.

As you answered 'yes' to your country having some kind of probationary period post-test for category B drivers, these questions seek further detail regarding this probationary period.

How long is the probationary post-test period for category B drivers?

- < 3 months
- 3-6 months
- 7-12 months
- Between 1-2 years
- More than 2 years

Is a driver on the probationary period made obvious to other road users? (e.g. through a 'P' plate displayed on the vehicle, or similar visual cues)

- Yes
- No

Are peer-age passengers (i.e. passengers of the same or similar age) permitted in the probationary period for category B drivers?

- No peer-age passengers may be carried at all when driving unsupervised during the probationary period
- Some peer-age passengers can be carried when driving unsupervised, but they are restricted in numbers
- No restrictions on peer-age passengers are currently in place in the country

If you answered 'some', please specify the number of peer-age passengers that can be carried:

Are there any driving restrictions for learners that prohibit unsupervised driving between certain times of the day (e.g. at night) in your country?

- Yes
- No

If you answered 'Yes', please give the start and end time of the period during which unsupervised driving is not permitted:

Is there a lower blood alcohol concentration (BAC) limit than is usual during the probationary period for category B drivers?

☐ Yes (BAC is lower during probationary period)

☐ No (BAC is the same for all drivers)

If you answered 'Yes', what is the permitted BAC limit for learners:

Is there a ban or restrictions on the use of mobile devices during the probationary period for category B drivers?

☐ Yes

☐ No

If you answered 'Yes', please give details:

Are there any restrictions on engine size or power output of the vehicle driven during the probationary period for category B drivers?

☐ Yes

☐ No

If you answered 'Yes', please give details:

Are there any additional restrictions (other than those already discussed) during the probationary period for category B drivers?

☐ Yes

☐ No

If you answered 'Yes', please give details:

For the three measures mentioned previously (minimum length of learning period, minimum number of on-road hours of supervised practice, restrictions in probationary period) do any of the following apply? (For measures not in place, simply leave answers blank).

	Discounts available for taking approved driver education course of some kind	Exceptions for access to work/education	Exceptions based on age
Minimum length of learning period			
Minimum number of on-road hours of supervised practice			
Restrictions in probationary period			

10. Graduated access to higher motorcycle categories

The section that follows contains questions about learner riders (Category A) and graduated access to higher powered motorcycles in your country. We would like to know more about the current practices, regulations and the impact that Directive 2006/126/EC may have had on these. Do you have some knowledge or understanding of Category A (motorcyclists) licencing in your country?

- Yes - I have at least some knowledge of Category A licencing practices in my country
- No - I have no knowledge of Category A licencing practices in my country

What is the minimum age for acquiring an A1 licence in your country?

- Under 16 years
- 16 years
- 17 years
- 18 years
- 19 years
- 20 years
- 21 years or older

What is the minimum age for acquiring an A2 licence in your country?

- Under 16 years
- 16 years

☐ 17 years

☐ 18 years

☐ 19 years

☐ 20 years

☐ 21 years or older

What is the minimum age for acquiring an A (unrestricted) licence in your country?

☐ Under 16 years

☐ 16 years

☐ 17 years

☐ 18 years

☐ 19 years

☐ 20 years

☐ 21 years or older

Are there any age-based exemptions in place in your country that allow learner riders to progress directly to a Category A (unrestricted licence) without having to go through categories A1 and A2?

☐ Yes

☐ No

If you answered 'Yes', please provide detail

Is there an official rider training curriculum in your country?

☐ Yes

☐ No

What does the official rider training include?

- [ ] Requirements for supervised on-road training
- [ ] Requirements for a minimum number of hours practice on-road
- [ ] Class-room based training
- [ ] Any other requirement (please specify)

What are the training requirements for learner riders in your country? (e.g. a minimum number of hours, attending a theoretical and/or classroom-based course) *

Are there any additional restrictions placed on riders of different Category A licences? (Please select all that apply)

	Zero or Lower BAC	Restrictions on pillion passengers	No night-time riding	No mobile phone use	Requirement to wear high visibility clothing
AM (mopeds)					
A1					
A2					
A (unrestricted)					

Are there any post-licencing training requirements for motorcyclists in your country?

- [ ] Yes
- [ ] No

What are these post-licencing requirements?

Are there any time-discounting schemes that allow riders to shorten their learner period if they undertake an additional training course or similar?

- [ ] Yes
- [ ] No

If you answered 'Yes', please provide the name/ details of the scheme

What were the key changes made to national Category A licencing regulations and/ or practice in your country as a result of Directive 2006/126/EC? (Please select all that apply)

 Changes to the age-based requirements for motorcycle riding

 Introduction of the A, A1, and A2 categories (i.e. you did not have these, or something like them, before the Directive)

 Any additional requirements for pre-licence training

 Any additional requiremens for pre-licence on-road supervised practice

 Any additional requirements for post-licence training

 Any additional requirements for post-licence on-road supervised practice

 Any other changes

Please specify:

Are there any research studies undertaken in your country which directly assess the impact of Directive 2006/126/EC on safety related measures to do with motorcyclists (e.g. crashes, violations, risk-behaviours, etc.)? (This could be published or unpublished material).

 Yes

 No

Please use this space to provide links. Alternatively you can send materials to shelman@trl.co.uk

Are there any foreseeable changes to your national strategy on Category A licencing as a result of Directive 2006/126/EC?

 Yes

 No

Please could you expand on these foreseeable changes?

21. Driving instructor competences

The section that follows contains questions about the competencies that driving instructors must have in order to be licensed to practice in your country. We would like to know more about the current practices, regulations and the impact that Directive

2006/126/EC may have had on these. Do you have some knowledge or understanding of the rules and regulations governing driving instructors in your country?

 Yes - I have at least some knowledge of the competencies and requirements for driving instructors in my country

 No - I have no knowledge of the competencies and requirements for driving instructors in my country

22.

The following questions refer to the content of the training program required for the training of driving instructors for category B licences.

Does your country have a mandatory national curriculum (syllabus) for the training of driving instructors?

 Yes

 No

Are learning objectives specified?

 Yes

 No

23.

The following section refers to the training for driving instructors, all of the questions refer to the training required for a category B licence only.

What are the minimum entry requirements (age or driving experience) for entering the training programme? (If there are no such requirements, leave the answer boxes blank.)

What is the minimum age?

What is the minimum number of years' driving experience?

What is the minimum level of general education required to enter the driver training programme? (Please select the option that applies)

 Primary education

 Junior general secondary education (no direct access to vocational colleges but direct access to senior vocational training and senior general secondary education)

 Pre-vocational education (direct access to senior vocational colleges but not direct access to vocational colleges)

 Senior general secondary education (direct access to vocational colleges but not to university education)

☐ Preparatory university education (direct access to university education)

☐ Vocational colleges

☐ University education

☐ There is no minimum required level of education

Is teaching experience required to be a driving instructor in your country?

☐ Yes

☐ No

Is a certificate in teaching required in order to be admitted to the training program for driving instructors in your country?

☐ Yes

☐ No

Do driving instructors who apply to teach category B learners need to possess other/ additional driving licences (other than category B)?

☐ Yes

☐ No

Which other licences are required for driving instructors applying for a category B licence? (Please select all that apply):

☐ All categories

☐ C

☐ D

☐ E to B

Are there specific driving record requirements for driving instructors? (Please select all that apply)

☐ Driving licence has never been suspended

☐ No conviction for driving under the influence of psychoactive substances (e.g. alcohol, ilicit drugs)

☐ No record of sexual harassment

☐ There are no specific record requirements

Do candidates who do not meet the entry requirements for the trainer programme have to pass an entry test?

☐ Yes

☐ No

25.

The following questions refer to the driving instructor test only.

Do aspiring driving instructors have to pass a theory test in order to become a qualified driving instructor?

☐ Yes

☐ No

What does this test encompass? (Please select all that apply)

☐ The rules of the road

☐ A hazard perception test

☐ Didactics

☐ Driver training methods (e.g. instruction)

☐ Learner centred methods (e.g. coaching)

☐ Other (please specify): ☐

27.

The following questions refer to the learning objectives specified as part of the mandatory national curriculum for the training of driving instructors for category B licences.

What do the learning objectives encompass with regards to driving? (please select all that apply)

☐ Driving skills

☐ Knowledge of the rules of the road

☐ Hazard perception/anticipation skills

☐ Eco-driving

☐ None of the above

☐ Other

If so please specify: ☐

What do the learning objectives encompass with regards to teaching? (please select all that apply)

☐ Didactics in general

☐ Driver training methods in particular

☐ Learning styles

☐ Learner centred training methods such as coaching

☐ Assessing the knowledge and skills of learners

☐ Adapting the teaching style and content to the need of learners and the progress they have made

☐ None of the above

☐ Other

If so, please specify: ☐

Are aspiring driving instructors taught how to apply methods, such as group discussions, that are not related to knowledge and skills which are tested in the theory test and the practical driving test? (For example, methods that are intended to motivate novice drivers to drive safely and to encourage eco driving. Other examples include methods that make learners aware of their own limitations, the dangers of drinking and driving, the dangers of distraction, peer pressure).

☐ Yes

☐ No

29.

All of the following questions refer only to the initial training programme for driving instructors of Category B licences.

In your country, is there a minimum length specified by law for the driving instructor training programme for category B driving licences?

 Yes

 No

Are there a minimum number of hours of tuition specified?

 Yes

 No

On average, how long does it take to become a driving instructor? (in months)

Do aspiring driving instructors have to pass a specialised practical driving test? (other than the practical test required for their own driving category in order to test their own driving skills)

 Yes

 No

Is there a separate practical test that assesses the teaching/coaching abilities for providing theory lessons?

 Yes

 No

Is there a practical test to assess the teaching/coaching abilities to train on-road driving skills?

 Yes

 No

31. Business competencies

In some countries business competencies are not incorporated in the curriculum, while in others they are incorporated in the basic training for driving instructors or alternatively in some countries driving instructors need to gain experience and/or need to attend additional training to become a manager of a driving school.

Are special management competencies required by law for managers of driving schools?

 Yes

 No

Is additional training required in order to become a manager of a driving school?

 Yes

 No

Are these competencies incorporated in the initial driving instructor programme?

 Yes

 No

Are these competencies tested after the initial driving instructor programme?

 Yes

 No

Is special experience required before an individual can start a driving school (e.g. experience as a driving instructor in a large driving school)? *

 Yes

 No

Are business competencies tested after driving instructors have attended a course in managing a driving school?

 Yes

 No

 Course attendance is not required

32.

The following questions refer to the provisions required to retain one's driving instructor licence.

Are driving instructors regularly tested in order to assess their competencies as driving instructors?

 Yes

 No

After how many years are driving instructors required to be retested or re-assessed?

Do driving instructors have to attend compulsory periodic training programs after they have become a qualified driving instructor?

 Yes

 No

How often is this periodic training required?

36. Requirements on medical fitness to drive

The section that follows contains questions about the requirements relating to medical fitness to drive in your country. We would like to know more about the current practices, regulations and the impact that Directive 2006/126/EC may have had on these. Do you have some knowledge or understanding of requirements on medical fitness to drive in your country?

 Yes - I have at least some knowledge of the requirements relating to medical fitness to drive in my country

 No - I have no knowledge of the requirements relating to medical fitness to drive in my country

What are the procedures for medical practitioners in your country for identification and action when confronted by a medically- or age-impaired patient?

Are there any guidelines available for medical practitioners to assist them when confronted with a potentially risky patient (in terms of the risk they may represent when driving)?

 Yes

 No

Do you or your country believe there is a need for a guideline for medical practitioners to assist when confronted with a potentially risky patient (in terms of the risk they may present when driving)?

 Yes

 No

What procedures are used in your country for assessing fitness to drive? (Please provide links to documents or procedures or a description.)

What screening tools are available in your country for use by licensing authorities and others for assessing fitness to drive? (Please provide links to documents or tools, or a description.)

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