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Trends in young driver risk and countermeasures in European countries

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Abstract

This paper reviews European trends regarding young drivers' accident risk and the effects of countermeasures. Young driver risk differs between countries, and has improved in the last decade, probably as a result of general improvements in road safety levels. Young male drivers' relative risk is rising, indicating that current policies are less effective for males than for females. Further research is needed to understand the causes of this development. In Europe, most countries are moving towards multiphase licensing systems, including elements like accompanied driving, protective measures, and probation periods. European evaluation studies show mixed results regarding these elements, pointing to a need for more research into the effective components.

1. Introduction

As of January 2007, the European Union (EU) is made up of 27 countries with a total population of 493 million people. In the EU, 23 official languages are spoken, and 15 different currencies are used. These figures give a rough impression of the great diversity that exists within the EU.

This is also true for the licensing systems. Each individual country has its unique system, and, as a result, within the EU licensing procedures range from standard uni-phase systems to more advanced multi-phase systems. While a full description of all the different systems in use is not available, the recent Organisation for Economic Co-Operation and Development (OECD) and European Conference of Ministers of Transport (ECMT) report (2006) provides an overview of the main features in the majority of countries. This overview is presented in Tables 1a and b.

Compared to other international licensing practices, European countries have one feature in common, namely a relatively high access age. In the majority of countries, it is not possible to hold a full license before the age of 18.

This paper focuses on recent trends in Europe with respect to young driver risk and countermeasures, with particular reference to licensing practices. It should be clear, given the previous description of the wide range of practices in the EU, that it is not possible to describe the nature of the young driver problem and the effects of the countermeasures in each country. Instead, the paper concentrates on the broader themes and the effects on safety of new initiatives. It is based on the recently published study from OECD and ECMT Transport Research Centre entitled "Young Drivers: The Road to Safety",[1] and the results of a workshop organized by the international commission for driver testing authorities CIECA) and VdTUEV (one of CIECA's member organizations from Germany) (on "Accompanied driving in Europe" in Berlin in December 2006.

Reducing young driver risks is important to achieve the European safety target: a 50% reduction in traffic fatalities in the period 2000–2001 (White paper, 2001).

2. Features of young driver risk in Europe

On major issues, the nature of the young driver risk in Europe does not differ from countries elsewhere in the world. However, the following features might not be unique

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[1] Please see http://www.cemt.org/JTRC/WorkingGroups/YoungDrivers/index.htm.

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Table 1a
Traditional Single-phase Licensing Systems, Europe

Country	Min. age to start learning	Min. age for probationary license	Min. age for full license	Accompanied driving
Czech Republic	N/I	N/I	18	N/I
Denmark	17 and 6 mths	18 Full license with probationary conditions during a minimum period of three years.	18	No Practical driving school lessons only.
France (a)		No probationary license. Full license issued on passing the practical test.		
Accompanied driving	16		18	Yes
France (b)	18	No probationary license. Full license issued on passing the practical test.	18	No
Germany (a) Ordinary form of driver training and licensing. Valid in all 16 federal states.	17 and 5 months	18 Full license with probationary conditions during a minimum period of two years.	20	No Practical driving school lessons only.
Germany (b) Accompanied driving from the age of 17. Valid in 12 of 16 federal states	16 and 5 mths Lowered age limit for starting driver education	17 a) Lowered age limit for licensure. b) Full license with probationary conditions during a minimum period of two years.	19	Yes *Before licensure:* practical driving school lessons only. *From licensure up to the age of 18:* accompanied driving
Great Britain	17	No probationary license. Full license issued on passing the practical test.	17	Yes
Greece	18	N/I	N/I	Yes
Iceland	16	17	19	Optional
Luxembourg (a)	17 and 6 mths	–	18	Not permitted.
Netherlands	18	N/I	18	No Practical driving school lessons only.
Norway	16	N/I	18	Optional
Poland	16	18	N/I	Yes
Sweden	16	N/I	18	Optional

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Restrictions on learner driver	Restrictions on accompanying lay person	Probationary period and conditions	Mandatory training units	
			Theory (hours)	Practice (hours)
N/I	No lay instructor admitted.	N/I	36	34 28 hours of driving. 6 hours of first aid and basic vehicle maintenance.
Driving in traffic during driving school lessons only.	No lay instructor admitted.	3 years	22 (28 lessons of 45 min.) This is a minimum. More lessons are recommended.	18 (24 lessons of 45 min.) This is a minimum. More lessons are recommended.
"A" Plates. Max. 110/100 km/h on motorways. Max. 80 km/h on secondary roads.	28 years-old Full license for 3 years. No lay instructor admitted.	– –	N/I	N/I
Driving in traffic during driving school lessons only.			N/I	N/I
Driving in traffic during driving school lessons only.	No lay instructor admitted.	2 years minimum, can be prolonged to 4 years. Full license with probationary conditions.	28 Pre-license training only.	*Pre-license training only*: Basic training: number of practical hours after the decision of the driving teacher. 12 special drives of 1 hour each.
Before licensure: Driving in traffic only during driving school lessons. *From licensure up to the age of 18*: Driving in traffic only under (lay) supervision.	Lay instructor has only supervising, but no instructional functions. - Minimum age 30. - License for 5 years. - Maximum 3 penalty points. - Maximum BAC 0.5 g/l.	2 years minimum, can be prolonged to 4 years.	28 (Pre-license training) N/I (Post-license training)	*Pre-license training*: Basic training: number of practical hours decided by the driving teacher. 12 special drives of 1 hour each. *Post-license training:* - Up to 1 year lay supervised training in real traffic.
"L" plates No driving on motorways.	21 years-old Full license for 3 years.	2 years	0	0
N/I	N/I	N/I	20	10
N/I	24 years-old. Full license for 5 years Lay instructor must be approved by the police.	2 years	18	12
N/I	N/I	N/I	16	12
Driving in traffic during driving school lessons only.	Dual brake pedal.	5 years BAC-limit 0.2 g/l.	0	0
"L" plates Learner must have completed mandatory course in Basic Traffic Knowledge.	25 years-old. Full license for 5 years.	2 years	21	15
N/I	Age, non-penalty record, participation in training.	2 years	N/I	N/I
Learners permit	24 years-old. Full license 5 years. Supervisors permit.	2 years	N/I	N/I

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Table 1b
Two-phase Licensing Systems, Europe

Country	Practice (hours)						Second phase					
	Min. age to start learning	Mandator training units		Accompanied driving	Restrictions on learner driver	Restrictions on lay instructor	Min. age for probationary license	Probation period	Restrictions on learner driver	Mandatory training units		Min. age for full licensing
		Theory (hours)	Practice (hours)							Theory (hours)	Practice (hours)	
Austria (a) Accompanied driving "L17"	16	2.5	5.8	yes	Driving experience: 3000 kms. BAC 0.1 g/l Medical fitness. First Aid course (8 hours)	Full license for 7 years. No serious traffic offences in the last 3 years. Practical driving experience in the last 3 years. Close, personal relationship to candidate.	17	2 years, starting at 18.	No convictions for certain traffic violations.	3 units (50 min. each) Track training 1 unit; Psychological group discussion 2 units.	7 units (50 min. each) Track training 5 units, Feedback drives 2 units.	20
Austria (b)	17 and 6 mths	2.5	7.5	Optional (Replaces 6 hours practical training)	BAC 0.1 g/l Medical fitness. First Aid course (8 hours).	Full license for 7 years. No serious traffic offences in the last 3 years. Practical driving experience in the last 3 years.	18	2 years, starting at 18	No convictions for certain traffic violations.	3 units (50 min. each) track training 1 unit; psychological group discussion 2 units.	9 units (50 min. each) track training 5 units, feedback drives 4 units.	20
Finland	17 and 6 mths	20	15	Optional	None	Family Full license for 3 years.	18	2 years	Probationary conditions. Stricter conditions for the novice driver (for 2 years).	4	4	20
Germany (c) Second-phase model Additional post license training course of 10.5 hours, 6–12 months after licensure Voluntary Valid in 13 of 16 federal states	17 and 5 mths.	28	Number of hours is decided by the driving teacher. Plus: 12 special drives of 1 hour each.	No Practical driving school lessons only.	Driving in traffic driving school lessons only.	No lay instructor involved.	18 Full licence with probationary conditions during a minimum period of one year.	1 year minimum can be prolonged to 3 years.	Probationary conditions. Obligatory driver improvement courses for drives commiting offenses.	6 (Three group discussions)	4,5 (Track training and feedback drive)	19 Expiry of probationary conditions after one year instead of two years: bonus for participation in the voluntary second-phase driver training
Luxemborg (b)	17	12	16	Optional	Learners permit. No trailers in tow. Max. 75 km/h on secondary roads. Max. 90 km/h on motorways. no driving 11p.m. -6 a.m.	Full licence for 6 years. Supervised by authorised. Instructor for 2 hours.Special permit. No traffic offenses. Dual brake pedal. Identity card valid for training period.	N/I	2 years	Max. 75 km/h on secondary roads. Max. 90 km/h on motorways.	One day with a combination of theory and practice. Also includes skid training.		N/I

for Europe and may form a promising basis for countermeasures. These are:

- The development in young driver risks in the last decade
- The relationship between overall safety in a country and young driver risks
- Exposure control
- The increasing risk of young male drivers
- The prevalence and risks of drug driving
- The migration to less safe two-wheeled vehicles

2.1. Developments in accident risks

Based on data from IRTAD (the International Road Traffic and Accident Database), Fig. 1 shows driver fatalities per population in the 18–24 year-old age group for different OECD and ECMT countries over approximately the last decade.

First of all, the figure clearly shows major differences in young driver mortality in Europe. As yet, no overall study has been carried out to understand the reason for these differences. In addition the graph shows the development of mortality in this age group in the last decade. Most countries are significantly improving. For those countries that are not improving, the factors behind this are not clearly understood, as data regarding issues like travel patterns and licensing rates are not gathered systematically in all countries.

2.2. Safe countries have safe youngsters

Countries in Europe differ in terms of road safety levels overall, as well as for young drivers in particular. The OECD and ECMT study looked at the relationship between these two factors, and concluded that countries that have relatively safe roads overall are also safer for young drivers. With reference to Fig. 2, the overall safety level of a country was defined as the absolute number of fatally injured older drivers (aged 39–59) per head of population in that age group. Similarly, the safety level of young drivers was defined as the absolute number of fatally injured young drivers (aged 18–24) per head of population in that age group.

Fig. 2 shows the relative situations in various countries in Europe comparing younger and older drivers. For comparison purposes figures are also presented for Canada, USA, Australia and New Zealand, although these are countries where driving begins before 18, meaning that this graph likely understates the extent of their problems where young drivers are concerned. The dotted lines on the graph show the averages for the age groups studied, which allows us to divide the figure in to four quadrants. Most countries are grouped in the lower left and upper right quadrants, indicating a strong relationship between the two indicators. Countries that are have relatively safer roads overall have safer young drivers (lower left quadrant) and relatively less safe countries also have relatively less safe young drivers (upper right quadrant).

Two possible explanations can be given for these patterns. Mileage is one of them. In countries with a low mileage per head of population of young and older drivers, fatalities will be low in both groups, because of the low exposure to risk. Alternatively in those countries with high mileage in both groups exposure to risk will also be high, resulting in more fatalities per head.

However, although detailed travel data is lacking for most European countries, the overall grouping pattern is not

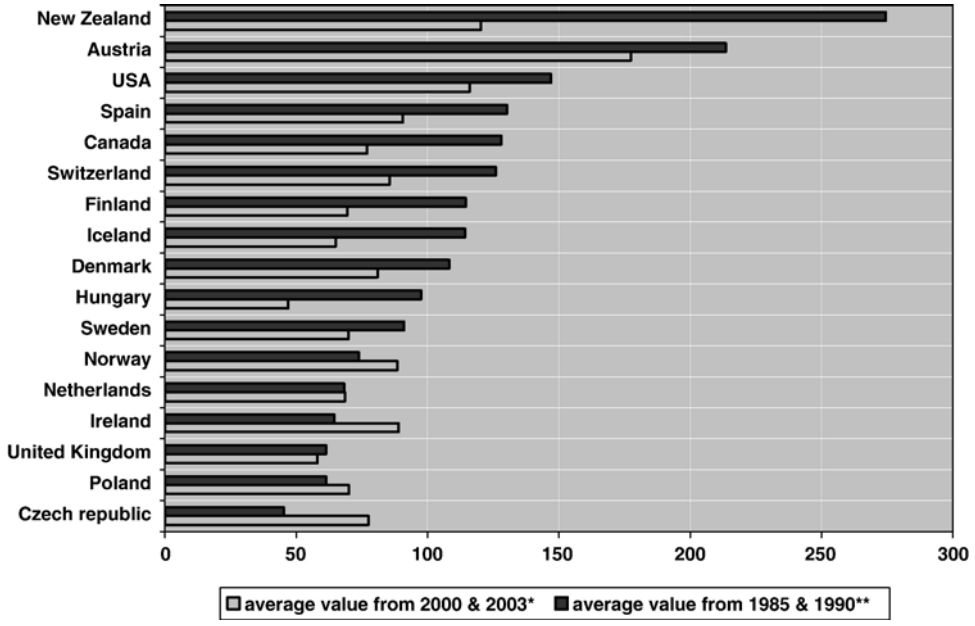

Fig. 1. Development over time of Driver Fatalities per Million Population in the 18–24 Year-old Age Group in various OECD and ECMT Countries.

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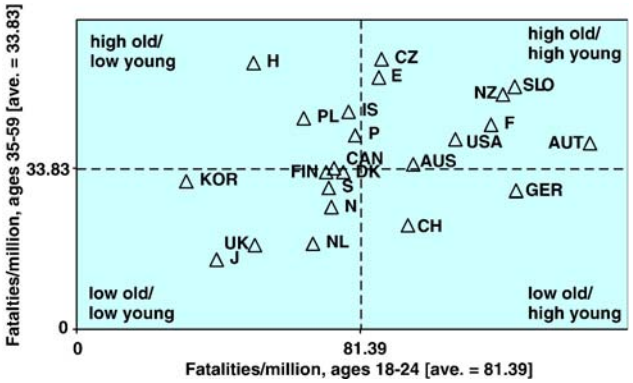

Fig. 2. Killed Drivers per Million Population in the 35–59 (Older Drivers) and 18–24 (Young Drivers) Age Groups 2003.

consistent with this explanation. More likely is the explanation that both expert and novice drivers benefit from the general safety measures in a country, such as appropriate legislation and enforcement (e.g., alcohol legislation, random breath testing, speed limits and control, safety belt laws), safe infrastructure (e.g., forgiving road sides, highly predictable traffic situations, safety barriers), and safe vehicles. For Europe, it could even be postulated that, given the strong relationship between general safety levels and young driver risks, the impact of these general safety levels is even greater than that of measures specifically targeting young drivers, in particular for the countries with relatively poorer performance. The effective application of these general safety measures will result in immediate improvements for all road users, including young drivers and will be highly effective. Moreover, this is an area where immediate action can be taken based on existing laws and regulations.

2.3. Exposure control

Research in various countries has shown that the risk of involvement in a crash during the first year of independent driving decreases substantially with an increase in the age at which one begins solo driving. This relationship was shown in Great Britain by Maycock (2002) but also demonstrated by Vlakveld (2004) for the Netherlands (Fig. 3), which is also adjusted for exposure. The solid lines in Fig. 3 show us that crash risk drops radically over the first year of driving, it is also clear that initial crash risk is higher if one starts driving earlier.

Clearly, those young people starting at a later age have a significantly lower accident risk per kilometer. Although these and similar findings can be taken as support for countermeasures that delay licensing, it should be borne in mind that it cannot be ruled out that this pattern may be influenced by volunteer bias. In countries were these patterns were observed, the actual licensing age is dependent on young people's personal preference to license early or late. In turn, this choice may be influenced by a young person's economic or social situation, interest in cars, and so forth. These differences may also be related to personal choices leading to a higher mileage, exposure to risk, and or risk taking resulting in the observed relationship between licensing age and accident risk.

In another example, analyses of travel data in relation to young drivers' involvement in fatal accidents (Twisk, 2000) showed that the introduction of a free public transport pass for young people led to significant reductions in mileage and, as a result, to major reductions in the accident involvement of this age group. Significant safety gains resulted from this measure, even though the young people were not forbidden to drive and volunteer bias may have played a role.

The combination of these findings leads us to conclude that exposure reduction, either by delaying licensing or discouraging driving, are effective measures.

2.4. The last decade: male risk is increasing

It is a well documented fact that, in many countries, young males have on average three times greater involvement in fatal road crashes than young females. One study compared the crash adjusted involvement rates of young people in the Netherlands, Sweden and Great Britain,

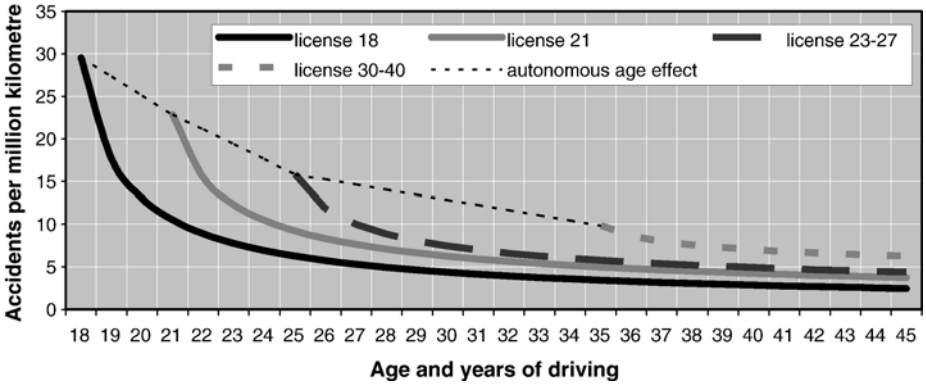

Fig. 3. Self-reported accidents per million kilometres by licensing and accident age.

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adjusted for exposure (involvement in fatal accidents per kilometer), and strongly indicated that the "young male problem" might be on the increase in Europe.

For example, Fig. 4 shows the development in the number of fatal crashes in which male and female young drivers were involved per kilometer, divided by the number of fatal crashes that male or female drivers aged 30 to 59 were involved in per kilometer. Based on this calculation, values larger than 1 indicate the relative risk of the young driver; for example, a value 2 means that the involvement rate of novices is two times greater than that of experts. Where young men are concerned, in the early 1990s, the relative risk of male drivers ranged across the three countries between a factor of 3.5 and 5. However, at the turn of the century this had risen sharply and now ranges between 6 and 7.5.

This was not the case for young women. For all three countries, young female drivers had a relatively higher risk than older drivers by a factor of about 2, but this remained largely stable over the 10 year period. This is because they experienced a general decline in the number of fatal crashes per kilometer, and this reduction was also of about the same magnitude as the decrease in the fatal crash involvement rate of female drivers in the older age group.

This pattern indicates that young female drivers generally profit from overall improvements in road safety much more than young men. In Europe, more and more, the young driver problem is becoming a problem of the young *male* driver. In combination with the fact that measures to date do not seem to be adequate for this group, more research is needed into the mechanisms responsible, in order to design effective strategies.

2.5. Combined use of drug use and risks

Drug use is clearly an issue that affects youth. Among Europeans, illicit drug use generally increases with age from 15 to 25, then decreases, and figures for youth are twice those of adults. Cannabis is the most commonly used illicit drug, and is more often detected among young drivers, except in the UK, where it is also frequently detected among 40 to 60 year-olds (EMCDDA, 2006). While use of legal drugs is more frequent among girls, alcohol, cannabis and ecstasy are more commonly used by boys. The EU's IMMORTAL[2] (Mathijssen & Houwing, 2005) study found that, in the Netherlands, drug use was concentrated among young male drivers in the 18–24 age group, where 1 in 6 had used drugs or a combination of drugs, although the vast majority of those who tested positive had used cannabis. However, in Europe, sex differences are decreasing, alcohol use is stabilizing, and cannabis use is increasing, sometimes becoming more important than alcohol.

It is clear that drugs, in general, represent a source of risk for young, novice drivers.[3] Based on the outcomes of an epidemiological case control study (Mathijssen & Houwing, 2005) in which the prevalence of drugs in the driver population in the Netherlands was compared with that of drugs in seriously injured drivers, it was concluded that drivers using illegal drugs and combinations of drugs have a 25 times higher risk of serious injury than "sober" drivers. The combination of drugs and alcohol leads to even higher risks, by a factor of 35.

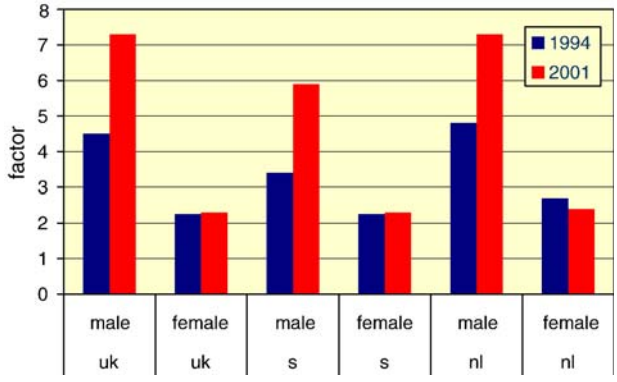

Fig. 4. The development of relative risk in male and female drivers in Sweden (S), the United Kingdom (UK) and the Netherlands (NL).

Table 2
Accidents per billion vehicle kilometres by transport mode in the Netherlands 2005

Vehicle	Risk
Moped	64.7
Motor cycle	66.3
Passenger car	6.61

2.6. Powered two-wheeled (PTW) vehicles are far more risky than passenger cars

In many countries in Europe, licensing systems make it possible to ride a motorcycle or moped when one is younger that the minimum age for solo passenger vehicle driving. To give an indication of the differences in risk, Table 2 presents the involvement in fatal accidents per billion vehicle kilometers in the Netherlands 2005. This pattern is not significantly different in other European countries, as can be concluded from the road safety figures presented at the European Road Safety Observatory (www.erso.eu).

Given these higher risks, young people's migration from relatively safe passenger cars to highly unsafe PTWs should be avoided at all costs. Such a migration is likely when licensing laws become too strict in comparison to licensing laws related to PTWs. Therefore the OECD and ECMT report (2006) recommended that conditions for driving motorcycles, mopeds and scooters should be similarly stringent compared to conditions for driving passenger cars.

[2] Please see http://www.cieca.be/.

[3] "Impaired Motorists, Methods of Roadside Testing and Assessment for Licensing" (www.immortal.or.at).

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3. Factors behind the problem

The reasons why age, gender and experience combine so destructively in some young people on the road and why some young people are more risk-prone than others are highly complex. They involve a myriad of interacting factors, including physiological and emotional development, personality, social norms, the role of youth in society, individuals' socio-economic circumstances, impairments to capabilities, the driving task itself, and the type of driving that young, novice drivers often engage in.

Certain personality types are particularly subject to high crash risk. Social norms, including peer pressure and the emphasis placed on rebellion in youth culture, affect driving style, as do the examples provided by role models. Alcohol, drugs, fatigue, emotions and in-vehicle distractions, such as mobile telephones, all impair a driver's abilities. Based on economic considerations, young people may also drive older vehicles with fewer safety features.

Recent research indicates that the parts of the brain responsible for inhibiting impulses and weighing the consequences of decisions may be under development until well after the teenage years, possibly impacting on driving behavior. Furthermore, different testosterone levels partially explain the divergence in behavior between young men and women.

In short, young drivers' high risk levels are a product of both who they are and the environment in which they exist.

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

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

4. Countermeasures in Europe

Given the severity of the problem, it is imperative that governments take action to reduce young driver risk, especially as measures to improve the safety of young and newly qualified drivers can be readily identified. Reducing the number of young, novice driver crashes and fatalities will require a focused and coordinated approach, involving education, training, licensing, enforcement, communication and the selective use of technology, in combination with other road safety measures.

The following are specific countermeasures that should be considered as part of licensing systems.

4.1. Problem awareness

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

Breaking this link inevitably involves measures that either limit the available choices, or alter the attractiveness of these choices. As yet the awareness of the young driver problem in Europe is relatively low. It is therefore to be expected that any measures that limit the available choices of candidate drivers will be met with great resistance.

Barriers such as these are difficult but not impossible to surmount. Measures like seat belts, motorcycle helmets, radar cameras and airbags all experienced initial resistance, but are now standard practice around the world, saving hundreds of thousands of lives. Attitudes can also change. Legislation to tackle drunk driving was initially controversial but today such behavior is widely considered socially irresponsible in most societies, as well as being an offence. So, the introduction of young driver measures needs to be accompanied by effective awareness-raising campaigns not only targeting young drivers, but – and perhaps even more importantly – directed at parents, politicians and stake-holders, such as insurance companies.

4.2. Licensing age

As noted above, the younger a person starts unrestricted solo driving, the more likely it is that he or she will have a fatal accident during the first period of driving, particularly below 18 years-old. Thus, as a first step, it is extremely important to set an appropriate age for solo driving.

European administrations should thus resist, on safety grounds, any pressure to lower current licensing ages; conversely, increasing the licensing age for solo driving would reduce fatalities. As yet the current European Union licensing guidelines recommend licensing at 18. Pre-license accompanied practice may result in earlier training, such as from the age of 16, but still only allow a full license at 18.

However the age discussion on solo driving needs to take into account that the licensing age may motivate young people to choose even less safe modes of transport, such as motorcycles. Thus, licensing conditions for motorized two-wheeled vehicles should be similarly stringent as those for passenger vehicles.

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4.3. Training and testing

To date, formal training itself has not proven to be highly effective in reducing accident risk (Engström, Gregersonen, Hernetkoski, Keskinen, & Nyberg, 2003). A meta analysis (Elvik & Vaa, 2004) shows that in experimental studies in a one-to-two year period, drivers with formal pre-license driver training have 11% more crashes per kilometer than drivers without formal training. This finding is in line with conclusions from many more studies (e.g., Mayhew, Simpson, Singhal, & Desmond, 2006). This is not to imply that formal training is without potential as a countermeasure, but rather that more work needs to be done to understand its possible benefits. Recent overviews on the content of formal pre-licensed training (Hatakka et al., 2003; Siegrist, 1999) have shown that in Europe current training systems primarily focus on the lower order car driving skills, such as vehicle control and the execution of maneuvers like overtaking, and crossing intersections, while there is a lack of training on more strategic issues like self-assessment of driving skills and calibration of skills (Kuiken & Twisk, 2001). Driver training should address all aspects that contribute to the high accident risk. In order to provide an overview of what the licensing process should cover, the Goals for Driver Education (GDE) matrix was developed in the context of an EU's project (Siegrist, 1999). On the basis of this matrix, several countries are now redesigning their driving courses, and testing procedure. Further research is needed to evaluate the effectiveness of the new approach. An addition to the improvement of the content of driver training also the competences of driver instructors need further development (EU merit project, 2005).

4.3.1. Hazard perception testing

It has long-since been recognized that young, novice drivers are poor at detecting and assessing hazards (e.g., Engström et al., 2003). and, therefore, the European Union Directive (Directive 91/439/EEC on driving licenses recommends testing of hazard perception, and the understanding of risks Many countries have introduced or are considering hazard perception tests as a compulsory element in the Driving Test.

However, Sagberg and Bjornskau (2006) did not find that a hazard perception test resulted in important safety improvements in the first nine months after licensing. On the other hand, Fisher, Pollatsek, and Pradhan (2006) found substantial improvements in scanning behavior on the open road after young drivers had attended a computer-based training program focusing on recognizing potential risks. In Europe a great many hazard perception tests and training programs are still under development, and their effects are under study.

4.4. Increased pre-license practice

Safe drivers are made and not born. Increasingly in Europe, high levels of practice are recognized as a precondition for reaching higher cognitive skill levels. Many countries allow private practice as a means to prepare for the driving test, but only few actively encourage high levels of such practice, with a view to increasing novices' experience by the time they start driving solo. The effects of accompanied practice has been assessed in three European countries, with mixed results. Possibly the mixed results are caused by *the total amount* of accompanied practice that occurred.

For instance, Sweden began promoting private practice in 1993 by reducing the minimum age for accompanied driving by learner drivers from 17.5 to 16, although the age for solo driving remained 18. This resulted in an increate to a mean of 117.6 hours of accompanied learning before licensing, compared to a mean of 47.6 before the change. In the two following years, the crash risk of those who had begun practicing at 16 was reduced by 40% (Gregersen, 1997; Gregersen et al., 2000).

In 1994, Norway also reduced its minimum age for driver training from 17 to 16. However, in contrast to the Swedish experience, the Norwegian change did not result in a reduction in crashes (Sagberg, 2000). On average, the change in Norway led to an increase of 106 kilometers of practice per learner before licensing, compared to 1 962 in Sweden. However, those who practiced more had lower crash involvement after licensing (see also Sagberg, 2002a, b). Thus, while Norway's experience is different, their results are not inconsistent with the overall conclusion that high levels of accompanied practice lead to crash reductions after licensing.

A question that needs further exploration is how much quantity practice is actually needed in terms of time or kilometers. Sagberg (2002b) tentatively concluded that between 5 000 and 7 000 kilometers are sufficient for a significant reduction in crashes after licensing. However further studies are needed to provide evidence-based estimations.

The evaluation study of the French system on the basis of insurance data (Page, Quimet, & Cuny, 2004) showed that, contrary to expectations, the accompanied driving group did not have better crash rates in the two years after licensing than the traditionally trained drivers. The authors suggest that the accompanied driving group did not gain sufficient experienced during the training phase and/or gain experience that involved more complex driving situations. The study demonstrated that the trips undertaken during accompanied practice were more "standard" (e.g., shopping and holidays), while the more demanding tasks were taken over by the supervisor, resulting in insufficient practice of more complicated driving tasks.

Interesting in this respect is the Austrian Model L17. As of 1999 it is possible to obtain a full license in Austria at the age of 17 on the condition of having undertaken a training scheme composed of a mix of professional driver training and accompanied practice — 26 theory lessons, 12 practical lessons and 3 000 kilometers of accompanied practice. To

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study the effects of this program on accidents, interviewees were asked about their current driving experience (licensing) and their accident involvement (Winkelbaum, 2004).

Fig. 5 shows experience (in terms of mileage) and gender as the most important factors in crash reduction. But, in terms of effective countermeasures, the graph also shows the large impact of the L17 scheme in the first 2 500 kilometers on males and females in comparison to traditional training. Although these results are promising and indicate a more than 50% decrease in crashes, volunteer bias cannot be excluded and may explain the differences between the groups.

In particular, it should be particularly noted that those in the L 17 group only represent about 8% of the total young driver population. Despite the fact that objective data like family income, place of residence and the levels of education of both the young drivers and their parents do not reveal significant differences, this does not rule out that volunteer bias played a significant role. The smaller the group is, the greater the threat of such a bias. Thus, although these findings are promising, generalization of these Austrian findings to all young drivers is not possible on the basis of this data.

The low uptake of accompanied driving is a common characteristic in Europe. A CIECA review of European licensing practices showed that accompanied driving is allowed in 15 out of the 27 EU countries. Driving school training, whether obligatory or mandatory, is taken in addition to accompanied driving in the vast majority of countries. In general, accompanied driving is not a popular option as can be seen in Table 3.

In particular these findings led the OECD and ECMT group (2006) to conclude that high levels of accompanied practice before licensing for solo driving, conducted in a methodical manner that involves a variety of driving circumstances, will result in lower levels of fatalities. While at least 50 hours of pre-licensing practice are recommendable in any system, the experience in Sweden showed that increasing this to approximately 120 hours reduced crashes in the two years following licensing by about 40%.

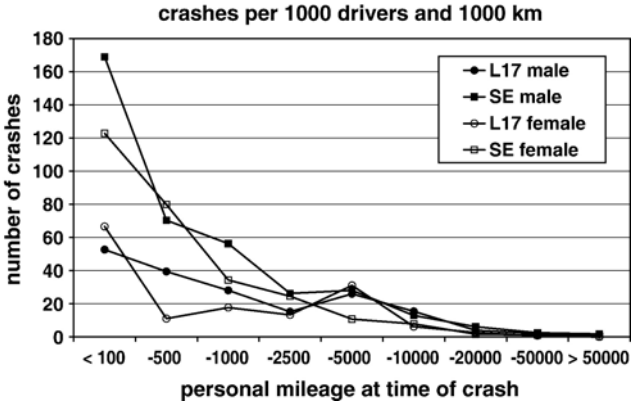

Fig. 5. The number af crashes per 1000 drivers and personal mileage at time of crash in Austria by gender, for the traditional training system (SE) and the L17 system.(traditional combined with accompanied driving).

Table 3 t4.1
Popularity of accompanied driving (%) and the average amount of pre-license accompanied practice in European countries (2006) Empty cells indicate that data is not available t4.2

Country	% of drivers	Average number of kms/hours Accompanied driving	Effects	
Spain	Under 1			t4.4
Estonia	5			t4.5
Luxembourg	10			t4.6
Austria	15	3000 kms	+	t4.7
Germany	20			t4.8
Finland	20	1000 kms	+	t4.9
France	30	3000 kms	+/−	t4.10
Northern Ireland	34	10 hrs		t4.11
Belgium	55			t4.12
Great Britain	60	15 hrs		t4.13
Latvia	80			t4.14
Norway	82	2000 kms	+/−	t4.15
Sweden	90	80 hrs (=4000 kms)	+	t4.16

(Source CIECA, 2006). t4.17

4.5. Post-license protective measures

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

- Young drivers have been shown to be more susceptible to the effects of alcohol, even at lower levels, than older drivers. Thus, maximum BAC levels of zero or 0.2 g/l for young, novice drivers would be highly desirable.
- Also, important risk reductions have been shown to result from temporarily restricting driving with young passengers and/or at night.

In Europe, however, only few countries have expanded their licensing systems to include protective measures. Moreover, there are large differences in the public acceptability of the different protective measure.

The one countermeasure that can count on the most public support is *the zero alcohol limit for novices*. This measure is already introduced in the Netherlands and Austria, without much resistance. The only debate is regarding whether zero alcohol should be the norm for any young driver irrespective of experience. A second issue is the question of zero versus 0.2 g/l. In Europe the tendency is to adopt 0.2 g/l as the alcohol limit. This is based on the relatively low risk below 0.2 g/l, the high chance of false positive results in tests, and concern regarding the withdrawal of enforcement capacity form higher risk categories (i.e., above 0.2 g/l; e.g., Mathijssen, 1999; Pentillä, Portman, Kuoppasalmi, Lunetta, & Nevala, 2004). To place these European policies in

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perspective, one should bear in mind that alcohol limits *for all drivers* differ between countries, ranging from zero in Sweden to 0.8 g/l in the United Kingdom. Many countries employ 0.5 g/l, which is the maximum recommended by the ECMT ministers.

In Europe there is strong public support for tough alcohol measures, as could be concluded from the responses to the SARTRE questionnaire (2002). SARTRE is the acronym "Social Attitudes to Road Traffic Risk in Europe." This questionnaire is regularly administered in the EU countries and deals with driver opinions, preferences and self-reported behavior. The results show that an overwhelming majority of the 24,000 drivers interviewed (88%) would like to have more severe penalties for drunk drivers in their country, and the differences on this subject between the EU member states were small. Of all the drivers, 45% are of the opinion that there should be a BAC limit of 0 g/l. On protective restrictions with respect to alcohol use by novices, even more Europeans are in favor of lower limits; 82% of drivers from all countries in the SARTRE project are 'very' or 'fairly' in favor of a BAC limit of 0 g/l for novice drivers.

As yet, no European countries have introduced a night curfew for novice drivers or restrictions on carrying passengers. However, there are insurance-based initiatives encouraging young drivers not to drive at night by using premium incentives and "black boxes" to monitor driving.

4.6. Advanced (or second phase) driver training

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

Depending on the system, advanced training is applied in Europe as part of a second phase in the licensing process, or after licensing for solo driving. In Austria, Finland and Luxembourg, post license training is a compulsory part of a two-phase licensing system. Post license training is also offered as a voluntary option in a number of countries such as Denmark, the Netherlands, Germany and Sweden (Evers, 2000).

Evaluation studies in several European countries (e.g., NovEV, 2002) have confirmed earlier findings (e.g., Glad, 1988; Gregersen, 1996) that these courses are counter-productive if they focus on vehicle skills (see also Advanced, 2002 for an overview of the literature).

4.6.1. Demerit point systems and incentives

Clearly, many of the countermeasures inherent to the licensing process will not be relevant without effective enforcement, coupled with serious repercussions that act as disincentives to infringements and unsafe behavior in general.

For this reason several countries in Europe have introduced demerit point systems that particularly target novice drivers who would either receive more points per infraction, or be subject to a lower point threshold than more experienced drivers for losing their licenses or being sent to a rehabilitation course.

Several evaluation studies were carried out to assess the effectiveness of such schemes. In Germany a general preventative effect was demonstrated in the first year after implementation of a special demerit point system, with decreases in the crash involvement of the target group or parts of it of about 5% (Meewes & Weissbrodt, 1992). The long-term effects could not be studied because of the major demographic and cultural changes that resulted from the reunification of Germany. A 19% crash reduction in Austria (Bartl & Stummvoll, 2000) resulted from the combined introduction of a point system and a lower alcohol limit for novice drivers (from 0.8 g/l to 0.1 g/l BAC). In contrast, the results of a new penalty points system for novice drivers introduced in Great Britain in 1997 did not lead to a significant decrease in crashes in the first year and only to a slight change in the second (Simpson, Chinn, Stone, Elliott, & Knowles, 2002). In Finland the introduction of such a system in 1996 only resulted in a decrease in the number of repeat offenders among young drivers (Hatakka, Keskinen, Katila, Laapotti, & Peraaho, 2000).

Despite the fact that meta-analyses have shown that *incentives* can be as effective as punishments in changing driver behavior (e.g., Hagenzieker, Bijleveld, & Davidse, 1997), only one program of this nature has been evaluated in Europe. In this study, a special "reverse bonus system" was offered to 18–22 year-old car insurance holders. When no claim was made in the course of a 5-year period the accrued bonuses, which amounted to about 2.5 times the annual premium, were paid out to insurance holder. This system led to a reduction in crashes of about 20% (Elvik & Vaa, 2004; Vaaje, 1990). However, volunteer bias may also account for (part of) the effect.

4.7. New technologies

New technologies are available to support young, novice drivers. For instance a UK-based insurance company has advertised a technology-based incentive scheme especially targeting young, male drivers, whereby clients are offered the option of putting a GPS-based black box in their vehicle in exchange for a 40% discount on their premium if they do not drive between 11 pm and 6 am. Each time they choose to drive during this period they pay £25. Notably, this program was only available to 17 and 18 year-old males insuring cars up to 1400 cc's and 19–25 year-old males with cars.

Similar schemes can be imagined for the use of alcohol interlocks, which have been proven to be effective with repeat-offending drunk drivers. As far as we know, no experiments have been carried out in the EU targeting the use of this technology at novice drivers.

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Current experiments on the effect of ADAS (Advanced Driver Assistance Systems) on safety do not include young drivers as a specific target group. Many of the technologies presently entering the market have potential for reducing young novice drivers' crash risk. In some instances there may also be potential for creating new risks. Much research remains to be done to understand the full implications of these technologies for young drivers.

5. Discussion

Taking all the new initiatives into account one may conclude that compared to earlier overviews (e.g., Heinrich, Neumann-Opitz, & Siebenhaar, 1994; Lynam & Twisk, 1995; Siegrist, 1999) most countries in Europe are now moving from uni-phased licensing systems to multi-phased licensing systems that contain elements like accompanied practice, protective measures, probation period and second phase training. Like the graduated driving licensing systems in USA, Canada, New Zealand and Australia, also the new developments in Europe are founded on the basic principle to allow novices to gain experience under safe conditions.

6. Conclusions

Young driver risk represents a serious public health problem. Young people's over-representation in traffic crashes and fatalities results from factors of experience, age and gender, and is exacerbated by a number of circumstances, such as driving at night, with young passengers, at high speed, under the influence of alcohol or drugs, and/or without using seat belts. The solutions lie in the application of a range of countermeasures, which will allow young drivers to gain adequate experience and develop skills before being exposed to the full challenge of solo driving. These countermeasures should include improvements in the areas of training, education, testing, communication, enforcement, and technology, among others. This action will not always be popular, and will thus require a strategic approach, based on scientific analysis of the problem and its solutions, clear communication, close co-ordination with stakeholders, and political leadership.

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