



HAL
open science

Vers un permis de conduire progressif en Europe : revue de la littérature sur les pratiques et leurs effets, et recommandation pour un modèle idéal

Sofie Boets, Jean-christophe Meunier, Ludo Kluppels

► To cite this version:

Sofie Boets, Jean-christophe Meunier, Ludo Kluppels. Vers un permis de conduire progressif en Europe : revue de la littérature sur les pratiques et leurs effets, et recommandation pour un modèle idéal. RTS. Recherche, transports, sécurité, 2017, Formation à la conduite, 2016 (01-02), pp.81-96. 10.4074/S0761898016002089 . hal-01670584

HAL Id: hal-01670584

<https://hal.science/hal-01670584v1>

Submitted on 21 Dec 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Implementing graduated driving license in Europe: literature review on practices and effects, and recommendation of an ideal model

Vers un permis de conduire progressif en Europe :

revue de la littérature sur les pratiques et leurs effets, et recommandation pour un modèle idéal

Sofie Boets · Jean-Christophe Meunier · Ludo Kluppels

© IFSTTAR et Éditions NecPlus 2016

Résumé Des systèmes de permis de conduire par étape (*Graduated Driving License* - GDL) sont appliqués depuis des décennies aux États-Unis, au Canada, en Australie et en Nouvelle-Zélande. Ces systèmes GDL comprennent habituellement trois phases. Au cours de la première phase (d'apprentissage), le candidat-conducteur peut uniquement conduire un véhicule s'il est accompagné d'un conducteur expérimenté, ce qui lui permet de vivre différentes situations de trafic en étant supervisé. Durant la deuxième phase (pratique indépendante), le candidat-conducteur peut conduire seul dans la circulation mais sous certaines restrictions strictes : il ne peut par exemple pas conduire la nuit ni accompagné de passagers du même âge. Cette phase permet au conducteur d'automatiser certaines capacités de conduite tout en évitant des situations spécifiques comportant un risque accru. Pendant la troisième phase, l'on dispose d'un permis de conduire sans restriction même si des sanctions plus sévères sont prévues dans certains cas. Le système GDL a pour but de permettre aux candidats-conducteurs d'acquérir progressivement de l'expérience de conduite tout en étant moins exposés aux situations de trafic à risque. L'idée derrière ce concept est d'« apprendre par l'expérience ». Bien que des systèmes européens se concentrent généralement sur un « apprentissage au travers d'instructions (professionnelles) », l'on a observé une attention accrue pour les approches GDL au cours des dernières décennies. Ceci est dû à l'opinion croissante

selon laquelle apprendre à conduire dans la circulation en toute sécurité requiert une longue période d'apprentissage et beaucoup de pratique. Par ailleurs, ceci correspond également aux points de vue concernant les objectifs de niveau supérieur pour la formation des conducteurs (*matrix Goals for Driver Education* - GDE). Cette étude synthétise la littérature récente sur l'efficacité des systèmes GDL et sur les tendances actuelles observées en Europe concernant la structure GDL. Des recommandations ont été formulées et une structure idéale pour la catégorie B (voiture) formation des conducteurs a été proposée.

Mots clés permis de conduire par étape · GDL · conducteurs jeunes/novices · formation des conducteurs multiphase

Abstract Graduated Driving License (GDL) systems are since many decades applied in the USA, Canada, Australia and New-Zealand. GDL-systems traditionally include three phases. During the first “supervised learning” phase the learner driver can only drive a vehicle when accompanied by an experienced driver. This allows experiencing different traffic situations while being supervised. In the second “autonomous practicing” phase the learner driver can drive alone on the road but under strict restrictions, like no driving at night or with passengers of the same age. This allows automating some driving abilities while avoiding specific situations with increased risk. In the third phase one has a full driving license without restrictions, although sometimes more severe sanctions are foreseen. The idea behind GDL is allowing learner drivers to gain driving experience gradually and with less exposure to risky traffic situations. The main idea behind is “learning through experience”. Although European systems traditionally focus on “learning through (professional) instruction”, an increased attention for the GDL-approach is seen the last decennia. This is related to the increased opinion that learning to drive safely in traffic does require a long learning time and much practice, and this also goes along with insights on higher

Sofie Boets (✉)

Institut Belge pour la Sécurité Routière, Centre de Connaissance Sécurité Routière, Chaussée de Haecht 1405, 1130 Bruxelles, Belgique e-mail: sofie.boets@ibsr.be

Jean-Christophe Meunier (✉)

Institut Belge pour la Sécurité Routière, Centre de Connaissance Sécurité Routière, Chaussée de Haecht 1405, 1130 Bruxelles, Belgique e-mail : jean-christophe.meunier@ibsr.be

Ludo Kluppels (✉)

Institut Belge pour la Sécurité Routière, Centre de Connaissance Sécurité Routière, Chaussée de Haecht 1405, 1130 Bruxelles, Belgique e-mail: ludo.kluppels@ibsr.be

order driver educational goals (Goals for Driver Education matrix–GDE). This article synthesizes recent literature on effectiveness of GDL-systems as well as on current tendencies in Europe that approach the GDL-structure. Recommendations are formulated and an ideal structure for category B¹ (car) driver education is proposed.

Keywords graduated driving license · GDL · young/novice drivers · multiphase driver education

Introduction and context

1.1 GDL systems worldwide

The Graduated Driver Licence (GDL) is a measure that targets a gradual acquisition of experience and opportunities to practice. The classic GDL system like in North America, Australia and New Zealand contains the following phases [1–3]:

1. Supervised learning phase limited to accompanied driving for the whole period by (mostly) one of the parents.
2. Autonomous learning or practice phase (interim phase) during which it is possible to drive unaccompanied under conditions where there is little chance of an accident. The restrictions imposed often include a ban on night-time driving and on driving with teenage passengers (peers). In most instances a zero tolerance applies to driving under the influence of alcohol (except in the US where alcohol is forbidden anyway under the age of 21).
3. Unrestricted, full driving license. At this stage the driver has a full driving license and may drive everywhere without any restrictions.

The first GDL systems were introduced in the late 1980s and early 1990s [4]. The basic concept is that learners begin to drive under relatively safe conditions and gradually gain experience in more complex or higher risk situations [4]. Different forms of GDL are applied all over the world. The entry age, imposed restrictions, number and duration of the GDL phases vary greatly depending on the country and continent.

¹Category B driving license is in use in the member states of the European Economic Area (European Union, Iceland, Liechtenstein and Norway) and in Switzerland. Category B is the most common license allowing to drive a car with passengers. More specifically motor vehicles of this category are vehicles with a maximum authorised mass not exceeding 3,500 kg and designed and constructed for the carriage of no more than eight passengers in addition to the driver; motor vehicles in this category may be combined with a trailer having a maximum authorised mass which does not exceed 750 kg.

The classic GDL system as such cannot be found in European countries. In Europe there is much more emphasis on driver education [5] but in recent years there is an increased interest in multiphase systems for driver education. A lot of countries are also starting to introduce a provisional or probationary driving license after learners have passed a practical driving test. During the term of this license learners may drive unaccompanied, but they are subject to a number of restrictions or stronger consequences if they breach the rules [3,6]. In this way European member states are integrating the underlying philosophy and a few specific aspects of the classic GDL system into their driver education system; even though they do not issue a specific (phase-related) driving licence.

1.2. Objectives and functions of GDL

The overrepresentation of learner drivers involved in serious accidents is caused by several aspects [7]. The risk of these accidents decreases rapidly during the first months after obtaining the driving license [8]. This downwards trend is more or less the same irrespective of the age that the driving license is awarded [9]. Research consistently shows that experience (the number of kilometres driven) is more important than age [7].

GDL systems were introduced progressively in North America, New Zealand and Australia in order to reduce the increased risk of accidents among young drivers. The goal behind adopting a phased approach of moving from learner drivers to fully-fledged drivers is to tackle the most important factors in accidents that are associated with age, lack of experience and a tendency to risk-take among learners and young drivers, by in the first instance limiting exposure to risky situations so that gradually via increased experience and maturity, they are able to master more difficult situations [10]. The basic idea behind GDL therefore is, in the first place, to guarantee sufficient driving experience, under safe circumstances, before awarding the definitive driving license. The core issue here is that increased practice/experience in different basic skills must be automatic before drivers are confronted with more complex situations. Automatic skills are manoeuvres that can be handled speedily and they require less mental effort. This means that the learners can focus more consciously on higher order skills such as risk perception and calibration (task requirements versus task competences). This approach breaks through the *paradox of young drivers*. In order to get beyond the period of risk, young drivers need to acquire experience and in order to acquire this experience, they have to be exposed to traffic risks. The GDL system allows them to acquire driving experience gradually without drastically increasing the risk of an accident [11].

The reason behind the introduction of GDL in the other continents was surely also aimed at putting off the moment of unaccompanied driving until the drivers are older—in these countries this was often from the age of 14-15 [12]. The GDL system replaced the original laws that allowed for a quick and easy access to unrestricted driving [13].

1.3. Link with formal driver education

Despite of a few recent changes in Europe, we notice that there is nevertheless a big difference in terms of the traditional focus and approach towards acquiring a driving license in Europe compared to the approach adopted on other continents. Where the other continents were increasingly interested in GDL systems with supervised and long practical phases, in Europe there was an increased interest in the theoretical aspects of driver education as reflected in the “Goals for Driver Education” (GDE) [14], and the curricula and driving tests that are based on this [12].

In recent years we have seen a renewed interest both in North America as well as Australia in formal driver education [15,16]. This renewed interest is attributed to the fact that a graduated driving license results in a reduction in the number of accidents in the restricted periods of this license, but does not or hardly does in the period immediately thereafter. In order to replace this, new proposals have been drawn up for driving lessons that focus mainly on learning higher order skills such as identifying dangers, being aware of risks and an ability to really assess one's own competences [3].

2. Impact of GDL systems

This section provides an overview of the most important findings from recent literature about the effectiveness of full GDL systems as well as of individual GDL components.

By *effectiveness* we mean the degree to which a GDL system contributes to traffic safety, and in particular among young drivers. GDL effectiveness is often evaluated against indicators such as (reduction in) accidents, and fatal and serious injuries among young drivers.

It is worth noting that effect studies of GDL systems are often subject to a number of limitations so that it is difficult to understand which GDL components or processes are actually responsible for the observed effect. This is partly due to the wide variety of systems in the different countries and partly also due to their complex “ecological” nature: the system is namely applied among big populations where other factors also play a role. As a result, some variables in the studies cannot be controlled for and intervening

factors shed doubt on the validity of the results and thus prevent researchers from identifying strong links. The fact that programmes are continually changing is an additional factor that makes comparison difficult. On the other hand Russel et al. [4] indicate that revisions of GDL programmes rather offer more possibilities for studying the different components within the programme of specific regions. It is also noticed that evaluation methods and statistical analyses in the different studies vary greatly, from less reliable and simple pre-post comparisons without control groups to strong analyses with time series [17]. This also hampers the task of making meaningful comparisons.

2.1. Effects of comprehensive GDL programmes

As a general rule effect studies of GDL systems (based principally on US data and to a lesser degree Canadian, New Zealand and Australian data) reveal a reduction in the number of accidents and victims among young drivers during the GDL phases in question. This reduction varies strongly according to the region or the country where the system was introduced and how extensively the system was integrated [3,4,17].

The most recent studies show that the most comprehensive systems (e.g. with regards to restrictions) have a positive impact on accident statistics of age groups subject to the system. In more advanced GDL programmes reductions in fatal accidents among 16-year olds of 26% [18] to 41% [19] were observed. The impacts of GDL also seem to differ according to the age of the young (learner) drivers.

Most GDL evaluations show a sharp drop in accident figures among 16-year old drivers [e.g. 4,18-21].

Russell et al. [4] did a Cochrane literature review based on 34 studies that evaluated 21 GDL programmes (US, Canada, New Zealand, Australia), and two analyses of more than 40 US states (until May 2009). They showed reductions in accident data in all jurisdictions and for all types of accidents (deaths, injuries, material damage) The results were the most pronounced among 16-year old drivers (compared to all teenagers: aged 15-19). Only studies on full GDL programmes, with a pre-post design and/or a control group, which compared accident data on 16-year olds and more generally on teenagers (under the age of 20) were included. The basis for comparison was the proportion of accidents in the last year before the introduction of GDL. The general percentage of accidents among 16-year old drivers dropped by 36% and 34% in the subsequent years (mean; % per 10,000 16-year old driving license holders). The proportion of deaths among 16-year old drivers dropped by 59% in the first year after the introduction of the GDL system; in the subsequent years, this reduction shrank back to 33%. This review underlines above all the great

impact of GDL on 16-year old drivers—the age at which many teenagers in the GDL programmes are undergoing the supervised learning phase [4]. The results relating to fatal accidents for all teenagers (under the age of 20) were less positive with a reduction of 12,5% in the first post-GDL year and 18% thereafter.

In their meta-analysis, Williams et al. [13] also found a reduction of 15.5% to 22% in the number of fatal accidents and accidents involving injuries among 16-year olds after the introduction of a comprehensive GDL system with a minimum entry age of 16 compared to the situation beforehand whereby 16-year olds, after a short driver education and having passed their driving test, were able to drive unaccompanied. A decrease of between 6% and 9% was observed among 17-year old drivers. Whereas an impact of 0-3% was observed during the subsequent period (provisional driving license). Another meta-analysis of 12 studies from 11 American states and one Canadian province produced the same observation: the number of traffic accidents involving 16-year old drivers dropped by 22% after the introduction of GDL. This figure was just 6% for 17-year olds and for 18-year old drivers there was no impact [22].

This overview indicates that there is less evidence of positive effects of GDL on 17-year olds than on 16-year olds. The literature suggests that the impact of GDL on 17-year-olds is still positive, but less than on 16-year olds. One possible explanation for this lower result among 17-year-old drivers is the composition of this group. While 16-year old drivers are forcibly still in the first learning phase and 18-19-year old drivers are in the final phase, it is difficult to define exactly where the 17-year old drivers are. Their exposure to GDL phases can vary strongly: from still being in the learning phase to being in the provisional driving license phase and this can have an impact on accident statistics [21].

Different effect studies on GDL also include the impact on 18-year old drivers. 18-year olds in the US are in general no longer subject to GDL restrictions. Williams & Tefft [23] studied the numbers of fatal accidents involving teenage drivers between 1990 and 2011, based on 49 American states and the District of Columbia. These are states where the GDL system was introduced during this period. One remarkable finding was that no impact at all, neither positive or negative, was found among 18- and 19-year olds: the age at which it is possible to drive autonomous without any restrictions, which implies higher risk situations. Moreover, the involvement in accidents for this age group remained greater than for younger and older age groups. A very recent meta-analysis of 14 GDL effect studies in the USA since 2001 that studied the impact of GDL programmes on accidents among 15-20-year old drivers produced the same findings. The results show that GDL programmes

generally show a reliable significant accident reduction of 16% for 16-year olds and of 11% for 17-year-olds. They also found that there was no reliable change in accident statistics involving 18- to 19-year old [20]. Zhu et al. [22] suggest that further research is needed to ascertain why GDL programmes (and more specifically certain GDL components, see later) sometimes seem to have a negative impact on 18-year-old drivers. Aside from that, some sociological theories [24–26] have suggested that risk taking behaviours are culturally rooted and collectively assumed by the population (which may be especially the case for young drivers). In light of that, GDL is thought to prevent young driver from taking driving risk—because of its rules and restrictions—but it may be assumed that culturally and sociologically rooted risk-taking attitudes still exist and may be expressed elsewhere than on the road. At the same time, such theories may explain why benefits of GDL drop down and even disappear as soon as young drivers are no longer submitted to its rules. However, such theories haven't yet been empirically tested within the context of the GDL.

2.2. Impact of GDL components

There has been a recent increase in effect studies that focus on components of GDL systems [e.g. 2,17,20].

Senserrick & Williams [17] carried out an extensive literature study on the effectiveness of GDL programmes and in particular on the relative impact of each component. They came to the conclusion that the best and most effective components are:

- An initial learning phase with supervision that starts at the age of 16 (not younger) and that lasts for a minimum of 12 months, with a considerable number of supervised hours (80-120 hours).
- A second phase (interim or autonomous practice phase) that starts after the age of 16 (knowing that the effectiveness increases as the minimum age increases) and subject to the following restrictions:
 - Widespread ban on night-time driving (starting no later than 21h00-22h00)
 - Forbidden to take passengers in the same age group.
 - Zero tolerance for alcohol
- Introduction of an advanced assessment (such as a risk perception test or an exit test).

With regard to the minimum duration of the supervised learning phase (in most GDL countries 6 to 22 months) the study of Masten et al. [27] showed a clear reduction in the number of accidents during a learning period of 9 to 12 months compared to shorter periods. Such longer learning phases led to a decrease in the number of fatal accidents of

26% among 16-year-olds and of 17% among 17-year-olds. A learning period of four months or less resulted, as for cases where there was no required minimum period, did not produce a reduction in the number of accidents. Periods of five to six months were associated with a moderate reduction in the number of fatal accidents (11% reduction among 16-year-olds and 9% among 17-year-olds). Periods over and above 12 months were not included in this study.

With regard to the mandatory minimum number of hours and/or kilometres of supervised driving, we note that this varies strongly: from no minimum (e.g. Australia Capital Territory, New Zealand) to as much as 120 hours (e.g. Victoria in Australia). In general the limit is often 40 to 50 hours (most US states and part of Australia). The recent reviews of Mayhew et al. [2] and Senserrick & Williams [17] came to the conclusion that the optimal threshold lies between 80 to 100 hours (or 5,000 km) and 120 to 140 hours (or 7,000 km). It seems that the advantage in terms of experience outweighs the increased accident risk caused by the increased exposure.

With regard to the minimum entry age for driving unaccompanied for the first time (individual practice phase or provisional driving license) studies repeatedly show that a later entry age leads to a decrease in the number of accidents [28]. Some studies show that an entry age of 17 years instead of 16 or 16,5 lead to a substantial reduction in fatal accidents (9% to 23%) [e.g. 18,19,27,29]. Consistent with this finding brain related research indicates that at the age of 16, both the impulsiveness as well as the susceptibility to distraction are increased. This supports the notion that it is better to drive independently at a later stage [30].

The effectiveness of a restriction with regard to driving at night during the first phase of unaccompanied driving (or provisional driving license) was demonstrated in a great number of studies [e.g. 20,31]. The meta-analysis carried out by Masten et al. [20] revealed that restrictions regarding driving at night are effective among 16- and 17-year old drivers, with 17% and 14% reductions respectively in the number of accidents, which does not apply to 18- and 19-year olds (possibly because they are no longer subject to the GDL restrictions). The relevance of this restriction is supported by the observation that the risk of a fatal accident at night is approximately twice as big as during the day [32]. Research also shows that a ban on driving at night is indirectly targeted at alcohol-related accidents: 88% of all alcohol-related accidents among 16- and 17-year olds happen at night and/or with passengers in the vehicle [33].

The effectiveness of restricting passengers is revealed in different studies [e.g. 34,35]. Studies also underline the fact that with regard to the *number of* passengers allowed, the risk is greatest when there are several passengers present. The study carried out by Tefft, Williams & Grabowski [36]

for example noted that one single passenger under the age of 21 in the vehicle with 16-17-year-old drivers resulted in an increase of the number of deaths per thousand kilometres driven of 44% compared to solo drives. With two passengers of the same age, this figure doubles and with three or more passengers, the result increases by as much as four times. "Naturalistic driving" studies highlight the reasons why taking young passengers along causes the risk to increase so strongly. Young passengers tend to cause an increase in distracted behaviour among young drivers such as loud discussions, playful behaviour, a tendency to drive fast, to tailgate, to show off and to brake sharply [37]. Other studies looked into whether a total ban or a restriction to just one passenger should be sought. The restriction of just taking one (young) passenger along would be adhered to better than a complete ban. The debate on this subject is not yet closed as different studies have produced different results, sometimes in favour of a complete ban regarding passengers [e.g. 19], and sometimes in favour of the presence of one single passenger [e.g. 18,20]. Results from several studies regarding the *age* of passengers, suggest that the highest risk emerges when young drivers take along passengers in their own age group. While some studies found that there was an increased risk even with passenger up to the age of 34 [38], Tefft et al. [36] found that the presence of at least one passenger over the age of 30 reduced the risk of an accident by 62%.

In general, a BAC (Blood Alcohol Concentration, in gram per liter) restriction leads to a significant reduction in the number of alcohol-related accidents among young drivers in the solo driving phase with restrictions [39,40]. In one review, six studies from North America with clear scientific criteria for design and execution were retained [41]. These showed a reduction of 4% to 24% in fatal or serious accidents, or in related indicators (such as violations involving driving under the influence as observed by the police) resulting from a lower BAC limit (zero tolerance) among drivers under the age of 21. These effects were less significant or disappeared altogether among learner drivers that were no longer subject to these restrictions. There are sufficient indications that a zero tolerance limit offers more advantages than any other limit (even when compared with a very low BAC limit of 0,2 g/L). An analysis of six studies carried out in Australia and the USA among drivers aged between 15 and 21 revealed that in states with a zero tolerance policy, there was an average reduction in night-time unilateral accidents of 17% compared to a reduction of just 17% in those jurisdictions where a 0,2 g/L limit was in place (and even just 7% reduction when the BAC limit varied between 0,4 and 0,6 g/L) [42]. Moreover, research in New Zealand estimates that the risk of an accident among young drivers doubles with each increase

of 0,2 g/L BAC. This increases even further during the night and with each additional passenger [43]. And finally, there is also considerable evidence that even low BACs have a negative impact on driving behaviour, including on observation, psychomotricity, attentiveness, vigilance and sleepiness [44] and that these effects are greater among young, novice drivers than among older more experienced drivers [45].

Senserrick & Williams [17] highlight some more components which were so far not sufficiently studied, but which could have a potentially reductive effect on the number of accidents or unsafe driving behaviour. These are:

- Inclusion of educational programmes targeted at possible shortcomings in cognitive skills like risk perception for instance.
- Working on the proper resistance and/or encouraging involvement of parents in the learning process (e.g. with regard to complying with the restrictions).

Some elements require further research before conclusions can be drawn on their effectiveness: optimal requirements for supervisors, optimal duration of the second (solo practice) phase, specific measures in case of violations (such as speeding, driving under influence). There also are a number of elements that seem to have no effect or in best-case scenarios have a very limited effect: educational programmes focussed on knowledge, attitudes and awareness; restrictions relating to the engine capacity of the vehicle. And finally, some studies indicate that a number of elements could even be counter-productive: educational or training programmes that reduce the duration of the first and/or second phase, specific speed limits for novice drivers [2,17].

One important factor that relates to the effectiveness of GDL systems is the compliance with all conditions and restrictions of learner drivers. Even a very strong GDL programme can be ineffective without adequate and consistent enforcement [4]. It is of essential importance therefore to have a guarantee that sufficient measures are taken to promote the compliance (besides enforcement, also for instance programmes to generate awareness or specific educational programmes, etc.). In Australia all drivers with a provisional driving license (second phase) are obliged to attach a P plate to their vehicles. This makes drivers who are still driving under certain restrictions immediately identifiable and therefor a greater compliance is expected of them. Most Australian jurisdictions also allow random police checks, which is not the case in North America (with the exception of New Jersey where P plates are also compulsory) [see 46]. In North American jurisdictions, drivers can only be checked if there is a clear traffic offence.

Besides that, parents can also play a crucial role in the effectiveness of a GDL system [17].

3. Current situation in Europe

3.1. General characteristics of the different European driver education programmes²

The principal reviews on which this overview is based, are Genschow [5] and Pesić [47]. The combination of these two studies allows to provide a reasonably detailed overview of 28 European countries (Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Macedonia (MK), Malta (MT), Norway (NO), Poland (PL), Portugal (PT), Serbia (RS), Slovakia (SK), Slovenia (SI), Sweden (SE), the Netherlands (NL), United Kingdom (UK)).

Each European driver education system originally included just two phases. The first was a supervised learning phase, accompanied either by a professional driving instructor or by a non-certified supervisor. Then there was a practical driving test, preceded by a theory exam, and if the learner succeeded s/he was awarded a full driving license (2nd phase). The GDL interim phase or the autonomous practice phase did not apply.

In most European countries a number of elements from the GDL autonomous practice phase have now been introduced during the first years of the full driving license. A number of restrictions can be applied during a specific period (e.g. lower BAC limit or lower speed limits) sometimes in combination with stricter penalties (more demerit points, compulsory course in case of certain offenses, extension of the provisional driving license or a policy of “back to the start”). This implies in fact a certain kind of interim phase, even though drivers already have a full driving license. The learning process is extended in a way because learner drivers are still protected through a number of restrictions.

A second important difference between the European systems and the classic GDL systems is the duration of the learning phase. In most European countries it is possible to complete the whole cycle from the learning phase to obtaining a normal driving license in one to two years, whereas the time required to obtain a full driving license in a GDL system is more like three to four years. This is a reflection of course of the basic principle behind the

²This part is based on the legislation in the different European countries which was in force until the end of 2014.

system. In the classic GDL systems, it is assumed that the best way to learn involves acquiring lots of experience that is gathered in different and increasingly complex situations. The practice element is crucial. Most European systems originally assumed an educational optimism. This refers to a belief that the best way to transfer driving skills is via instruction, providing insights and teaching the right ways to handle. Over the past decade though it has been acknowledged more and more in Europe that experience and longer practice are also crucial factors.

And finally, in Europe the aim is to obtain a driving license for independent driving at the age of 18, which is also the age in most countries when people are granted the legal status of “adult”. Nowhere in Europe there is a higher minimum age and also the age at which practical driving lessons can begin is not before the age of 16.5 (with the exception of France where one can already start at 15.5). In the classic GDL systems the entry age is more often before 16 and it is often possible (via the autonomous practice phase) to drive unaccompanied at around the age of 16.

In the following parts we discuss in greater detail how the different possible phases are organised in Europe and include the results of available evaluation studies.

3.1.1. Supervised learning phase

The learning phase is split up in most countries into one phase in which the learner driver prepares for a theory test and a phase in which one prepares for the first practical driving test.

Theory lessons. Theory lessons focus mainly on knowledge of the Highway Code and the principles of safe anticipative driving. In almost half of the 28 countries, these lessons include a First Aid course. In 18 countries, compulsory professional lessons are provided in order to acquire this knowledge. However, there is a great variety in the number of compulsory driving hours from a minimum of seven hours in Portugal (subject to following an additional official e-learning programme) up to 60 hours in Lithuania (most of which is included in state education). In a number of countries some of these lessons form part of the education curriculum, partly compulsory and partly as an additional optional subject.

In most countries it is only possible to move on to practical driving lessons after one has passed the theory test. In some countries, the theory test is carried out at the same time as the practical driving test.

Practical driving lessons. Almost all European countries impose a minimum number of hours with a driving instructor. Only in four of the 28 countries, it is possible

to obtain a full driving license without the intervention of a professional driving instructor (Belgium, Italy, Malta and the United Kingdom (UK)). We also see a great deal of variation when it comes to compulsory professional lessons ranging from a minimum of six hours in Norway to 42 hours in Slovenia. In the Netherlands sometimes even 50 hours are mentioned, but that is not a compulsory limit. Nevertheless this is a very short period to practice sufficiently and to gather a number of basic automatisms. In spite of this, different countries have extended the supervised learning phase by adding the possibility of working with a non-certified supervisor.

A number of countries (Germany (BF17), Ireland, Latvia, Lithuania) offer the option, besides the professional driving lessons, to further exercise the practical driving in real traffic with a non-certified supervisor, without the need for an agreement or integration between both. In countries like Luxembourg (CA), Norway, Austria (L17) and Portugal there is some form of collaboration between professional instructors and non-certified supervisors. In Portugal this involves just filling in a logbook that can be inspected by the professional instructor who provides the 12 hours of compulsory driving lessons. In Luxembourg there has to be a logbook, but the non-certified supervisor must also follow two hours of the compulsory driving lessons for the learner driver. In Norway and Austria, different feedback moments are planned during the extended accompanied driving stage.

In all of these cases, there are specific requirements for the persons that accompany the learner driver: with regard to age, driving experience, absence of serious traffic offenses. A certain relationship (family member) should also exist between the learner driver and the non-certified supervisor.

The combination of a professional driving instructor with a non-certified supervisor leads to a longer supervised learning phase which then often reaches a full year.

3.1.2. Autonomous learning/practice phase (interim phase)

As has already been indicated, this phase did not exist originally in Europe. After the supervised learning phase and having passed a driving test, a full (European) driving license was awarded. A large number of countries have gradually introduced specific stipulations that apply to the first phase of the full driving license. This way a kind of interim phase was introduced without foreseeing a specific type of driving license and without having to pass another driving test at the end of this period. In some countries, the term “provisional driving license” is used though.

The specific stipulations can on the one hand be restrictions to prevent exposure to risky situations and on the other hand also more strict sanctions can be imposed

ensuring that novice drivers get a quick strong warning for smaller offenses.

Full driving license with restrictions during an initial period. In most European countries a number of extra measures are taken within the first years of the full driving license with the aim of channelling the driving behaviour of novice drivers. In 17 (DE, EE, FR, GR, IE, IT, HR, LV, LT, LU, MK, NL, AT, PT, RS, SI, SE) of the 25 European countries covered in this article where this system is in place, the measures include restrictions such as a lower BAC limit, speed limits below the official limits or a ban on driving at night and during the weekend. In two of the countries there is also a limit on the engine capacity of the vehicle (Croatia and Macedonia).

A lower BAC limit is defined as zero tolerance. Although there are cases where 0,2 g/L is the norm, this is more related to technical considerations with regard to measurement and it actually comes down not drinking any alcohol when driving.

Remarkable are the six countries where a speed limit applies (Estonia, France, Italy, Croatia, Lithuania and Macedonia). The maximum speed limit there for novice drivers is 70 or 100 km/h depending on the road category. In Croatia and Macedonia this is also linked to a restriction in engine capacity of the vehicle (< 80 kW and < 75 kW respectively).

A ban on driving at night is in place in just three countries (Latvia, Macedonia and Serbia).

The restrictions in the European autonomous phase are much lower than the restrictions recommended in the classic GDL programmes. This is perhaps associated with the age. In the classic GDL programmes in the USA and Canada these restrictions only generally apply up to the age of 18 (the autonomous learning phase is usually between 16 and 18). In Australia however, there are states where restrictions also apply after the age of 18.

Novice drivers who are subject to these restrictions are not obliged to put special learner plates on their vehicles in all countries. This often presents a problem as to the enforcement of these restrictions. In Ireland a law came into force in August 2014 obliging novice drivers to put clearly visible N plates on their vehicle for the first two years of their full driving license.

Full driving license with stricter penalties during an initial period. In 20 countries (BE, DK, DE, EE, FI, FR, IE, IT, LV, LU, MT, NL, NO, AU, PL, PT, SI, SK, UK and SE) there is only a stricter reaction in the event of an offence. This includes imposing stricter normal penalties (such as loss of demerit points, faster withdrawal of the driving license), extension of the period of restrictions or restarting

the complete or partial education, or an obligation to follow an additional course. Table 1 provides an overview of the stricter sanctions in an initial phase of the full driving license (in GDL terms: autonomous practice phase) in the 20 European countries.

Duration of the specific period. In the countries where a period with restrictions and/or stricter penalties after obtaining the full driving license is applied, this period usually lasts two to three years. We found an exceptional situation in Slovenia where this period lasts five years.

Compulsory feedback courses. During this first period of autonomous driving with a full driving license only a handful of countries foresee an obliged feedback moment for all novice drivers.

In Luxembourg novice drivers are obliged to follow a one-day course between 6 and 9 months after obtaining their license. The goals of this day are: 1. self-reflection about own risk, 2. gaining awareness about specific risks and 3. gaining a real picture of specific technical aspects such as braking distance, safety distance and preventing situations that could cause loss of control of the vehicle. In Austria two return sessions are foreseen for the category A driving license (motorbike) and category B driving license (cars): a "Safety Training" between the 3rd and 9th month and a feedback drive between the 8th and 12th month. In addition to a number of technical skills related to observing, identifying risk and the engine capacity of the vehicle, group discussions are also held that are facilitated by a traffic psychologist. These group discussions cover overconfidence, recognising own risk and typical accidents among novice drivers. Slovenia obliges novice drivers to follow an improvement training course within 24 months of obtaining their driving license. The goal of this course is twofold: firstly to learn skills that will enable them to drive safely and secondly to generate awareness about a safety-oriented attitude. In Finland novice drivers follow a safety training course after minimum six months. This training session takes two days and includes both theory and practical elements. The emphasis is on identifying risks.

Evaluation studies are carried out in a few countries. In Austria, the number of accidents involving young drivers fell by almost 12% after the introduction of their course [48]. In Luxembourg the first evaluation was rather disturbing: there was no significant difference among men and among women there even was an increase in the accident risk [49]. Following these results, the content was heavily changed: more focus on risk perception and not anymore on teaching driving skills. In Finland a significant drop in the risk of accidents was observed after the second year of autonomous driving [50].

Table 1 Stricter penalties in place in the first period of the full driving license.

| Stricter penalties | More demerit points | Faster withdrawal of driving license | Redoing exams | Extension of period | Other |
|--------------------|------------------------------|--------------------------------------|-----------------------|---------------------------|---|
| Belgium | | yes | in case of withdrawal | | |
| Denmark | yes | | | | in case of driving under influence course |
| Germany | | | | | |
| Estonia | | | | yes | |
| Finland | yes | | | | |
| France | | | | | course |
| Ireland | | yes | | | |
| Italy | yes | | yes | | course |
| Latvia | yes | | possibly | yes | |
| Luxembourg | | | | yes | |
| Malta | | | yes | everything all over again | |
| The Netherlands | specific system ³ | | yes | | course |
| Norway | | | | yes | |
| Austria | yes | | | | |
| Poland | yes | | yes | back to first phase | |
| Portugal | | yes | | | |
| Slovenia | yes | | | | |
| Slovakia | yes | | | | course |
| United Kingdom | yes | | | | |
| Sweden | | yes | yes | | |

3.1.2. The full driving license phase

After a period of autonomous driving with specific restrictions and/or more severe rules, European countries automatically award a full driving license. In certain countries (BG, HU and CZ) this change takes place earlier, after passing a practical driving test and no provisional driving license is awarded. In these countries one can have a full driving license at the age of 18 at the earliest. In other countries learners also get an official driving license at the age of 18 (or earlier), but they remain subject to restrictions/stricter penalties until they are at least 19-20 years of age.

Advanced training courses. A large number of European countries offer a range of voluntary advanced training courses for novice drivers. Some of the courses are promoted by insurance companies that offer lower premiums after following a course. In Bulgaria, France, the Netherlands, the United Kingdom, Sweden and Germany, these additional

courses are in line with the driver education and are officially accredited by the corresponding government authorities.

The European ADVANCED study [50] provides a complete overview of the different possibilities and goals and also makes an evaluation of these courses. The evaluations do not provide a clear picture however. Advanced training programmes that focus exclusively on teaching driving skills within a short time frame, like recovering a car from a slip situation, seem in fact to have more negative effects. Drivers become too self-confident and are more likely to take risks. What does seem to work are courses that are based on insight, particularly about oneself and risks caused by one’s own driving behaviour. Analysis of one’s own driving behaviour and group discussions about the potential risks and how to avoid them seem to work (see feedback courses in Austria for example). However, de Craen & Twisk [51] suggest that teenagers may experience this as an increase in their driving skills anyway. Attention to such side effects is thus very important and requires teachers to have a specific attitude and didactic skills. This is why there is a demand that this type of

³The Netherlands only have a demerit point system for novice drivers.

training is supervised by at least one person qualified in psychology.

Time restriction of the driving license. In most European countries a driving license is for life. It is assumed that all driving license holders are sufficiently self-critical to be able to adjust their driving behaviour, driving skills and traffic knowledge to the changing circumstances. In Spain, Romania, Hungary, Latvia, Estonia and Lithuania there are however regular medical checks [52]. Portugal is also working on introducing such a regular screening. On their 30th birthday, all drivers must apply for a renewal of their driving license and this is repeated every 10 years until the age of 60 when this process must be repeated every five years until the age of 70 when it changes to every two years. In most European countries the medical check is only carried out among older drivers (The Netherlands, Luxembourg, Denmark, Finland, Ireland, Slovenia, Slovakia, Italy, Greece, Czech Republic, Malta, Switzerland). In Sweden and the United Kingdom, there is just an administrative procedure in order to extend the driving license for older drivers and in a number of Central European countries (Germany, France, Poland, Austria, Bulgaria), driving licenses are in principle for life. In Belgium driving licenses awarded after 2013 are valid for a limited period of time, namely ten years, but they can be extended subject to a mere administrative procedure.

3.2. GDL related components in Europe

Given the positive effects of comprehensive GDL systems in North American and Australian states, there is an increasing tendency in Europe to introduce a number of GDL elements. However, the effects of GDL systems or specific elements cannot be transferred just like that to other states or countries and need to be adapted somehow to the EU context. Notwithstanding these potential limitations, we take a critical look below at the global trends in European systems. Three aspects are focussed on: the period of accompanied driving, the introduction of a provisional driving license during the first years of autonomous driving (after obtaining the driving license) and the lifelong learning in the period thereafter.

3.2.1. The period of accompanied driving/practical lessons and the entry age

Based on the pedagogic assumption that a good professional instructor can teach the required insights and manoeuvres within a targeted and efficient educational programme, most driver education systems in Europe only allow for a

relative short phase of driving lessons. In most countries the minimum number of hours does not exceed 20. The fact that this is not higher comes down to the conviction among a great number of government authorities that the cost of driver education should not be too expensive (driver education is provided mainly by non-subsidised private schools).

Being able to drive a vehicle efficiently requires above all automatic responses [53] and this needs a long period of practice. Only when these basic skills are sufficiently automatic greater attention can be paid to insight into traffic situations, calibration and other higher order skills. Often a necessary learning period of at least six to eight months—and ideally even 12 months [2,17]—is referred to before sufficient automatism is achieved. Gaining practical experience can be achieved in a number of ways: (1) by coaching while the learner is driving; (2) by letting learners practice themselves and letting them evaluate themselves; and (3) allowing learners to practice alone and give them feedback later about their experiences and performance. Although this practical experience is best acquired while driving, certain actions and situational evaluations can also be practised via driving simulators.

Extending the period of practical driving lessons with a coach in the car (accompanied learning) is for financial reasons mostly only possible by allowing a non-professional supervisor; preferably a relation of the learner driver. We see this in all fully operating GDL systems and also in the European education systems that aim for a longer learning period. Examples of this are the “2 to drive” in the Netherlands, L17 in Austria, BF17 in Germany, “Early learning” in Estonia, “AAC” in France, Ireland, Latvia, Lithuania, the CA system in Luxembourg and Norway.

Two types of criticism often come up against using a non-certified supervisor: one being the lack of reliability about the availability of this supervisor, and particularly whether there is, and sufficiently is, practice in all types of circumstances; on the other hand whether the non-certified supervisor has sufficient pedagogic skills to teach others to drive. Different kinds of systems have been thought up in order to control the non-certified supervisors such as filling in a logbook and monitoring them for a few hours in an official driving school. Although a non-certified supervisor in a joint learning project has another role (namely practising handlings and manoeuvres) than professional instructors (their main task being to teach new manoeuvres and teaching learners to assess new situations correctly), it seems to make better sense to ensure that there is cohesion between both roles [54]. In Norway [55], and also in the L17 system in Austria [56], different feedback sessions are organised during the accompanied driving phase both with learner drivers as well as with their non-certified supervisor.

The effectiveness of a longer learning phase with a non-certified supervisor has been proved in recent studies. In Sweden [57] it was observed that including a non-certified supervisor (in addition to the professional instruction) not only led to an increase of the number of practice hours (from an average of 38 hours to an average of 117 hours), but also to a decrease of around 40% in the number of accidents during two years after obtaining the driving license. In Germany [58] there was a reduction of 17% to 36% in the number of accidents after the introduction of the BF17 system and a reduction of 15% to 26% in the number of offenses among novice drivers. These observations are in line with the North American and Australian studies on the effects of a general GDL system.

SWOV [3] indicates that the effectiveness of accompanied driving depends on a large number of factors. In addition to the number of kilometres, the quality of the accompaniment, and the variation in the trajectories, the effect of a reduction in the age is also important. European countries that have introduced accompanied driving have also lowered the entry age for driver education (e.g. NL to 16,5 years of age), but not the age at which learners can drive autonomous. Gregersen et al. [57] studied the effect of this measure on traffic safety in Sweden and concluded that the positive effect of having more driving experience exceeds the potential negative effect of age due to an earlier entry age. Lowering the entry age for driver education can, according to SWOV, have an additional positive impact because teenagers will make less use of mopeds (that present a much greater risk of traffic accidents). An analysis of Belgian data (relative risks based on the number of deaths and serious injuries per type of transport and distance travelled) revealed that the risk for mopeds and motorbikes among 15- to 17-year-olds is hugely increased compared to the average risk for car drivers [59].

Introducing a longer supervised learning period including an integration of a professional and a non-professional supervisor seem to present strong advantages. The limited reduction in the entry age would thereby not have a negative impact on traffic safety.

3.2.2. The provisional driving license during the first years of autonomous driving

Working with restrictions. Different European countries have introduced one or more restrictions during the first phase of autonomous driving (with full driving license) where a lower BAC limit and a speed limit (or engine capacity limit) are the most prevalent ones. In the GDL effect studies evidence is found for introducing a *lower BAC limit*. The European Union also supports this measure [60]. There is also sufficient scientific evidence to suggest that low

alcohol concentrations among novice drivers lead to bigger risks than among experienced drivers [e.g. 61].

No evidence was found in the GDL effect studies to support *speed restrictions*. This may even have a potential negative effects.

It is striking that in spite of the scientific consensus about the benefits of a *night-time driving ban* just three of the 28 European countries (Croatia, Macedonia and Serbia) have introduced this restriction. As already indicated, this has presumably to do with the adult age of the novice drivers in this period in Europe. Given the abundant evidence that night-time driving results in a serious increase in the risk of accidents among novice drivers it seems that this type of restriction, even at the age of 18 and older is justifiable [62]. Given that accidents are more prevalent among young drivers during the weekend, perhaps a compromise is possible so that during the first period there is a night-time ban during the weekend.

The GDL effect studies also show that a restriction regarding *passengers* can have a positive impact on the risk of accidents among young drivers. In Europe there is no single country that imposes this restriction once the driving license is gathered. Although further research on the influence of passengers produced rather contradictory results in terms of the risk of accidents [62], such a temporary restriction for novice drivers could have a positive effect. Here again a compromise of imposing the ban during the weekend, could be a first step.

A difficult issue associated with introducing restrictions is the *capacity to enforce them*. Only a few countries impose the presence of a clear plate in the vehicle during this phase. This makes it difficult for police forces to control whether the restrictions are complied to and thus the compliance can be expected to be less too. This underlines clearly the difference between a “graduated driving license system” and a “gradual driver education system”. There is a tendency in most European countries for a multi-phased education, without a specific official type of driving license linked to the phase. This makes it more difficult to apply specific conditions in the first years of autonomous driving with a full driving license.

Working with stricter penalties. As in many North American and Australian GDL systems, different European countries choose to apply stricter penalties during the first phase of autonomous driving. They hope that this stricter approach will have a certain dissuasive effect. Some countries link additional educational measures to serious offenses, either mandatory courses to follow or extending the provisional licence period. As part of a pedagogic approach to novice drivers such measures seem to be more recommended than just allocating more demerit points

and/or withdrawing the driving license and making the novice drivers retake exams. With regard to driving under the influence, there is sufficient evidence that this works, but for other wrong driving behaviour the evidence seems to be more limited [63].

3.2.3. A full driving license—then what?

In many European countries a wide range of additional educational programmes and training courses for novice drivers is offered. They are often aimed at practising specific skills with a lot of emphasis on control of the vehicle (first level of the GDE matrix). Effect studies are rather rare and do not offer uniform results [64]. Different studies [65] have revealed that the risk of negative side effects of courses where the accent is placed on driving skills, and in particular in specific situations such as slippery surfaces, is quite significant. It was proven on several occasions that overestimating one's own skills is a particularly big problem among young male drivers. Practising driving skills may well increase the competence, but it also increases self-confidence which in turn increases the risk factor. People think that they can cope with any kind of situation. These types of training programmes should not be promoted unless they are subject to a thorough quality control and then only if there is no clear evidence of possible side effects.

A number of countries demand a medical certificate before renewing driving licenses. The legal medical criteria are also important indications for evaluating the fitness to drive. They form the basis for the capacity to drive a car. Meeting these medical criteria is not enough though to warrant driving in current traffic conditions. In this sense it is better to assume three levels that are important for safe driving behaviour: fitness to drive, ability to drive and "worthiness to drive" [53].

Fitness to drive refers to the physiological, medical and psychological basic conditions required in order to handle a vehicle in a busy traffic situation, e.g. good vision and sufficient motor skills.

Ability to drive includes the mastery of a number of specific skills, like for instance knowledge of the traffic rules, risk perception, ability to react, looking and scanning skills and flexibility in handling a vehicle.

Worthiness to drive refers to deeper psychological aspects such as a focus on safety, ethical behaviour towards other road users, avoiding sensation seeking, etc. A crucial element here is above all a degree of self-reflection and self-control. In addition to acknowledging the complexity of the risks in traffic situations, drivers also need to be able to make a good assessment of their own capacities and limitations and be able to weigh up how they

should approach the situation and adjust their own driving behaviour (i.e. calibration).

4. Conclusions and recommendations

4.1. Added value of GDL

Based on the in-depth literature study, we can present a number of arguments that show that introducing a full GDL system or a number of its components would be useful:

1. We generally see a favourable effect of certain components of the GDL system on the number of accidents involving young drivers both in the traditional GDL countries as well as in the European countries. We can cautiously presume that this impact also applies to countries with a prominent presence of teenagers in accident statistics.
2. The most powerful element within a GDL system is the longer learning time, both accompanied and unaccompanied (supervised learning period and autonomous practice phase).
3. During the first phase of autonomous driving, the proposed restrictions (passengers/driving at night) provide a strong protection for novice drivers.

4.1.1. Sufficiently long learning phase

Studies [e.g. 2,17,20,21] consistently showed that a longer supervised learning period (e.g. minimum 12 months and 80 to 120 hours) is a strong and effective component irrespective of whether the driving learners are in the presence of a professional or non-professional supervisor. Given the early entry age of 16 in most of the GDL systems studied, the total duration may be shortened if the entry age is older (which is also the case in the UK). In a study by Maycock et al. [66] it was clear that the age when a driving license is acquired has a limited impact on the involvement in accidents. This is also confirmed by Vlakoveld [8]. We also note that irrespective of this limited cohesion, the fall in the accident risk depends in all age groups on driving experience. A more recent study by McCartt et al. [67] also underlines the importance of driving experience.

Based on this, we recommend that each learning phase, even when learners can only drive under supervision, should comprise a sufficient number of hours and diversity in situations.

It is also important that a certain form of control or guidance be available so that learners really practice driving in different situations and at different times of the day. This could be a task for driving schools that could provide

an induction for non-certified supervisors via a logbook and a joint launch. Examples of this can be seen both in Norway as well as in other European countries, where several components of a GDL system have been introduced (Ireland, UK, Austria).

4.1.2. *Introducing restrictions during an initial phase of autonomous driving*

Irrespective of the entry age or the education system, most accidents involving young drivers take place in the first year of their unaccompanied driving after obtaining their driving license [8,66,67]. According to Sloodmans et al. [9] the risk increases particularly during the first 1,000 kilometres. Introducing specific restrictions prevents novice drivers seeking out extra difficult situations and they also get the message that their learning phase is not completely over.

Restrictions that appear to be the most effective are [2,17,20,21]:

- General ban on night-time driving (starting no later than 21h00-22h00),
- Ban on passengers in the same age group,
- Zero tolerance towards alcohol.

4.1.3. *Further monitoring*

Different studies show that the moment when restrictions fall away is very crucial, even in a long practice phase and a high entry age. At that moment the advantage in terms of involvement in accidents is often lost. Young drivers put themselves into more risky situations for which they have not yet had sufficient practice. The risk is not so much related to the mastery of the technical driving skills (which are already automated to a great degree by that time), but the higher order skills such as recognising one's own risky behaviour, assessing the impact of specific hazards, etc. Besides that all drivers by then have developed their own driving style and habits that they think are good, but which they do not assess in a critical way anymore. Therefore, different countries have imposed a return moment focussing on these higher order skills.

4.1.4. *The ideal category B driver education?*

Based on the classic GDL systems' effect studies and inferred GDL framework [2,17,20,21] as well as established international practices and new developments within Europe, we propose the following plan (Fig. 1) that could be called a feasible "ideal" driver education model in Europe.

Learning phase. The supervised learning phase can start at the age of 17, after passing the theory test. A choice can be made between a professional and/or non-certified supervisor. It is recommended to apply the same structure (and duration, at least nine and maximum 12 months) irrespective of which supervisor is chosen. But even if one chooses a non-certified supervisor (accompanied driving), we recommend that a professional supervisor follows up the whole learning phase, by going through the logbook and having two feedback drives after three and six months of driving (like the Austrian system). During this learning phase a minimum number of hours (or kilometres) must be driven and the supervisor must accompany the learner driver through a number of different types of traffic situations (times of the day, weather conditions, types of road, etc.). The logbook (e.g. with a simple black box or a dongle) can offer a guarantee for that.

In the proposed rationale, the professional supervisor would be the person who, based on a competence test, decides whether the learner driver is ready to move on to the autonomous practice phase. Even if he or she passes this test, a risk perception test⁴ must also be passed (see [68] from SWOV, 2014 for more details). During this learning phase driving schools and professional driving instructors can offer different educational packages and modules. If these modules contain elements that are a form of accompanied driving, they should be reported in the logbook and contribute to the minimum number of kilometres or driving hours they need to accumulate.

Practice phase. Only when the two tests have been passed (competence and risk perception) the learners can start driving on the road unaccompanied, but with certain restrictions. This can start at the earliest at the age of 17 years and nine months. After six months of restricted autonomous driving, the learner driver can have a first attempt at obtaining a full driving license by taking a final driving test. In the event of serious errors, the learner driver should have to undergo further educational measures that focus on the error. This extends the learning process and offers the possibility to focus even more on the higher order skills.

Normal driving license. After passing the driving test, learners can obtain their normal driving license. At

⁴Risk or "hazard perception consists of more than merely perceiving and recognizing hazards. It also concerns the appraisal of the seriousness of the hazard and knowing what to do to avert the danger. There are clear indications that lack of hazard perception plays a major role in the occurrence of crashes, especially in the case of novice drivers. . . At present, hazard perception of candidates taking the driving examination can best be measured using film tests." (SWOV, 2014).

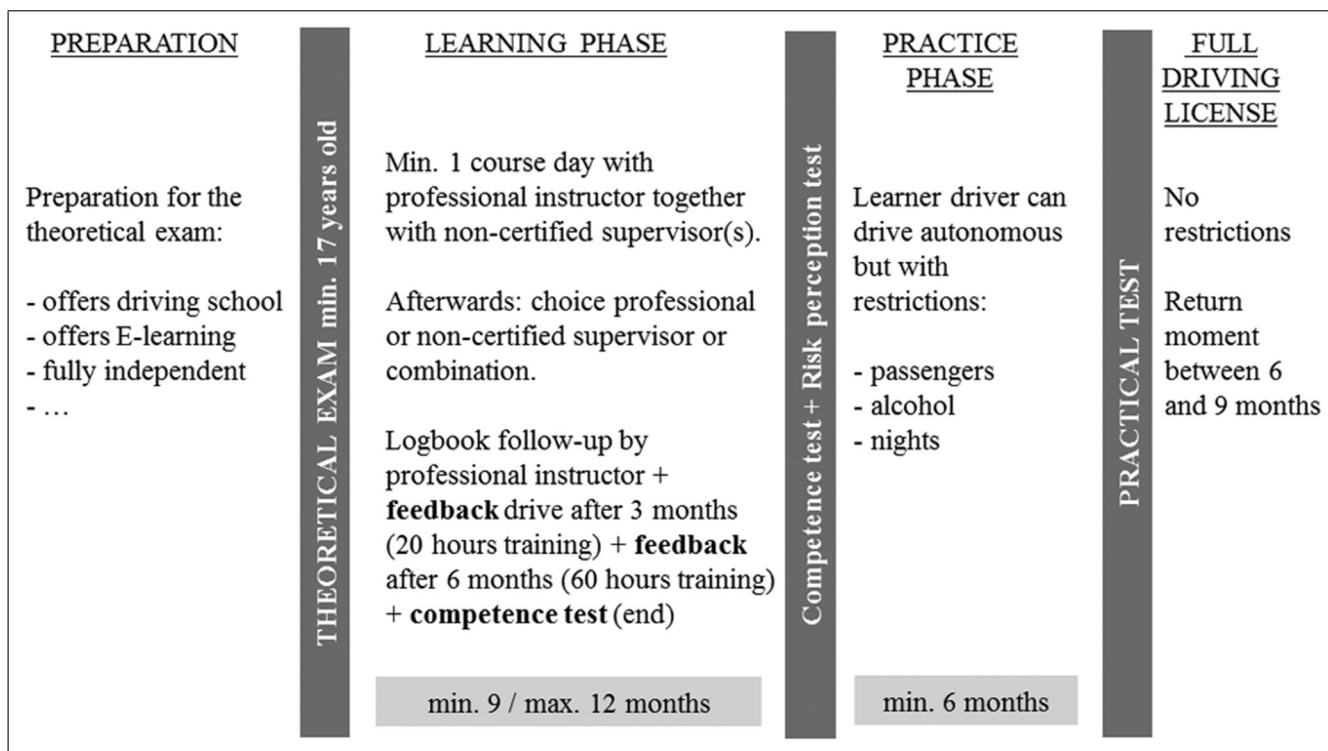


Fig. 1 Recommended category B driver education structure.

the earliest 6 months after driving autonomous without restriction, novice drivers must take a short additional course. At this point they will receive final feedback about their driving behaviour and further focus will be placed on attitude and self-reflection. The Austrian feedback course model seems to be effective with less focus on vehicle handling, and sufficient focus on attitudes and self-reflection through psychologically oriented group discussions.

4.2. Creating framework conditions

The introduction of a new or adapted driver education system always involves a number of difficulties. Change might meet with resistance from different corners. It is also important therefore to create support so that the change becomes acceptable and rational for the different stakeholders (e.g. politicians, professional driver education sector, teenagers). These types of changes can also come up against administrative and legal obstacles that first have to be dealt with before an effective start can be made.

Within the proposed “ideal” system, professional driving instructors are given more the role of a coach for both the learner drivers and their non-certified supervisors. This requires specific communication skills. Their own didactic input furthermore has to be aimed more at higher order skills such as encouraging self-reflection among both learner

drivers as well as their supervisors. Besides that this also gives them the possibility of focusing more on very specific and more difficult situations for which they can develop and market a specific and targeted solution.

Given the high number of required hours of supervised driving, most learner drivers will need to call on the services of non-professional supervisors. The question is whether this is possible for everyone. For a number of learner drivers it will be necessary to find a solution, possibly via a pool of volunteers.

Gaining a 100% guarantee of a correct logbook is not something one can ever achieve. Learner drivers and their supervisors can indicate that they have driven in different circumstances as well as the required number of kilometres, without this necessarily being the case. A simple black box, as has already been tested out by a number of insurance companies as one of the conditions for obtaining a lower premium, could offer a guarantee, given that it reports time frames and GPS locations. Different transport companies work with the same kind of system in order to increase efficiency. If this type of system is chosen it will be necessary to look how this can reconcile with the laws on privacy.

And finally, introducing restrictions only makes sense if they can be enforced. Although parents and teenagers themselves bear a great deal of responsibility for this, the police also have an important role to play. One important

aspect in order to enable the enforcement is the visibility of the learner driver. How can the police know whether a driver is in his/her learning phase? Like in Ireland, we would recommend using a specific sign/plate.

4.3. Conclusions

The results of the effect studies of both classic GDL systems and new developments within Europe provide sufficient evidence for a number of recommendations regarding the ideal driving license category B education. We plead the case for adjustments that would come close to the ideal model that we have suggested, whilst taking account of the financial implications and the need for specific emphasis in different countries or regions.

Reference

- Ehsani, JP (2012) The effect of graduated driver licensing on teen driver crash involvement. *Unpubl Dr Diss*.
- Mayhew, DR, Williams, AF, Pashley, C (2014) *A New GDL Framework: Evidence Base to Integrate Novice Driver Strategies*. Traffic Injury Research Foundation, Ottawa, Canada.
- SWOV (2013) *Getrapd rijbewijs / Graduated driver licensing Samenvatting*. SWOV, Den Haag, Netherlands.
- Russell, K, Vandermeer, B, Hartling, L (2011) *Graduated driver licensing for reducing motor vehicle crashes among young drivers*. John Wiley & Sons.
- Genschow, J (2014) *Novice driver preparation—an international comparison Novice driver preparation—an international comparison*. Bundesanstalt für Straßenwesen (BASt), Germany.
- Marshall, B, Parish, A (2014) *Young Driver safety: A public attitude survey*. RAC Foundation, London, UK.
- Dupont, E (2012) *Risico's voor jonge bestuurders in het verkeer: Literatuur onderzoek*. Belgisch Instituut voor de Verkeersveiligheid – Kenniscentrum Verkeersveiligheid, Brussels, Belgium.
- Vlakveld, WP (2005) *Jonge beginnende automobilisten, hun ongevalsrisico en maatregelen om dit terug te dringen*. SWOV, Leidschendam, Netherlands.
- Slootmans, F, Dupont, E, Silverans, P (2011) *Risques pour les jeunes conducteurs dans la circulation: Analyse des facteurs de risque pour les conducteurs de 18 à 24 ans sur la base d'une enquête concernant leur implication dans les accidents*. Institut Belge pour la Sécurité Routière, Brussels, Belgium.
- Senserrick, TM, Whelan, M (2003) *Graduated Driver Licensing: Effectiveness of systems and individual components*. Monash University Accident Research Centre, Australia.
- Assailly, J (2008) *Recherches et pratiques éducatives innovantes (matrice GDE) pour l'accès au permis de conduire en Europe*. Institut national de recherche sur les transports et leur sécurité, France.
- Keskinen, E, Hernetkoski, K (2011) Driver education and training. In Porter, BE (ed.), *Handbook of Traffic Psychology* pp 403-416. Elsevier Inc.
- Williams, AF, Tefft, BC, Grabowski, JG (2012) Graduated Driver Licensing Research, 2010-Present. *J Safety Res* 43: 195–203.
- Hatakka, M, Keskinen, E, Gregersen, NP, Glad, A, Hernetkoski, K (2002) From control of the vehicle to personal self-control; broadening the perspectives to driver education. *Transp Res Part F Traffic Psychol Behav* 5: 201–215.
- Beanland, V, Fitzharris, M, Young, KL, Lenné, MG (2013) Driver inattention and driver distraction in serious casualty crashes: data from the Australian National Crash In-depth Study. *Accid Anal Prev* 54: 99–107.
- Thomas, FD, Blomberg, RD, Donald, L, Fisher, DL (2012) *A fresh look at driver education in America*, 96.
- Senserrick, TM, Williams, AF (2015) *Summary of literature of the effective components of graduated driver licensing systems*. Austroads, Sidney, Australia.
- Masten, SV, Foss, RD, Marshall, SW (2011) Graduated driver licensing and fatal crashes involving 16- to 19-year-old drivers. *J Am Med Assoc* 306: 1098–1103.
- McCartt, AT, Teoh, ER, Fields, M, Braitman, KA, Hellinga, LA (2010) Graduated licensing laws and fatal crashes of teenage drivers: a National study. *Traffic Inj Prev* 11: 240–248.
- Masten, SV, Thomas, FD, Korbelak, KT, Peck, RC, Blomberg, RD (2015) *Meta-Analysis of Graduated Driver Licensing Laws*. National Highway Traffic Safety Administration, Washington, DC.
- Vanlaar, W, Mayhew, DR, Marcoux, K, Wets, G, Brijs, T, Shope, J (2009) An evaluation of graduated driver licensing programs in North America using a meta-analytic approach. *Accid Anal Prev* 41: 1104–1111.
- Zhu, M, Cummings, P, Chu, H, Coben, JH, Li, G (2013) Graduated driver licensing and motor vehicle crashes involving teenage drivers: an exploratory age-stratified meta-analysis. *Inj Prev* 19: 49–57.
- Williams, AF, Tefft, BC (2014) Characteristics of teens-with-teens fatal crashes in the United States, 2005–2010. *J Safety Res* 48: 37–42.
- Beck, U (2001) *La société du risque*. Flammarion, Paris, France.
- Illich, I (2005) *Œuvres complètes. Tome 1 et 2*. Fayard, Paris, France.
- Wilde, G (2001) *Target Risk 2. PDE publications*, Toronto, Canada.
- Masten, SV, Foss, RD, Marshall, SW (2013) Graduated driver licensing program component calibrations and their association with fatal crash involvement. *Accid Anal Prev* 57: 105–113.
- Williams, AF (2009) Licensing age and teenage driver crashes: a review of the evidence. *Traffic Inj Prev* 10: 9–15.
- Trempel, RE (2009) *Graduated Driver Licensing Laws and Insurance Collision Claim Frequencies of Teenage Drivers*. Highway Loss Data Institute, Arlington, VA, USA.
- Johnson, SB, Jones, VC (2011) Adolescent development and risk of injury: using developmental science to improve interventions. *Inj Prev* 17: 50–54.
- Williams, AF (2007) Contribution of the components of graduated licensing to crash reductions. *J Safety Res* 38: 177–184.
- Williams, AF (2003) Teenage drivers: patterns of risk. *J Safety Res* 34: 5–15.
- Williams, AF, West, BA, Shults, RA (2012) Fatal crashes of 16- to 17-year-old drivers involving alcohol, nighttime driving, and passengers. *Traffic Inj Prev* 13: 1–6.
- Baker, SP, Chen, L-H, Li, G (2006) *National Evaluation of Graduated Driver Licensing Programs*. National Highway Traffic Safety Administration, USA.
- Fell, JC, Jones, K, Romano, E, Voas, R (2011) An Evaluation of Graduated Driver Licensing Effects on Fatal Crash Involvements of Young Drivers in the United States. *Traffic Inj Prev* 12: 423–431.
- Tefft, BC, Williams, AF, Grabowski, JG (2012) *Teen driver Risk in relation to Age and Number of Passengers*. AAA Foundation for Traffic Safety, Washington, DC, US.
- Goodwin, AH, O'Brien, NP, Foss, RD (2012) Effect of North Carolina's restriction on teenage driver cell phone use two years after implementation. *Accid Anal Prev* 48: 363–367.

38. Ouimet, MC, Simons-Morton, BG, Zador, PL, Lerner, ND, Freedman, M, Duncan, GD, Wang, J (2010) Using the US National Household Travel Survey to estimate the impact of passenger characteristics on young drivers' relative risk of fatal crash involvement. *Accid Anal Prev* 42: 689–694.
39. Agent, K, Steenbergen, L, Pigman, J, Stinson Kidd, P, McCoy, C, Pollack, S (2001) Impact of Partial Graduated Driver's License Program on Teen Motor Vehicle Crashes in Kentucky. *Transp Res Rec J Transp Res Board* 1779: 54–60.
40. Shope, JT, Molnar, LJ, Elliott, MR, Waller, PF (2001) Graduated driver licensing in Michigan: early impact on motor vehicle crashes among 16-year-old drivers. *J Am Med Assoc* 286: 1593–1598.
41. Shults, RA, Elder, RW, Sleet, D.A, Nichols, JL, Alao, MO, Carande-Kulis, VG, Zaza, S, Sosin, DM, Thompson, RS, Services TF on CP (2001) Reviews of evidence regarding interventions to reduce alcohol-impaired driving. *Am J Prev Med* 21: 66–88.
42. Zwering, C, Jones, MP (1999) Evaluation of the effectiveness of low blood alcohol concentration laws for younger drivers. *Am J Prev Med* 16: 76–80.
43. Keall, MD, Frith, WJ, Patterson, TL (2004) The influence of alcohol, age and number of passengers on the night-time risk of driver fatal injury in New Zealand. *Accid Anal Prev* 36: 49–61.
44. Chamberlain, E, Solomon, R (2002) The case for a 0.05% criminal law blood alcohol concentration limit for driving. *Inj Prev* 8: iii 1.
45. Peck, RC, Gebers, MA, Voas, RB, Romano, E (2008) The relationship between blood alcohol concentration (BAC), age, and crash risk. *J Safety Res* 39: 311–319.
46. Curry, AE, Pfeiffer, MR, Localio, R, Durbin, DR (2013) Graduated driver licensing decal law: effect on young probationary drivers. *Am J Prev Med* 44: 1–7.
47. Pesić, D (2015) *Models of training of candidates for drivers*. University of Belgrade, Belgrade, Serbia.
48. Gatscha, M, Brandstätter, C (2008) *Evaluation der zweiten ausbildungsphase in Österreich*. Forschungsarbeiten aus dem Verkehrswesen, Bundesministerium für Verkehr, Innovation und Technologie., Wien, Österreich.
49. Peräaho, M, Keskinen, E, Hatakka, M, Katila, A (2000) *Finnish driving school students evaluate their training*. Kuratorium Für Verkehrssicherheit, Wien, Österreich.
50. Bartl, G, Assailly, JP, Chatenet, F, Hatakka, M, Keskinen, E, Willmes-Lelz, G (2002) EU Project ANDREA: Analysis of driver rehabilitation programmes. In, *Department of Transport, Behavioral Research in Road Safety: Twelfth Seminar* pp 36–45.
51. de Craen, S, Twisk, DAM (2005) *Assessment of a Diary to Study Development of Higher-order-skills During Driving Experience*. Ashgate Publishing Limited, London, UK.
52. Martensen, H, Kluppels, L (2016) *Accidents involving the escape of one driver: An overview of the occurrence in Belgium and other European countries*. Belgian Institute for Road Safety, Brussels, Belgium.
53. Kluppels, L (2015) *Non-DUI offenders: some reflections after 20 years of experience in Driver Improvement courses*. In, *Workshop Traffic Psychology International.*, Vienna, Austria.
54. Tronsmoen, T (2011) Differences between formal and informal practical driver training as experienced by the learners themselves. *Transp Res part F traffic Psychol Behav* 14: 176–188.
55. Kjelsrud, H, Robertson, K (2015) *How to be aware of - and target the learner driver's state of mind*. In, *47th CIECA congress.*, Berlin, Germany.
56. Kaltenegger, A (2015) *Accompanied Driving in Austria*. In, *VSV-werkgroep Rijopleiding*, Mechelen, België.
57. Gregersen, NP, Berg, H-Y, Engström, I, Nolén, S, Nyberg, A, Rimmö, P-A (2000) Sixteen years age limit for learner drivers in Sweden—an evaluation of safety effects. *Accid Anal Prev* 32: 25–35.
58. Goldenbeld, CH, Wesemann, P, Schoon, CC (2011) *Verkeersveiligheidseffecten in 2020 van nieuwe maatregelen op het gebied van gedragsbeïnvloeding: Effectschatting van 'mensgerichte' maatregelen uit het Strategisch Plan Verkeersveiligheid*. Stichting Wetenschappelijk Onderzoek SWOV, Leidschendam, Nederland.
59. Martensen, H (2014) *@RISK: Analyse van het risico op ernstige en dodelijke verwondingen in het verkeer in functie van leeftijd en verplaatsingswijze*. Belgisch Instituut voor de Verkeersveiligheid – Kenniscentrum Verkeersveiligheid, Brussel, België.
60. Europese Gemeenschappen (2006) Aanbeveling van de Commissie van 17 januari 2001 betreffende het wettelijk toegestane alcoholpromillage voor bestuurders van motorvoertuigen (2001/C 48/02). *Publ van Eur Gemeenschappen* 48: 2–10.
61. Dupont, E, Martensen, H, Silverans, P (2010) *Verlaagde alcohollimiet voor onervaren bestuurders en voor bestuurders van grote voertuigen: 0.2 pro mille*. Belgian Institute for Road Safety, Brussels, België.
62. Casteels, Y, Focant, M, Nuytens, N (2012) *Risico's voor jonge bestuurders in het verkeer: Statistische analyse van langeselonevallen met jonge bestuurders van 18 tot 31 jaar*. Belgian Institute for Road Safety, Brussels, Belgium.
63. CBR (2014) *Educatieve Maatregel gedrag en verkeer: Handboek trainers*. Centraal Bureau Rijbewijzen, Divisie Vorderingen, Rijswijk, Nederland.
64. Sanders, N, Keskinen, E (2004) *EU NovEV project; Evaluation of post-licence training schemes for novice drivers*. International Commission of Driver Testing Authorities CIECA, Rijswijk.
65. Bartl, G (2000) *DAN-report: Results of EU-project: Description and Analysis of Post Licensing Measures for Novice Drivers*. KfV, Vienna.
66. Maycock, G, Lockwood, CR, Lester, JF (1991) *The accident liability of car drivers*. Transport and Road Research Laboratory, Crowthorne, Berkshire, UK.
67. McCartt, AT, Teoh, ER, Fields, M, Braitman, KA, Hellinga, L.A (2009) *Graduated Licensing Laws and Fatal Crashes of Teenage Drivers: A National Study*. Insurance Institute for Highway Safety, Arlington, VA, USA.
68. SWOV (2014) *Hazard perception test and how to test it*. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (SWOV), The Hague, The Netherlands.