

Young novice drivers, driver education and training

Literature review

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VTI rapport 491A · 2003

Second revised edition 2004-03-05

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Publisher:  Swedish National Road and Transport Research Institute SE-581 95 Linköping Sweden	Publication: Rapport 491A	
	Published: 2003	Project code: 40509
	Project: Literature review: Young novice drivers, driver education and training	
Author: Inger Engström, Nils Petter Gregersen, Kati Hernetkoski, Esko Keskinen, Anders Nyberg		Sponsor: Swedish National Road Administration Swedish Agency for Innovation Systems
Title: Young novice drivers, driver education and training. Literature review		
Abstract (background, aims, methods, results) max 200 words: <p>A great many people are killed or seriously injured in road traffic with young novice drivers every year, which constitutes a major public health problem. Considering the rapid progress being made in developing different road safety measures, new knowledge must be spread more quickly and be put into application. Therefore, VTI and the University of Turku has carried out this literature review about young novice drivers, driver education and training on commission from the Swedish National Road Administration with additional funding from Swedish Agency for Innovation Systems (VINNOVA). The review was carried out from January to April 2003. The aims were to review literature concerning:</p> <ol style="list-style-type: none"> 1. Driving behaviour and accident involvement during the first years with a licence, including the underlying psychological and social processes as well as in-vehicle support systems and their implication for young, novice drivers. 2. Methods and incentives used to influence young drivers' attitudes and behaviour, with special attention to alcohol, seat belt use and speeding. 3. The impact of high school driver education on young novice drivers' safety. 4. The impact of different licensing systems on young novice drivers' safety. <p>In all, this review contains 322 different references.</p> <p>As a result of the review, conclusions were drawn about the accident situation for young novice drivers, the different psychological, social and pedagogical processes that contribute to their driving behaviour and how their safety can be approved through driver education and other methods.</p> <p>The literature review has clearly shown that there is much knowledge about driver behaviour, road safety and educational methods that has not yet been applied in the Swedish driver education system. It is thus suggested that an experiment is launched where new methods and structures are tested on a large scale basis. If this is never done, it will be impossible to solve the road safety problems of young drivers.</p>		
ISSN: 0347-6030	Language: English	No. of pages: 138

<p>Utgivare:</p>  <p>Väg- och transport- forskningsinstitutet</p> <p>581 95 Linköping</p>	<p>Publikation: Rapport 491A</p>	
<p>Författare: Inger Engström, Nils Petter Gregersen, Kati Hernetkoski, Esko Keskinen och Anders Nyberg</p>	<p>Utgivningsår: 2003</p>	<p>Projektnummer: 40509</p>
<p>Titel: Unga nyblivna förare och förarutbildning. Litteraturöversikt</p>	<p>Projektamn: Litteraturöversikt: Unga nyblivna förare och förarutbildning.</p>	
<p>Uppdragsgivare: Vägverket VINNOVA</p>		
<p>Referat (bakgrund, syfte, metod, resultat) max 200 ord:</p> <p>Ett stort antal människor skadas och dödas varje år i olyckor där unga förare är inblandade, ett förhållande som är ett av våra största folkhälsoproblem både nationellt och internationellt. Med tanke på den snabba utvecklingen av kunskaper och trafiksäkerhetsåtgärder finns det ett stort behov av en effektiv kunskapspridning så att bra åtgärder kan komma till användning så snabbt som möjligt. Därför har VTI och Åbo Universitet på uppdrag av Vägverket och med tilläggsfinansiering från VINNOVA gjort en litteraturöversikt om unga förare och förarutbildning. Översikten har gjorts under våren 2003. Studiens syften var att sammanställa litteratur avseende:</p> <ol style="list-style-type: none"> 1. Förarbeteende och olycksinblandning under de första åren med körkort, inklusive underliggande psykologiska och sociala processer samt IT-baserade stödsystem i bil och deras specifika innebörd för användning bland unga nya förare. 2. Metoder och åtgärder för att påverka unga förares attityder och beteenden med speciellt fokus på alkohol, bilbälten och hastighet. 3. Effekten av förarutbildning i skolan på unga nya förares säkerhet. 4. Effekten av olika körkortsutbildningssystem på unga nya förares säkerhet. <p>Sammanlagt omfattar översikten 322 olika referenser.</p> <p>Som ett resultat av översikten har ett antal slutsatser dragits om olycksituationen för unga nya förare, de olika psykologiska, sociala och pedagogiska processer som bidrar till deras körbeteende och hur deras säkerhet kan förbättras genom förarutbildning och andra metoder.</p> <p>Litteraturöversikten har tydligt visat att det finns en stor kunskapsbank om förarbeteende, trafik-säkerhet och utbildningsmetoder som ännu inte tillämpats i det svenska utbildningssystemet. Därför föreslås att en experimentell studie startas upp där nya metoder och strukturer för förarutbildning provas i stor skala. Om nya metoder och angreppssätt i förarutbildningen inte provas kommer det att vara omöjligt att lösa trafiksäkerhetsproblemet för de unga nyblivna bilförarna.</p>		
<p>ISSN: 0347-6030</p>	<p>Språk: Engelska</p>	<p>Antal sidor: 138</p>

Preface

This literature review has been carried out on commission of the Swedish National Road Administration (SNRA) with additional funding from Swedish Agency for Innovation Systems (VINNOVA). Contact person at SNRA has been Hans-Yngve Berg. Project leader at VTI has been Nils Petter Gregersen and at the University of Turku, Esko Keskinen. Thanks to Claes Eriksson at VTI library who performed large parts of the literature search. Thanks also to Margareta Rosberg for taking care of the administrative matters of the project and to Gunilla Sjöberg for making the final layout of the report.

Linköping August 2003

Nils Petter Gregersen
Project leader

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Young novice drivers, driver education and training. Literature review

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Summary

A great many people are killed or seriously injured in road traffic every year, which constitutes a major public health problem. Considering the rapid progress being made in developing different road safety measures, new knowledge must be spread more quickly and be put into application, first and foremost by system designers, but also by others in positions of responsibility within the road safety sector. One fast and cost-effective means of finding out where research stands today is to systematically review, analyse and make a compilation of the scientific literature published in the field.

Therefore, VTI and the University of Turku has carried out this literature review about young novice drivers, driver education and training on commission from the Swedish National Road Administration with additional funding from the Swedish Agency for Innovation Systems (VINNOVA). The review was carried out from January to April 2003.

The aim of the study

The area of this literature review is young, novice drivers, driver education and training. To cover this field there were four aims in accordance with the commission from the Swedish National Road Administration. The aims were to review literature concerning:

1. driving behaviour and accident involvement during the first years with a licence, including the underlying psychological and social processes as well as in-vehicle support systems and their implication for young, novice drivers
2. methods and incentives used to influence young drivers' attitudes and behaviour, with special attention to alcohol, seat belt use and speeding
3. the impact of high school driver education on young novice drivers' safety
4. the impact of different licensing systems on young novice drivers' safety.

Method

Literature was searched at VTI and Turku University. From these searches approximately 1,300 abstracts were obtained, which were classified as relevant or not relevant with regard to the aims of the study. Apart from these searches additional literature was incorporated through the authors' knowledge of relevant literature from earlier own work in the area, information from colleagues around the world, by checking reference lists from earlier reviews, reports and articles as

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well as searches via different reference programs. In all, this review contains 325 different references.

Disposition

After an introductory chapter, four separate chapters follow written to fulfil the aim of the study.

- Chapter 2 which contains information about young novice drivers, their driving behaviour, accident involvement during the first years with a licence, accident pattern, epidemiology and observed behaviour, underlying psychological and social processes and implications of in-vehicle systems on young novice drivers.
- Chapter 3 which contains information about methods and incentives that have been used to influence young drivers' attitudes and behaviour, especially regarding alcohol, seat belt use and speeding. This chapter also includes a description of the so called GDE (Goals of Driver Education) model.
- Chapter 4 which contains information about high school driver education.
- Chapter 5 which contains information about the impact of different licensing systems on young novice drivers' safety.

The report ends with chapter 6 which consists of general conclusions and recommendations from the findings in the earlier chapters as well as proposals relevant for a possible renewal of the Swedish driver training system.

Conclusions

The review led to the following conclusions:

- The high accident involvement among young novice drivers is partly an effect of lack of knowledge, insight, risk awareness and experience and partly an effect of age- related factors such as lifestyle, peer groups, socialisation process and maturity.
- The acquisition of much experience is a crucial ingredient in driver education and training. The evaluations of lowered age limit for practising in Sweden and of GDL systems in many countries have shown that if experience is gained under supervision and under safe circumstances, the accident involvement after licensing is reduced compared with gaining the experience alone, together with peers after having obtained a full licence.
- In order to be a safe driver, it is not enough to be able to control the vehicle well and in accordance with the traffic rules. A safe driver must also be able to plan the trip safely with regard to mode of transport, with whom, route choice, etc. It is crucial to be able to decide when to avoid driving, such as under the influence of alcohol, other drugs or fatigue. It is also important to have a realistic assessment of own ability to control the vehicle, to drive in traffic and to be aware of what motives and preferences govern own behaviour and own choices. The knowledge about where risks in traffic may occur is crucial and how they are avoided through large safety margins and well developed hazard perception. All these aspects are covered in the GDE-matrix (described in Section 3.2).
- Young drivers are especially over-represented in certain types of accidents such as single accidents, loss-of-control accidents, accidents related to excessive speeding, alcohol, fatigue, night-time and weekends. Accidents

where seat belt has not been used and accidents with young passengers are also over-represented among young drivers.

- Certain youth groups are involved in more accidents than others. Male drivers have a higher accident risk than female drivers (even if young women also are over-represented compared with older women). There is also a difference between male and female drivers in terms of accident types where male accidents more often lead to serious injuries. It is possible to identify high-risk groups through analyses of personality, lifestyle, or socio-economy (economy in the family, parents' education and occupation, school grades, criminal records etc.). None of the currently available tests, however, is good enough to predict who will be involved in accidents.
- If high-school driver education is to be introduced, it should be arranged in a way where earlier licensing with thereby following higher accident risk is avoided. The content of the high-school education should not focus on vehicle manoeuvring and control but more general aspects belonging to the higher levels of the GDE-matrix.
- Second-phase education and other education countermeasures where the upper parts and the right columns of the GDE matrix are covered are beneficial for safety. In driver education risk awareness methods should be used on a regular basis and as a standard procedure to gain changes in attitudes. Educational methods that might be appropriate to increase drivers' skills for self-evaluation include e.g. improved feedback during training, self-evaluation tools like questionnaires and scales, discussions with other drivers about personal experiences and evaluations made by instructors or examiners.
- Restrictions in GDL systems have proved to be successful for lowering crash involvement during the learner stage. These conclusions apply to night time curfews, rules for lower BAC levels and passenger restrictions.
- The introduction of short professional courses in exchange for a reduction of general practising periods has not been proved to be beneficial for safety. The extended practice that is achieved during this period seems to give more safety benefits than the currently evaluated courses.
- There is a need for structure of the supervised practice. Research shows that just gaining experience is not enough to solve the accident problem during the first years as a novice driver. The effect will most likely be greater both considering accidents happening during supervision and during the first years as a novice driver, if the necessary experience has been gained in a well structured way.
- A system that includes the combination of structured supervised driving and a professional driver education with a relevant content has a potential to reduce accidents during both practice and the first years as a novice driver.
- Laws and enforcement are effective in influencing the behaviour of drivers, not just young drivers. Examples of positive laws and enforcement effects are the decrease in drunken driving, the increase in the use of seat belts and the lower speeds. Besides these effects, laws and enforcement have decreased crashes. However, certain groups of young drivers and males are harder to influence.
- Laws and enforcement can produce even better results if the acceptance and support of the general public is gained. But there must be awareness and knowledge of laws which could be reached via campaigns and enforcement.

Another way to get people to follow the laws is to have a penalty point system. A system that gives strict rules for behaviour.

- Despite laws, enforcement, good driver training, educational measures and campaigning, there are drivers who are not reached via these methods. These high risk drivers often have problems other than those directly related to their driving behaviour. Driver improvement courses and driver rehabilitation can offer possibilities when dealing with these drivers.
- Campaigns and educational methods have not been very successful in changing drivers' attitudes and behaviour. Some of the campaigns have been more promising than others, but long lasting effects seem to be hard to get. This does not mean that they are unnecessary or a waste of time and money. It means that campaigns should be conducted on a regular basis and more often.
- Campaigns and educational methods are also essential and important in maintaining the present situation. Their meaning is also essential because there will always be new cohorts to educate as new generations of young people enter traffic.
- Attitudes are closely connected to motives and emotions and they have connections to all levels of a person's behaviour because they operate on the highest levels of the driver behaviour hierarchy described in chapter 3.
- Attitudes affect behaviour, but behaviour also affects attitudes. Attitudes are connected to behaviour but they do not determine it, there are also other important factors such as motives and emotions.
- Safety increasing laws concerning alcohol are for example lowered blood alcohol levels for novice drivers, minimum legal drinking age, sobriety checkpoints etc.
- Laws need enforcement to be effective and effects of laws and enforcement can be supported by media campaigns. Combinations of different methods give the best results.
- Knowledge gains are easier to produce by campaigns than changes in attitudes and behaviour and effects are bigger in low risk groups.
- Short term effects of brief intervention campaigns for increasing the use of safety belts are often found. Campaigns should be repeated regularly.
- Safety promoting methods using active participation of drivers have had positive results concerning safe behaviour.

Recommendations with special relevance for the Swedish licensing system

The following recommendations for the Swedish driver education system are partly based on the results of the literature review and partly on the facts of how the Swedish system is designed today. There is a need for a new national curriculum, in which the whole GDE-matrix is covered. A prerequisite for all educational measures is that there must be a harmony between the goals of the curriculum, the content of the education and the design of the licensing test. As a consequence of introducing a new curriculum, a number of additional changes will be necessary.

- The lay instructed training in Sweden is extensive and should be maintained and strengthened.
- The education should be structured in accordance with the goals of the curriculum.
- The professional instructors and the lay supervisors should have the necessary competence for their respective role in the education process.
- There are accidents during practice, which lead to fatalities and injuries. In accordance with the Swedish “Vision Zero” the Swedish driver education system must be changed in order to avoid these accidents in the future.
- The lay supervisors need an introductory education in order to understand the risks during lay instructed practice and the need to adjust the practice in order to avoid these risks. The education should also provide knowledge about how to structure the training in a correct way.
- Professional driving instruction should have a stronger role in the education, mainly for two purposes; to support and structure the lay instructed practice and to cover aspects from the curriculum that lay supervisors or students cannot be expected to handle themselves. Mandatory training is thus necessary for parts that lay supervisors cannot be expected to manage such as driving in darkness, overtaking and environmental friendly driving.

The literature review has clearly shown that there is much knowledge about driver behaviour, road safety and educational methods that has not yet been applied in the Swedish driver education system. It is thus suggested that an experiment is launched where new methods and structures are tested on a large scale basis.

Unga nyblivna förare och förarutbildning. Litteraturöversikt

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Sammanfattning

Ett stort antal människor skadas och dödas varje år i olyckor där unga förare är inblandade, ett förhållande som är ett av våra största folkhälso-problem både nationellt och internationellt. Med tanke på den snabba utvecklingen av kunskaper och trafiksäkerhetsåtgärder finns det ett stort behov av en effektiv kunskapspridning så att bra åtgärder kan komma till användning så snabbt som möjligt. Ett snabbt och kostnadseffektivt sätt att ta reda på var forskningen står idag är att systematiskt granska, analysera och sammanställa den vetenskapliga litteratur som finns publicerad inom området. Därför har VTI och Åbo universitet på uppdrag av Vägverket och med tilläggsfinansiering från VINNOVA gjort denna litteraturöversikt om unga förare och förarutbildning. Översikten har genomförts under våren 2003. Översikten har resulterat i en rad konkreta rekommendationer för hur situationen för de unga nyblivna förarna kan förbättras, bl.a. genom förändringar av körkortsutbildningen på flera punkter.

Studiens syfte

Området för denna litteraturöversikt är unga nyblivna förare och förarutbildning. För att täcka detta område formulerades 4 delsyften i överensstämmelse med uppdraget från Vägverket. Dessa syften var att sammanställa litteratur avseende:

1. Förarbeteende och olycksinblandning under de första åren med körkort, inklusive underliggande psykologiska och sociala processer samt IT-baserade stödsystem i bil och deras specifika innebörd för användning bland unga nya förare.
2. Metoder och åtgärder för att påverka unga förares attityder och beteenden med speciellt fokus på alkohol, bilbälten och hastighet.
3. Effekten av förarutbildning i skolan på unga nya förares säkerhet.
4. Effekten av olika körkortsutbildningssystem på unga nya förares säkerhet

Metod

Litteratursökningar genomfördes med hjälp av biblioteken på VTI och på Åbo universitet. Dessa sökningar resulterade i ca 1 300 referat från olika vetenskapliga studier. Dessa klassificerades som relevanta eller ej relevanta med hänsyn till studiens syften. Utöver dessa litteratursökningar inkluderades ytterligare studier genom författarnas kännedom om relevant litteratur från tidigare egna studier,

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från kollegor runt om i världen, genom att gå igenom referenslistor i tidigare sammanställningar, rapporter eller artiklar samt genom egna sökningar på Internet. Sammanlagt har 325 studier inkluderats i översikten.

Disposition

Efter ett introduktionskapitel följer fyra separata kapitel i enlighet med studiens fyra delsyften.

- Kapitel 2, vilket innehåller information om unga, nyblivna förare, deras körbeteende, olycksinblandning under de första åren med körkort, olycksmönster, epidemiologi och observerat beteende, underliggande psykologiska och sociala processer samt konsekvenser av IT-baserade stödsystem i bil för dem.
- Kapitel 3, vilket innehåller information om metoder och åtgärder som har använts för att påverka unga förares attityder och beteende, speciellt med avseende på alkohol, bilbälten och hastighetsöverträdelser. Detta kapitel innehåller också en beskrivning av den s.k. GDE-matrisen (Goals of Driver Education).
- Kapitel 4, vilket innehåller information om erfarenheter av förarutbildning som genomförts i den vanliga skolan.
- Kapitel 5, vilket innehåller information om erfarenheter av olika körkortsutbildningssystem och deras effekt på trafiksäkerheten för den aktuella förargruppen.

Rapporten avslutas med kapitel 6 som innehåller generella slutsatser och rekommendationer som baseras på resultaten av sammanställningens fyra delar samt förslag till möjliga förbättringar av det svenska förarutbildningssystemet.

Slutsatser

Från översikten drogs följande slutsatser:

- Unga nyblivna förares höga olycksinblandning är delvis en effekt av bristande kunskap, insikt, riskmedvetenhet och körerfarenhet och delvis en effekt av åldersrelaterade faktorer såsom livsstil, kamratgrupper, socialiseringsprocess och mognad.
- Tillägandet av stor erfarenhet är en central komponent i förarutbildning och träning. Utvärderingen av 16-årsgräns i Sverige och stegvisa körkortssystem i många länder har visat att om erfarenhet byggs upp under handledning och under säkra omständigheter, minskar olycksinblandningen mera efter att man tagit körkort än om erfarenheten byggs upp utan handledning, ensam eller tillsammans med kamrater efter att man tagit körkortet.
- För att bli en säker förare räcker det inte med att kunna manövrera fordonet bra och i enlighet med trafikreglerna. En säker förare måste också ha kompetens att kunna planera sitt resande med avseende på färdväg, med vem man färdas, när, vilka vägar man väljer etc. Det är avgörande att kunna bedöma när man skall avstå från bilkörning, t.ex. när man konsumerat alkohol, mediciner eller andra droger eller när man är trött. Det är också viktigt att ha en realistisk uppfattning om ens egen förmåga att hantera bilen, att köra i trafik och att vara medveten om vilka motiv och preferenser som styr de egna valen och det egna beteendet. Kunskaper om var riskerna i trafiken är som störst är centrala liksom förmågan att undvika dessa genom att köra med stora säkerhetsmarginaler och välut-

vecklad förmåga att upptäcka farliga situationer. Alla dessa aspekter omfattas av den s.k. GDE-matrisen (se avsnitt 3.2).

- Unga förare är speciellt överrepresenterade i vissa typer av olyckor såsom singelolyckor, olyckor där de förlorat kontrollen över bilen, olyckor relaterade till höga farter, alkohol, trötthet, kvällstid och helger. Olyckor där säkerhetsbälte inte används och olyckor med unga passagerare är också överrepresenterade bland unga förare.
- Vissa ungdomsgrupper har en högre olycksinblandning än andra. Unga män har en högre olycksrisk än unga kvinnor (även om också unga kvinnors risk är högre än andra kvinnors). Det finns också en skillnad mellan män och kvinnor när det gäller olyckstyp där mäns olyckor oftare leder till allvarigare skador. Det är också möjligt att identifiera högriskgrupper genom analyser av personlighet, livsstil eller socioekonomisk position. Inget av de test som använts för detta syfte har emellertid speciellt god förmåga att förutsäga vilka som kommer att bli inblandade i olyckor.
- Om förarutbildning skall införas i gymnasiet bör den arrangeras på ett sätt så att den inte leder till att man tar körkort tidigare och därmed leder till en ökad olycksinblandning. Innehållet i gymnasieutbildningen skall inte fokusera på fordonsmanövrering utan istället ta upp mer generella aspekter som hör till de övre nivåerna i GDE-matrisen.
- Den andra fasen av tvåfasutbildningar där de övre nivåerna av GDE-matrisen vanligtvis tas upp, har visat sig vara bra för trafiksäkerheten. För att åstadkomma positiva attitydförändringar bör metoder regelmässigt användas i förarutbildningen som ger större medvetande om vilka riskerna är i trafiken. Utbildningsmetoder som är lämpliga för att öka förarens förmåga till självinsikt är t.ex. bättre återkoppling till eleven under träning, självvärderingsformulär såsom frågeformulär och olika skalor, diskussioner med andra förare om egna erfarenheter samt utvärderingar gjorda av instruktörer och provare.
- Restriktioner i stegvisa körkortssystem (GDL) har visats leda till sänkning av olycksrisken under inlärningsperioden. Detta har påvisats för körförbud nattetid, regler för lägre tillåten alkoholhalt i blodet och regler för begränsning av att ha passagerare i bilen.
- Att införa korta professionella kurser i utbyte mot förkortning av privat övningskörning har inte visats vara bra för trafiksäkerheten. Den utökade erfarenhet som mycket övning i trafik ger tycks ge större vinster än de utbyteskurser som hittills utvärderats.
Det finns ett behov av att strukturera den privata övningskörningen. Forskning visar att enbart erfarenhetsinhämtning inte är tillräckligt för att lösa olycksproblemet under de första åren med körkort. Effekten blir sannolikt större både med avseende på övningsolyckor och på olyckor under de första åren med körkort om den nödvändiga erfarenheten uppnås på ett välstrukturerat sätt.
- Ett system som innehåller en kombination av strukturerad handled övningskörning och en professionell förarutbildning med ett relevant innehåll har en potential att minska olycksinblandningen både under övning och under de första åren med körkort.

- Lagar och sanktioner är effektiva sätt att påverka förarens beteende både bland unga och bland andra. Exempel på positiva effekter av lagar och sanktioner finns när det gäller minskning av rattonykterhet, ökning av bältesanvändning och sänkning av hastigheter. Utöver dessa beteendeförändringar har dessa åtgärder inneburit färre olyckor. Vissa grupper av unga förare och män har visat sig vara svåra att påverka.
- Lagar och sanktioner kan åstadkomma ännu bättre resultat om man kan få acceptans och stöd från allmänheten. Det krävs också medvetenhet och kunskap om vilka lagar som gäller, något som kan åstadkommas genom kampanjer och sanktioner. Ytterligare en metod för att få förare att följa lagar är att införa straffpoängssystem, vilket är ett system som ger strikta regler för körbeteende och vad överträdelser leder till.
- Trots lagar, sanktioner, bra förarutbildning och kampanjer finns det förare som inte går att komma åt med dessa metoder. Dessa förare har ofta andra problem i kombination med deras farliga körbeteende. Här har rehabiliteringsinsatser visat sig kunna vara en framkomlig väg.
- Kampanjer har generellt sett inte påvisats vara lyckosamma i att förändra förarens attityder och beteende. Vissa kampanjer har lyckats bättre än andra, men långsiktiga effekter tycks vara svåra att uppnå. Detta innebär inte att de är onödiga eller slöseri med tid och pengar. Det visar istället att kampanjer bör bedrivas på ett mer regelbundet sätt och oftare.
- Kampanjer och utbildning är också viktiga metoder för att upprätthålla den rådande situationen eftersom det ständigt tillkommer nya förare som är i behov av utbildning och kunskap om vilka beteenden som är de riktiga.
- Attityder hör nära samman med motiv och känslor och de har förbindelser med alla aspekter av en persons beteende eftersom de verkar på de högsta nivåerna i den s.k. GDE-matrisen.
- Attityder påverkar beteende men beteende påverkar också attityder. Attityder är relaterade till beteende men relationen är inte absolut. Det finns andra viktiga faktorer såsom motiv och känslor.
- Säkerhetshöjande åtgärder för alkohol är t.ex. sänkt promillegräns för nyblivna förare, lägsta åldersgräns för alkoholkonsumtion och nykterhetskontroller.
- Lagar behöver övervakning och sanktioner för att vara effektiva. De kan stödjas av att kombinera dem med t.ex. mediakampanjer. Kombination av olika metoder ger bästa resultat.
- Genom kampanjer är det lättare att åstadkomma kunskapsökning än förändringar i attityder och beteende. Effekterna är större i lågriskgrupper.
- Säkerhetsförbättrande insatser där man använder aktivt deltagande av förare har haft positiva effekter på säkerheten.

Rekommendationer med speciell relevans för det svensk förarutbildnings-systemet

Följande rekommendationer baserar sig dels på resultaten av den föreliggande översikten, dels på fakta om hur det svenska utbildningssystemet är upplagt idag. Det behövs en ny kursplan där hela GDE-matrisen kan omfattas. En förutsättning för alla utbildningsinsatser är också att det finns en harmoni mellan utbildningens mål, dess faktiska innehåll och genomförande samt utformningen av provet. En konsekvens av att införa en ny kursplan blir därför att också andra komponenter i systemet behöver förändras.

- Den privata övningskörningen i Sverige är omfattande och bör behållas samt förstärkas.
- Utbildningen bör struktureras i enlighet med kursplanens mål.
- Professionella lärare och privata handledare måste ha nödvändig kompetens för sina respective roller i utbildningsprocessen.
- Det inträffar olyckor under övningskörning som leder till att människor skadas eller dödas. I enlighet med nollvisionen bör därför utbildningssystemet förändras så att sådana olyckor undviks utan att de positiva effekterna av den privata övningskörningen äventyras.
- De privata handledarna behöver en introduktionsutbildning för att förstå vilka risker som finns under övningskörning och hur övningen kan läggas upp så att dessa risker minimeras. Utbildningen bör också ge kunskaper om hur träningen skall struktureras på bästa sätt.
- Den professionella utbildning måste få en starkare roll i utbildningen, främst med två focus; att stödja och strukturera den privata övningskörningen och att utbilda i sådana aspekter av kursplanen som handledaren inte kan förväntas klara av själva. Obligatoriska inslag är därför nödvändiga för ett flertal moment såsom t.ex. mörkerkörning, omkörning och miljövänlig körning.

Litteraturöversikten har tydligt visat att det finns en stor kunskapsbank om förarbeteende, trafiksäkerhet och utbildningsmetoder som ännu inte tillämpats i det svenska utbildningssystemet. Därför föreslås att en experimentell studie startas upp där nya metoder och strukturer för förarutbildning provas i stor skala. Om nya metoder och angreppssätt i förarutbildningen inte provas kommer det att vara omöjligt att lösa trafiksäkerhetsproblemet för de unga nyblivna bilförarna.

1 Introduction

1.1 The commission

A great many people are killed or seriously injured in road traffic every year, which constitutes a major public health problem. Considering the rapid progress being made in developing different road safety measures, new knowledge must be spread more quickly and be put into application, first and foremost by system designers, but also by others in positions of responsibility within the road safety sector. One fast and cost-effective means of finding out where research stands today is to systematically review, analyse and make a compilation of the scientific literature published in the field.

Therefore, the Swedish National Road Administration has commissioned this literature review about young novice drivers, driver education and training. The review was carried out by VTI and the University of Turku from January to April 2003.

1.2 The aim of the study

The area of this literature review is young, novice drivers, driver education and training. To cover this field there were four aims in accordance with the commission from the Swedish National Road Administration. The aims were to review literature concerning:

1. driving behaviour and accident involvement during the first years with a licence, including the underlying psychological and social processes as well as in-vehicle support systems and their implication for young, novice drivers
2. methods and incentives used to influence young drivers' attitudes and behaviour, with special attention to alcohol, seat belt use and speeding
3. the impact of high school driver education on young novice drivers' safety
4. the impact of different licensing systems on young novice drivers' safety.

1.3 Method

Literature was searched with the help of the VTI library. Searches were performed in the databases ITRD, TRIS and ERIC. Searches were also made in the VTI library catalogue TRAX. Database searches were limited from the year 1995 and forward. At Turku University searches were conducted in the databases PsycInfo, MedLine and ERIC.

Examples of words used in the searches are;

- novice drivers/young drivers/teenage drivers/learner driver/adolescent/recently qualified driver
- traffic safety
- evaluation/assessment/surveys/literature reviews/state of the art/bibliography
- accident/accident rate/accident reduction/accident prevention/crashes/collisions/injury/traffic accidents/risk
- driver training/education/curfew/lay instruction/supervision
- licensing systems/graduated licensing/provisional licence/probationary licence/post licensing measures/two-phase driver training/driving licence
- high school/school/college
- behaviour/attitude/attitude change

- campaign
- emotion/metacognition/self-evaluation
- seat belt/speeding/alcohol/drunkenness/drunk driving/blood alcohol content
- driving experience/personality/traits/social/sensation seeking/lifestyle/risk taking
- enforcement
- learning
- intervention/prevention
- before and after studies/cost benefit analyses/follow up
- human factor
- violations/offences/convictions/penalty.

From these searches approximately 1,300 abstracts were obtained, which were classified as relevant or not relevant with regard to the aims of the study. Thereafter the relevant studies were ordered. Apart from these searches additional literature was incorporated through the authors' knowledge of relevant literature from earlier own work in the area, information from colleagues around the world, by checking reference lists from earlier reviews, reports and articles as well as searches via the reference program ENDNOTE in PUBMEDGM and LIBRIS. In chapter two and three there are several older references included because these chapters include fundamental epidemiological, psychological, social and pedagogical processes. In all, this review contains 325 different references.

1.4 Disposition

After this introductory chapter, four separate chapters follow written to fulfil the aim of the study.

- Chapter 2 which contains information about young novice drivers, their driving behaviour, accident involvement during the first years with a licence, accident pattern, epidemiology and observed behaviour, underlying psychological and social processes and implications of in-vehicle systems on young novice drivers.
- Chapter 3 which contains information about methods and incentives that have been used to influence young drivers' attitudes and behaviour, especially regarding alcohol, seat belt use and speeding. This chapter also includes a description of the so called GDE (Goals of Driver Education) model.
- Chapter 4 which contains information about high school driver education.
- Chapter 5 which contains information about the impact of different licensing systems on young novice drivers' safety.

The report ends with chapter 6 which consists of general conclusions and recommendations from the findings in the earlier chapters as well as proposals relevant for a possible renewal of the Swedish driver training system. Also, the reader should be aware that every chapter (2–5) ends with a reference list containing references used in that chapter.

2 Young novice drivers

by Nils Petter Gregersen

2.1 Driving behaviour and accident involvement during the first years with a licence

The aim of this chapter is to summarise the literature concerning driving behaviour and accident involvement during the first years with a licence, including the underlying psychological and social processes as well as in-vehicle support systems and their implication for young, novice drivers.

One approach that has been used for increased understanding of this is epidemiological, i.e. to analyse accidents and accident distributions as such and actual driving behaviour more or less in depth. Accidents may be studied through in depth accident investigations or through more comprehensive statistical analysis. Actual driving behaviour may for example be studied through observation. Another way to increase understanding has been to analyse the psychological, social and educational processes which contribute to the development of a driver.

In the following text, the review has been divided into these two parts, where the first section covers accident and actual behaviour analyses and the second focuses on psychological and social aspects. The educational aspects are covered in chapters 3, 4 and 5.

If nothing else is written, “accidents” means injury accidents.

2.2 Accident pattern and observed behaviour

2.2.1 Accident statistics

Age related aspects

During the period 1994–2000, there were approximately 800 police reported injury accidents per year in Sweden in which 18–19 years old drivers were involved. For 18–24 year olds the corresponding number was 1,430. In all these accidents a little more than 2,300 persons were injured and about 40 were killed per year (Gregersen and Nyberg, 2002). In terms of health risk (accidents per 1,000 licence holders), 18–19 years old drivers were involved in 5 times more accidents than drivers in the 35–50 years age group during 2001 (2.6 for older drivers compared with 13.2 for younger drivers). The situation with an overrepresentation of young novice drivers is similar in most countries.

In several analyses of accident statistics month by month after licensure, it has been shown that the initially very high accident involvement decreases rapidly already during the first half year of driving. In a Norwegian study, Sagberg (2000) showed that the reduction of accidents per 1,000 drivers was about 50% during the first 8 months. Similar results were shown for Sweden by Gregersen et al. (2000a, 2000b) in their evaluation of the reduced age limit for practising and in Canada by Mayhew et al. (2000) in an analysis of novice drivers' collision rates during their first months of driving. In the Swedish study, the general accident reduction was about 50% during the first 8 months and in the Canadian (Nova Scotia) study the reduction was 41% during the first 7 months. In the Canadian study it was also shown that the reduction was larger for the youngest drivers, mostly due to a lower starting level of collisions for the older novice drivers. This finding is consistent with the results shown by Maycock et al. (1991) where the

initial risk was lower for older novices than for younger ones. The mechanisms behind these changes in accident risks are presented in Sections 2.3.3–2.3.5 below.

During the period 1989–1998, the number of accidents among young drivers in Sweden was dramatically reduced compared to other age groups, mainly as a consequence of a reduction in the number of young licence holders but also as a result of the reduced age limit for practising from 17½ to 16 years (Gregersen, 2000). During the last years, however, the young driver accidents increase again in spite of a continued reduction in youngsters obtaining a licence.

A large number of studies have been published where accident patterns have been analysed thoroughly. Twisk (1995) presented an overview of 5 European studies from 5 European countries where she made a list of typical accident components and how they were found to be associated with young driver accident involvement. Some results concerning over-represented components from four of these studies are shown in table 1 (Germany has been removed here since that study was made when Germany was still divided into West and East Germany).

Table 1 Summary of results from 4 European countries on typical accident components and their association with young driver accidents. Several of these components are discussed further below (from Twisk, 1995).

Country	NL	B	UK	FR
Weekend			+++	+++
Night			+++	+++
Weekend night	+++	+++	+++	
Speed	+++			+++
Single accident	++	+++	+++	++
Severity	++	++		++
Experience	+++	+++		+++
Passengers	++			
Curves	++			
Male	+++	+++	+++	
Young age	+++	+++	+++	
Leisure trip	+++	+++		+++
Age of car	++			++

++ = moderately over-represented

+++ = strongly over-represented

Differences between men and women

When accident patterns of young novice drivers are compared to other drivers without separating men and women, the general pattern often is similar to the male drivers' situation. The accident risk of female young drivers is lower than the risk of male drivers and will, at least in Sweden, gradually diminish with increasing age. For the oldest drivers the risk is highest among women. This has been shown for example in an overview of accident patterns among Swedish drivers (Gregersen, 2001). In Sweden, during the period 1994–2000 male drivers were involved in 77% and female drivers in 23% of the accidents that occurred during the first two years with a licence (Gregersen & Nyberg, 2002). The accident risk during the period 1992–1997 among 18–19 years old Swedish drivers who started practising after 17½ years of age were approximately 10

accidents per 10 million km for male drivers and 8 for female (Gregersen et al., 2000a). When taking exposure into account, the Swedish differences in accident risk between young men and women are not typical for other countries. In a study from Western Australia (Ryan et al., 1998) it was shown that female drivers aged 17–19 had a substantially lower number of accidents and accident rate per population than male drivers of the same age. When taking mileage into account they found that the difference disappeared and the risk per 100 million km was the same for both sexes. Data from the nation wide US data base FARS (Fatality Analysis Reporting System), analysed by Kweon and Kockelman (2003) showed that there was a difference between young (<20 years) male and female drivers of private cars both in terms of accident counts (1.3 times higher for men) and accident risk per million miles (1.2 times higher for men). The difference in accident risk disappeared in the mid age group (20–60 years) and reversed in the oldest, as was the case for Swedish data described above.

2.2.2 Accident type

Young novice drivers are over-represented in most types of accidents. However, there are certain types of accidents in which this over-representation is extra noticeable and where one can assume that these accidents have a close correlation with their novice status as drivers or their youth.

Single accidents and loss-of-control accidents are the type of accidents that have the highest over-representation. From Swedish statistics from 1994–2000 (Gregersen & Nyberg, 2002) it was shown that 27% of the accidents among 18–19 years old drivers were single accidents while the share for other ages was 14%. Of fatal accidents, 32% were single accidents among the youngest and 24% among others. A similar pattern has been reported from several other countries such as UK, where 22% were single accidents among 17–19 years old drivers (Clarke et al., 2001) and Maryland where 25.6% of the accidents of 16 years old drivers were single accidents (Ballesteros et al., 2000).

In accordance with the over-representation of single accidents, the loss-of-control accidents are also clearly over-represented among young drivers as shown by for example Clarke et al. (2002), Harrison, Triggs and Pronk (1999) and Laapotti and Keskinen (1998). Harrison et al. analysed accident data from Victoria and found that loss-of-control accidents held 18% of causal injury accidents among young drivers. Laapotti and Keskinen found that loss-of-control accidents among male drivers more often lead to single accidents while the typical outcome from loss-of-control accidents among female drivers was collisions.

Also left turn accidents have been found to be over-represented among young drivers. In a study by Kirk and Stamatiadis (2000) of young driver accidents in Kentucky it was shown that the involvement in left turn accidents was approximately 2.5 times more common among 16 than 20 year olds. No significant difference was found in their data for gender.

2.2.3 Time and day of accident

Another example is accident occurrence over a typical 24-hour period. There are relatively few studies which provide statistics over accident occurrence relative to time of day and which also take account of the distance driven. Swedish data from 1994 to 2000 on time distribution of accidents showed that young drivers 18–24 years old were over-represented during all hours but especially much

during evening and night hours (Gregersen & Nyberg, 2002). During 1994–2000, 32% of the accidents with 18–19 years old drivers occurred during darkness. The corresponding share for other ages was 22%. The difference was especially high during Friday nights between 19 and 24 and Saturday nights between 19 and 02. Laapotti and Keskinen (1998) also found that fatal loss of control accidents involving young male drivers typically took place during evening and nights. In these figures, there was no control for exposure differences.

An American study (Williams, 1985) has, however, also shown a clearly increased risk per kilometre driven during the night hours, a difference that was clearest among young male drivers. Williams established that although just 20% of their driving took place at night, 16–19 year-olds had 50% of their fatal accidents during this period. The excessive risk was particularly notable during weekends and weekend nights. According to Twisk (1995), even older, more experienced car drivers have a higher accident risk at night, but the difference is less than in the case of young drivers.

2.2.4 Alcohol

Alcohol-related accidents are also common among young drivers. It has been established that youngsters probably do not drive much more often with alcohol in the blood, but that when they do, young drivers are at higher risk than older drivers. Since young drivers driving under the influence of alcohol most often do so during week-end nights, it is primarily then that these drivers are over-represented in alcohol-related accidents. Several studies have also shown that the combination of excessive speed and alcohol is an important and crucial cause of single accidents, especially among young men (Brorsson, Rydgren & Ifver, 1993; Twisk, 1994). In a Norwegian study (Glad, 1985) it was found that if the fatality risk for a sober driver is set at 1, the corresponding relative figure for a drunk 18–25-year-old is 901, and 142 for a drunk aged 25–49.

From Swedish statistics it is clear that the share of alcohol related accidents among young drivers has increased by approximately 30% during the last two years. To a large extent, this increase is regarded as a consequence of the generally increasing consumption of alcohol in Swedish society, which is believed to be related to a changing culture towards alcohol consumption, where everyday consumption in accordance with “continental” European habits becomes more common. In the southern part of Sweden, the Swedish National Road Administration has made in depth studies of fatal accidents. Their results showed that alcohol was involved in about 20% of all fatal accidents, a figure that is much higher when looking at young drivers and weekend nights. German studies of so called “Disco-unfälle” found that 61% of the young drivers in these accidents had a BAC-level above 0.3‰. It was also established that 31% had a blood alcohol concentration above 1.3‰ (Schulze, 1996).

In New Zealand, Begg and Langley (1999) analysed risky road traffic practices among an age-cohort of young adults. In a questionnaire study when the cohort was 21 years old, they found that 49% of the males and 32% of the females had been drinking and driving during the last 30 days. They also found that 19% of the males and 8% of the females had driven the car at least once during the 30-day period after drinking too much to drive safely. The relation between substance use and accidents will be discussed further in connection with lifestyle aspects in Section 2.3.8.

2.2.5 Sleepiness

Research has shown that tiredness is an important direct cause behind many accidents. Corfitsen (1994) and Pack et al. (1995) referred in Clarke et al. (2002) have shown that fatigue is a specially common problem among young male night-time drivers. Corfitsen also claimed that this could lead to a reaction time that is three times longer than in a rested driver. The study of Pack et al. showed that accidents, which could be attributed to drivers falling asleep, peaked at the age of 20 in USA.

From a study in UK, the Department for Transport (DfT) summarises results from the Sleep Research Centre in Loughborough (Flatley, 2001). They showed that men aged 30 years and under are more likely to have a sleep related vehicle accident. They also found that sleep-related vehicle accidents were more likely to result in serious injury than the 'average' road accident. One of their conclusions was that driver education, linked to greater public awareness of the potential dangers of sleepiness, present the best approaches for reducing sleep related accidents.

2.2.6 Car model

Another characteristic of youth-related accidents is that older car models are more often involved. The proportion of accidents involving older cars may not be higher than the proportion of older cars driven by young drivers, but since young people more often drive older cars, they are more exposed to the risk of serious injuries. Older cars often lack modern safety features so they do not protect the human body as effectively as newer models.

In Swedish analyses of statistics where all accidents have been compared to novice driver accidents (SNRA, 1999) it was found that the novice drivers were over-represented in accidents with cars from 1986 and older.

2.2.7 Seat belt usage

In annual observation studies of seat belt usage at a selection of roundabouts in Sweden it is continuously shown that young male drivers are the most typical non-users (Cedersund, 2002). Approximately 83% of young male drivers (18–25 years) used the seat belt in the 2001 observations which may be compared with 90% wearing rate for drivers of all ages. In fatal accidents the seat belt was not used in 40% of the cases, a number that is even higher among young male drivers since their wearing rate is lower than average. In a closer analysis of seat belt usage among novice drivers, Matsuura et al. (2002) showed that novice male drivers started with a high (97%) wearing rate during the first 10,000 km but reduced it to 76% during the following 10,000 km.

In the European SARTRE studies, approximately 17,000 European drivers from 15 countries were questioned about their opinions, attitudes and norms concerning traffic issues. Goldenbeld (1999) reported from these studies that half (50%) of the young male drivers in Europe report not to wear the seat belt always in towns. Also on motorways the use of seat belts was low among young male drivers. Only 72% report that they always wear the seat belt on motorways.

2.2.8 Speed

Young drivers often drive at high speed, which more often leads to them losing control over the vehicle and driving off the road. The higher speed in combination with the fact that young drivers often have more passengers in the car, also results in more severe injuries and more people injured (Evans, 1991; Twisk, 1994; Jonah, 1990). In the UK cohort study, (Forsythe et al., 1995) speeding was found to be by far the most common offence among both male and female young drivers. During the first three years of driving they found that the number of offences for speeding increased. In an American analysis of young driver accidents in California and Maryland (McKnight & McKnight, 2000) driving too fast was estimated to contribute to approximately 20% of all accidents. Among those accidents, failure to adjust to traffic or road conditions was the single largest (approximately 9%) subcategory. In an analysis of accident data from Victoria, Harrison, Triggs and Pronk (1999) found that young drivers were clearly over-represented in speed related accidents. Speeding was most common among male drivers (almost 30% of all causation accidents) compared with female ones (about 21%). Speeding contributed, as a comparison, to approximately 15% among older drivers. They also found that speeding had the highest over-representation among young drivers on roads with bends, subject to speed limits of 70–90 km/h.

Results in line with this pattern were also found by Begg et al. (1999) in their longitudinal study of a cohort of 1,037 young drivers in New Zealand. They found that 38% of the males and 11% of the females reported that they often were driving faster than 120 km/h on the open road.

In observation studies by Waylen and McKenna (2002) young drivers in UK were found to drive significantly faster than older drivers, and male drivers were driving significantly faster than female drivers. The results were valid for dry roads but not for wet roads where no age and sex differences in speed choice were found. In a special study they also observed speed choice in a bend as an accident black spot. Also here they found that young male drivers chose speeds which were higher than those chosen by either younger female drivers or older drivers of either sex.

In the European SARTRE studies, questions were asked about speed choice. Goldenbeld (1999) reports that 35% of young male drivers reported that they drove faster than other drivers and a similar share (33%) said that they drove above the legal speed limit. The percentage of speeding drivers was found to decrease with increasing age and was substantially lower among women of all ages.

2.2.9 Discussion

Most knowledge of this sort is still at a fairly general level. There is only limited amount of literature providing in-depth analysis of novice drivers' accidents compared with accidents involving experienced drivers and which tries to go further back in the causal chain than factors apparent at the time of the accident. With a deeper analysis of this sort, it would be possible to obtain a variety of interesting information, such as the aim of the trip, which motives were important in choosing one's driving style, social influence mechanisms etc. Such psychological/social factors can probably offer a more fundamental starting point for understanding accident-contributory processes than situation-related accident parameters alone, such as the driver's condition and behaviour at the time of the

accident, the vehicle's equipment, road conditions, traffic conditions, time of day etc.

In the next section, a review of factors is presented, that is not directly related to the specific moment of the accident, but rather has to do with the drivers' knowledge and skill, how they are used in traffic, which motives govern driving behaviour and how individual and social circumstances influence the role as a driver.

2.3 Underlying psychological and social processes

2.3.1 Historical development of research

Research about driver behaviour has historically taken a variety of approaches. During the 50s and 60s, when road safety research was in its infancy, much emphasis was placed on the assumption that there were a number of drivers who, for a variety of reasons such as personality, caused most accidents. The focus was also on developing methods of identifying these "accident-prone" types, so as to remove them from the traffic situation. Analyses of various personal circumstances did indeed show some connection with the risk of accidents, but these links were often rather weak. It was soon realised that if one was to create selection principles on the basis of these links, the result would be that many safe drivers would be refused to drive, while many unsafe drivers would slip through the selection process. Since this approach did not meet with much success, it was gradually abandoned, with the emphasis during the 1960s shifting to regarding the driver as a victim who, with his or her basic abilities, is not really created to handle the complexity of modern traffic.

The horizon was accordingly widened to regard accidents as a consequence of the fact that interaction between driver-vehicle-road did not work. Special emphasis was placed on the problem of the human being's perceptual ability. This ability was regarded as inherited and difficult to influence, which meant that the driver became dependent on the design of his vehicle and the road, and could simply be regarded as a fairly passive victim in this interplay.

During the first half of the 1970s, research underwent yet another change, with increasing emphasis being placed on the driver as someone who influences his driving, and who thus shapes his own degree of accident risk. The various motives for driving were studied, and special attention was focused on conditions such as risk compensation and risk homeostasis, which describe how various motives affect our driving and point out that the motive for driving safety does not always necessarily receive the priority it deserves.

Modern research on driver behaviour is dominated by two schools of thought. The first deals with learning and the ability to automate behaviour, while the second emphasises the driver's personal and social circumstances, lifestyle etc. and studies how this affects behaviour. One can to a certain extent discern a slight return to the perspective adopted in earlier 50s and 60s research, but on more stable foundations and with appreciation of the fact that this knowledge cannot be used to select who may or may not drive a car. For a more in-depth description of historical developments in this regard, see for instance the overview of Englund et al. (1997). As an example of a modern study focusing on the ability to predict accidents by defining the accident prone driver Elliot et al. (2000) analysed the persistence of violation and accident behaviour over time. The aim of their study was to investigate the ability of previous offences or accidents to prevent future

involvement by using driver history data. Their results revealed that previous at-fault accident involvement increased the odds for subsequent at-fault accidents by nearly 50%. For offences the corresponding odds were roughly doubled. The study showed, however, that the predictive value was highest among experienced drivers and that in early stages of driving, offences and accidents are, at least partly, attributable to inexperience. Furthermore it was found that accident proneness among experienced drivers is related more to individual factors and circumstances.

Different angles of approach have gained ascendancy over many years of research and development, but we still lack a comprehensive understanding as to why young drivers are over-represented in road accidents. Much know-how has naturally been acquired over the years and we are thus familiar with many of the contributory reasons, but many problems remain unsolved. It is undoubtedly so that although accident risks drop during various periods, the over-representation of young drivers remains relatively constant. One vital concern is therefore to continue to develop the body of knowledge which clarifies just why young drivers are so over-represented in road accidents.

2.3.2 A model for structuring

In order to contribute optimally to the cumulative growth in know-how and to the development of theories and models about car drivers' behaviour, it is important that the problem is also regarded from the other perspective that is to say from the viewpoint of the psychological, educational and social processes which affect our behaviour. Considerable benefit can be drawn here from the general theories about learning, information processing and decision making, attitudes and values or about social interaction and influence, but here it is necessary to further refine both their application in the particular context of novice driver behaviour, and also their mutual significance and interaction in this context.

The starting point for the remaining parts of this chapter is a model which describes some important processes which affect novice drivers' behaviour and their accident involvement (Gregersen & Bjurulf, 1996). The model describes two main processes, firstly the learning process whereby a person learns to drive a car, and secondly the aspects of life one applies to the driving process, that is to say the significance of one's social influences and individual circumstances (Figure 1).

The learning process is conducted through education, training and experience acquisition. This promotes increased skill in handling the car in a safe way and it also promotes increased understanding of the traffic regulations, as well as the risks involved in traffic. Three problems are built into this process:

- experience level: it takes time to develop driving skills and automated behaviour behind the wheel
- overestimation: people sometimes have an unrealistic subjective ability, they overestimate their abilities
- perceived probability of an accident occurring: one does not perceive any real risk of being involved in an accident as an individual, thus promoting a false sense of safety.

Together with the individual and social circumstances, these three factors (experience level, overestimation and perceived likelihood of an accident)

influence motives, attitudes and decision making processes, which in turn affect driving behaviour, for example as expressed in driving style and choice of safety margins.

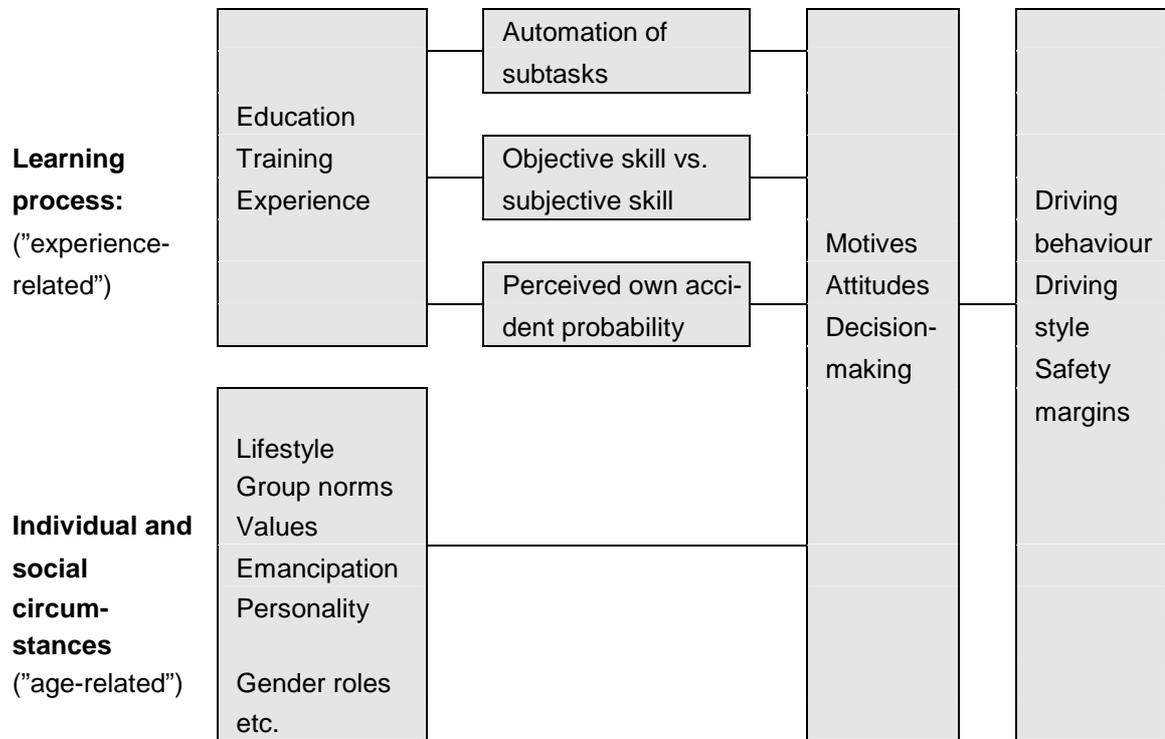


Figure 1 Model of factors which are of significance to young novice drivers' driving behaviour and accident involvement (Gregersen & Bjurulf, 1996)

2.3.3 Learning process

What is known as the learning process in Figure 1 encompasses the way in which one approaches the know-how and skills needed for the new situation which one faces as a car driver, that is to say driving a car. Learning can take place through controlled and structured education involving both training and absorption of other people's already-achieved knowledge, but also through spending a lot of time driving a car, thus obtaining the necessary routine and experience.

It is obvious that one needs experience in order to be a good and safe driver. An examination of age-related accident statistics, however, shows that it is difficult to see if the gradual reduction in accidents stems from the fact that drivers become more skilled at driving as time goes by or simply from the fact that they become older, since the two aspects accompany each other so closely. Various studies have been undertaken with the aim of separating the two factors' relevance, and it has, for instance, been proven that those who drive more have fewer accidents per kilometre (Spolander, 1983; Pelz & Schuman, 1971). This does, however, not mean that drivers with high exposure are safer since their lower accident risk (per kilometre) is compensated by more accidents per driver. Annual mileage has been shown to be one of the strongest predictors of accident involvement (Massie et al., 1997).

In an English study (Maycock et al., 1991), a follow-up was conducted of a large number of novice drivers who had received their driving licences at various

ages. This study revealed that the initial risk was considerable in all age groups and that the risk level dropped with increased age and experience. However, the novice risk element was clearly higher amongst the youngest novices, declining successively the older the drivers were when they got their driving licences. Similar results were found in a Canadian investigation of accidents among novice drivers aged 16–55 (Cooper et al., 1995). Also in their study it was found that all ages had a higher initial accident involvement in causal accidents. The youngest novices, those aged 16 years, were found to have the highest initial risk.

In the Swedish evaluation of the lowered age limit for practising to 16 years it was found that those who gained more experience in terms of hours and kilometres on the road during practising became safer drivers (Gregersen et al., 2000a, 2000b). A reduction was found for both men and women but the reduction among women was larger. In a similar evaluation study from Norway (Sagberg, 2000) no general accident reduction as a result of their reform was found, partly due to a low utilisation where the general practising time did not increase enough. A tendency was, however, found where those who practised much had a lower accident involvement. It was also shown by Sagberg that the reduction in accidents among new drivers was about 50% during the first 8 months. His interpretation was that since the time period is so short, it is not probable that age factors are of main importance here. Instead, the reduction would mostly be due to experience increase. In both studies (Norway and Sweden) it was shown that there is a threshold of amount of practising where the accident involvement is influenced in a positive way. This threshold was passed by the 16-years old learner drivers in Sweden, but not in Norway (Sagberg & Gregersen, in manuscript).

The relative contribution levels of age vs. experience related factors have varied from one study to the next. If the results from the different studies are compared age-related factors account for about 30–50% of accident reduction while experience accounts for 50–70%.

In American studies, the age factor is generally of higher importance since the age limit for obtaining a licence is lower. The importance of age related aspects increases with younger age.

2.3.4 Mental workload

Skill acquisition

Closely related to the learning process and the acquisition of experience is the level of mental workload that is needed for solving the driving task. To understand the relation, general theories of mental workload may be used. The ability to fulfil several tasks simultaneously depends on the quantity and type of "processing resources" that are available or can be allocated. The less resources a task needs, the easier is it to combine it with other tasks. Recent research has also found that effective time sharing is possible by using different kinds of processing resources. This is described in the "multiple resources theory" (Wickens, 1991). Wickens illustrates the information processing with the model in Figure 2. In the upper part the attention resources is symbolised by a membrane that may be affected. Resources may be allocated by concentration etc. or weakened through tiredness etc.

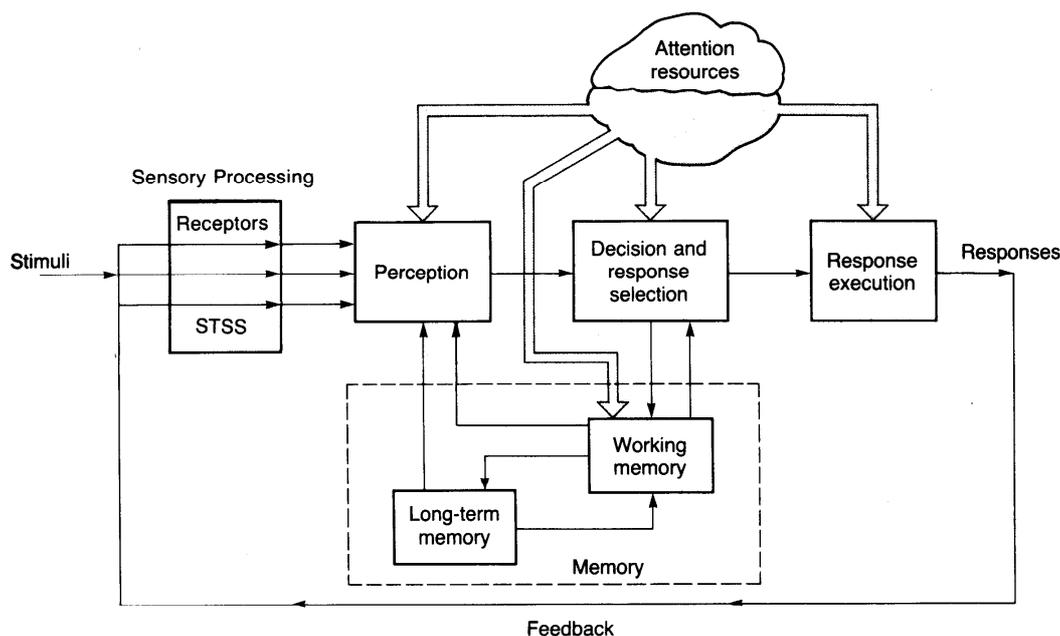


Figure 2 A model of human information processing (Wickens, 1991).

It is well known that novice drivers need to engage more mental capacity to handle all the situations that occur during driving and that this need decreases with acquisition of experience. A common explanation why experience reduces accident risk is that novice drivers go through several phases when they learn to handle the large variety of tasks involved in driving a car. The novice is faced with many new situations and tasks which all require mental resources. The perceptual situation is new and imposes special demands on visual search skills and interpretation of what is happening around the vehicle. The novice cannot handle this new situation as well as an experienced driver can. The mechanical handling of the car itself also requires mental capacity, with a number of controls, levers, stalks and warning devices which must be used and coordinated in a complex pattern. The entire traffic environment with its regulations and demands on specific behavioural patterns also increases the mental workload.

Rasmussen (1984) suggests a way of describing this development in his theory of skill acquisition, where a person undergoes three stages of behavioural control in skill development. He describes the knowledge-based, the rule-based and the skill-based levels. Behaviour at the *knowledge-based* level is new; there are no ready-to-use solutions. Such behaviour is regulated by reasoned arguments and by know-how which was acquired from previous experiences relating to other situations, and also by obtaining help from other people. When own know-how and experience is gradually built up and integrated into rules or mental models, this behaviour gradually becomes increasingly controlled by the *rule-based* level. With increased experience, rule-based behaviour will be increasingly automated and, in its most-developed form, will be executed without conscious attention and control. This is when one reaches the *skill-based* level. Since skills are utilised and developed, more and more subordinate tasks will be linked together until the entire behavioural complex is undertaken without conscious attention as long as no unexpected discrepancies occur. As soon as a discrepancy does occur, there is a switch to either rule-based behavioural control if one has a set of ready-made

rules to fall back on, or knowledge based behaviour if the problem has to be solved from the outset. In a complicated task such as driving a car, there is a frequent switch between different levels depending on which subordinate tasks are to be tackled.

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

The implication of this is that a novice driver does not have so many ready-to-use rules from before but must instead use those which are on offer, namely the formal rules, those which are described in legal texts and official regulations. However, the framework of official regulations is an attempt to regulate traffic in certain specific conditions. They are not comprehensive. This means that traffic is naturally governed by rules but that it cannot actually be described by using these rules. There is a lot else which has an effect, for example our feelings and our mood, our motives and social norms. Our driving behaviour is also largely shaped by informal "common-sense based" rules, which do not always match the formal rules and which from the road safety viewpoint may have both advantages and disadvantages. Increasing attention is granted to these informal rules about how one should behave as one frees oneself mentally from technically operating the car and formal rules. Examples of informal rules are letting other road users through even if one actually has the formal right of way, to creep somewhat above the speed limit "to keep up with the flow of traffic", to warn other drivers of police speed traps, to neglect to use turn indicators, to realise that the right-of-way rule for cars approaching from the right is seldom applied in practice, to realise that many road users are unpredictable and often ignore traffic rules and that this therefore requires extra caution etc.

Although many studies have shown or discussed the mental workload in the driving task, the specific implication for young novice drivers is unclear. Several studies have shown that experienced drivers perceive potential risk situations more quickly than novice drivers (Soliday & Allen, 1972; Ahapalo et al., 1987; Quimby & Watts, 1981; Finn & Bragg, 1986), which supports the theory of automatic behaviour and mental workload.

The question is also which driving tasks are automated and which are not. There are studies showing that some tasks are more easily automated while others never are. Shinar et al. (1998) studied automation and mental workload development in gear shifting by comparing novice and experienced drivers' performance

detecting road signs when driving cars with manual or automatic gears. They found that the detection of signs was poorer among novice drivers with manual gears than those with automatic gears. No such difference was found among experienced drivers. This was interpreted as a support for regarding gear shifting as a task that becomes automated over time. They, however, also conclude that gear shifting is a task that even after a year is not fully automated.

Hazard perception

An area that has received increased interest during the last decade is the driver's ability to detect hazards. Hazard perception (HP) includes the process of discovering, recognising and reacting to potentially dangerous situations. Several studies have shown that experienced drivers and expert drivers detect hazards better and faster than novice drivers (i.e. McKenna & Crick, 1991; 1994). For hazards far away from the driver, the difference is even larger (Drummond, 1995), a fact that may also support the theories of automation and mental workload. Renge (1998) compared hazard perception abilities for day and night situations separately among driving students, just licensed, novice drivers, experienced drivers and driving instructors. He found a pattern of improved hazard perception scores with experience. The pattern was clearer for day time than for night time situations. Renge also tested the correlations between hazard perception scores and risk rating, choice of speed and safe driving confidence. There was a significant correlation between high HP scores and high risk rating of the situations ($r=0.44$), between high HP scores and lower speed choice ($r=-0.27$) but no significant correlation between HP and driving confidence. Renge's own conclusions were that the results strongly suggest that it is very important for drivers to develop their abilities of perceiving hazards in traffic. The training/testing of hazard perceptual skills should thus be more broadly and effectively introduced in traffic safety countermeasures.

In order to test the hypothesis, that hazard perception as such could be automated, McKenna and Farrand (1999) tested hazard perception skills among novice and experienced drivers with and without combination of a secondary task (produce a random sequence of 2 letters per second). They found that the secondary task interfered with the hazard perception for both groups and that the experienced drivers performed even worse than the novice drivers on hazard perception when performing the secondary task. Their conclusion was that hazard perception is a demanding task and when attention is divided to other tasks the ability to detect hazards will decrease. The study gave no support for regarding hazard perception skills as something that will become automated with increased experience. The improvement of hazard perception skills may instead be a result of learning to identify situations in combination with automation of other driving tasks, thus reducing the mental workload and leaving more mental capacity for the hazard detection task.

2.3.5 Visual perception

The early studies undertaken by Mourant and Rockwell (1972) was carried out with very few subjects and is thus not possible to generalise, but it did put into focus the young novice drivers' shortcomings in terms of visual search skills relate to their high mental workload and inspired to a growing field of research. Their comparison between novice and experienced drivers revealed that novice drivers

looked more to the front and right of the car, looked more seldom in the rear-view mirror and moved their point of focus more often. They were also less skilled in utilising their peripheral vision than their more experienced counterparts. Much research has been done in the field of visual search since Mourant and Rockwell's studies. Several studies have also focused on the difference between novice and experienced drivers. In a laboratory experiment using video sequences, Miltenburg and Kuiken (1990) investigated the relation between traffic experience and visual search strategies, but their results did not support the findings of Mourant and Rockwell. Miltenburg and Kuiken found that the experienced drivers had a larger number of fixations on irrelevant cues than the novice drivers. Seen in the light of experienced drivers' lower accident risk, their results may be interpreted as a consequence of reduced mental workload since the experienced drivers had capacity to look at irrelevant objects. Falkmer and Gregersen (2001) did, however, confirm the findings of Mourant and Rockwell in an eye-tracking study where novice and experienced drivers were compared. They found that novice drivers concentrate their visual search to a smaller area, closer to the front of the vehicle, compared to experienced drivers. The search strategies of inexperienced learner drivers were also found to be more inflexible and the experienced drivers had a wider horizontal search pattern. Chapman and Underwood (1998) found that novice drivers had longer durations of fixations than experienced drivers, particularly in hazardous situations. Experienced drivers, in their study also fixated lower and had less vertical variance in fixation locations than novice drivers. These findings were exploited in a later study where novice drivers were given a short training programme for increased knowledge, scanning and anticipation. The drivers were informed about their typical pattern of visual search and the need for scanning multiple locations in the visual field for potential dangers. By measuring eye movements they found notable changes in search patterns for horizontal spread compared with a control group (Chapman, Underwood & Roberts, 2002). Crundall and Underwood (1998) also found that experienced drivers select visual strategies according to the complexity of the road environment. They showed that experienced drivers increase their horizontal search relative to the type of road. The strategies of the novice drivers were found to be inflexible. These findings concerning horizontal search confirmed earlier studies by Nagata and Masuda (1987).

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

In a literature review Åberg (1981) showed that there are certain processes which are related to experience. He described so-called "predictive head movements", which means that the head moves before the eyes start moving when searching for an object which appears in the peripheral field of vision. Mourant and Grimson (1977) found that experienced drivers use more predictive head movements than novices, which is interpreted as indicating that novices do not utilise their peripheral vision as effectively as experienced drivers. Åberg also studied literature on the perceptual process of instinctive reaction which is

probably closely related to the instinctive driving-behaviour process described above. Perceptual instinct is explained as a process whereby repeated experience of stimuli leads to automatic discovery. In environments in which stimuli do not change a lot, a car driver may slip into automatic perception and thus lose his or her conscious search for critical events, such as wild animals by the roadside. This is in line with Åberg's result, which points out that when attention focuses on oncoming vehicles, the driver may fail to observe the presence of an animal even if he is looking straight at it. This process was also demonstrated in an experiment (Åberg, 1981) in which drivers who were instructed to look for a moose discovered the (stuffed) moose more often than when they were driving without having received this instruction.

2.3.6 Overconfidence

Through the initial training period, the learner driver acquires a range of knowledge and a number of skills. The driver achieves a certain individual level of actual driving ability. An assumption which has also gained support in a large number of studies is that young novice drivers have a rather poor perception of their actual ability. Subjectively they overestimate their ability behind the wheel. This is a reasonable hypothesis bearing in mind the usual behaviour of teenagers, in particular young men in the midst of the process of freeing themselves from the ties of parents and "authority figures".

The most common way of measuring self-esteem in research is through questionnaires. Drivers are usually asked to assess their own ability compared with other drivers (Svenson, 1981; Moe, 1984; 1986; Spolander, 1983; Finn & Bragg, 1986; Matthews & Moran, 1986; Gregersen, 1993; 1994; McGormick et al., 1986). This type of survey traditionally reveals that young novice drivers regard themselves as better than other drivers. This pattern also appears to be most typical among young men.

The conclusion to be drawn from these studies is that young drivers are often bad at accurately estimating their own ability and that they are therefore not very good at assessing potential and real actual risks. They underestimate the risks they encounter since they overestimate their own ability behind the wheel. It is obvious that there is a link between subjective risk and subjective ability. If a driver believes that he is a skilled driver who can handle hazardous situations, then these situations are no longer regarded as equally hazardous. From the training viewpoint, this condition is difficult to rectify since such drivers are not motivated to drive more carefully than they feel is necessary. This attitude also complicates matters since it is difficult to get through to drivers about theoretical information on the risks involved. They lightly dismiss advice, with responses like "That's only a problem for others, it doesn't apply to me since I'm such a good driver". Several studies have shown that young novice drivers choose to behave more dangerously which has been described in Section 2.2 above.

The difference between the subjective evaluation of oneself and others may be a result of two different estimations, either "positive self" or "negative other". In order to understand the consequences of overestimation on behaviour, it is important to appreciate the relative significance of these explanations. The development of countermeasures depends on whether they should focus on self assessment or the assessment of others. This was done in a study by McKenna et al. (1991) in which drivers were asked to assess themselves and the average driver

on separate scales. Since the average driver received a rating above the average on the scale, the conclusion was that he/she was not regarded as being a poor driver. The personal assessments of their own abilities were even higher, however, and supported the view that the prevailing attitude was more likely to be explained by "I am good" rather than "the others are bad". In another survey (1993), McKenna experimented with one's perceptions as to whether the individual underestimation of the likelihood of being involved in negative events was a result of imagined control (that is to say the ability to handle the vehicle in various situations) or unreasonably high optimism (i.e. luck, random chance etc.). He drew the conclusion that there is "clear support for the illusion of control and little support for unrealistic optimism".

The level of risk taking behaviour may also be described as the level of experienced risk that the driver accepts. A relationship has been shown between youth, excessive speeding, short following distance and driving against amber light, from which the conclusion has been drawn that young drivers could be expected to accept a more risky driving style than older drivers (Elander, West & French, 1993). According to Deery (1999) this may imply that young drivers tend to accept riskier driving, but may also be a support for the findings that they have greater difficulties in detecting risks fully.

2.3.7 Motives and driving

During the 1970s, the focus of research shifted from regarding the driver as a victim of a complicated traffic situation to seeing him as someone who himself largely influences and controls his behaviour behind the wheel. Emphasis was placed on Man's various motives as having an important bearing on driving behaviour. The motives which influence driving may be largely divided into two groups: *why* we drive and *how* we drive (Gregersen, 1996). Both these motives affect our driving behaviour. One example of a motive for why we drive is that we want to transport something from one point to another. It may also be so that we simply enjoy the satisfaction of driving – we drive for the sake of driving, because it is an enjoyable pastime. We may have purely personal motives such as pleasure, relaxation, etc., but we may drive owing to social reasons influenced by norms, role expectations and group pressure.

The border between the two groups of motive – *why* we drive and *how* we drive – is rather unclear. The motives for how we drive encompass such factors as safety, economy and environmental consideration. Other examples are a desire to show off, test our limits or compete against other drivers (Wahlqvist, 1996).

The way in which these motives affect driving behaviour is controlled by the reward or punishment which this behaviour promotes. The link between motive and such result amplification is not entirely uncomplicated. Most people want to drive safely (Wahlqvist, 1996). The problem is to identify what this means in terms of actual behaviour. For the individual driver, it is not so difficult to draw conclusions regarding driving style. The problem is that the individual may easily draw the wrong conclusions from the safety viewpoint. A driving style which statistically is dangerous may perhaps not be perceived as such by the individual driver. If a driver exceeds the speed limits, the most likely result is that he will not be stopped by the police, no accident will occur and he will get to his destination faster. This feedback helps him reinforce conclusions regarding his own "safe"

driving style, a driving style which really counteracts safety from a statistical viewpoint (Näätänen & Summala, 1976).

The safety motive may be regarded as a "negative" motive. The reinforcement is either neutral or negative. There is never any immediate individual reward if a driver tries to drive more safely. As soon as the negative effect (occurrence of an accident) ceases, the safety motive can be regarded as being entirely satisfied. The absence of accidents is the normal state of affairs, so there is really no means of reducing the accident rate if one looks at the situation from the individual's viewpoint. Even if one were to improve safety levels by driving more carefully, one would not see which accidents were avoided. The same pattern applies to the desire to avoid police checkpoints. As soon as one has been avoided (which is also the normal situation) – and so has the punishment – the motive is regarded as satisfied (Gregersen, 1996).

On the other hand, the need to get to one's destination and other similar motives may be regarded as "positive" motives. It is possible to obtain a relatively immediate reward. If one drives fast, then one gets to the destination more quickly. Speeding may also provide immediate positive enhancement through "the thrill of speed" etc.

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

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

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

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

These assumptions regarding a link between motive, driving behaviour and accident involvement are also supported in a questionnaire survey covering young novice drivers (Wahlquist, 1996), who were asked to report 1) how important various motives are in their driving behaviour, 2) how they drive (driving style) and 3) their own accident involvement rate. The study shows a clear pattern, with certain motives correlating closely with certain driving styles. Drivers who often drive for pleasure, in order to get rid of their frustrations or to seek adventure etc., have a driving style which is more aggressive, they drive faster and with smaller safety margins than others. These drivers also have a higher accident involvement rate than others. Young novice drivers who feel that it is important to prove to themselves that they are responsible and safe drivers adopt a more observant and tolerant driving style. If a driver feels that it is important to show consideration to others, then one result is lower accident involvement.

2.3.8 Lifestyle, social circumstances and group norms

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

By subjective norms they refer to norms that are believed to exist in the social environment, among people who are closely related. The term subjective is used since it is the personal assessment of the norm that is important, not the actual norms. In their emancipation process, youngsters are more dependent on conformity with certain parts of the social context. There is an individual difference concerning which context is important. Hermansson (1988) defines peer-related versus parent related lifestyle, which is a symbol for who one tends to turn to. For many youngsters, peers are of significant importance and thus also their subjective norms. Parker et al. (1992) reported findings from a questionnaire study showing that young drivers experienced higher peer pressure to commit violations such as speeding, driving under the influence of alcohol or to make dangerous overtaking than older drivers.

In car driving, peer pressure may be expressed through passenger influence on driving behaviour. Several studies have shown that there is a relation between the

presence of passengers on the one hand and driving behaviour or accident involvement on the other. McKenna and Crick (1994) have shown that young drivers, both male and female, drove faster and with shorter following distance in junctions if they had young passengers in the car. Their results were supported in a later study by Waylen and McKenna (2002). In a study by Baxter et al. (1990) similar results were found, but only for young men having young men as passengers. In two other studies, one by Doherty, Andrey and McGregor (1998) and one by Chen et al. (2000) it was also shown that passenger influence on driving behaviour was largest among young drivers. Not only driving behaviour has been studied but also relations between the presence of passengers and accident involvement. In an accident register study of teenaged drivers, Williams (2000) found that the more passengers in the car, the higher the accident risk. Among 16–17 years old drivers, the accident risk was 4 times higher with 3 passengers than driving alone. Among 18–19 years old drivers the risk was double and among older drivers the risk decreased with passengers.

There are, however, also studies showing the opposite pattern that passengers do not increase accident risk. A study by Balesteros et al. (2000) analysing accidents in Maryland 1996–1998 could not find any at-fault accident increasing effect of passengers to young drivers 16–20 years of age. As an example, in accidents with 16 years old drivers, the at-fault rate in accidents without passengers was 75.9%, with one passenger 73.7% and with more passengers 74.2%. The authors, however, stress that the study is not directly comparable to other studies since they had no opportunity to compare their data with those not involved in an accident and how often young drivers in general drive with and without passengers.

With the aim of investigating the potentially constructive role that passengers can play to positively influence the behaviour of drivers, Regan and Mitsopoulos (2001) carried out a study, which among other sub studies included a telephone survey and a focus group study. From the telephone survey several conclusions were drawn. From the perspective of the drivers it was found that their role types were affected by the passengers' age, sex and relationship. The presence of a young passenger, especially male, was more likely to stimulate to risky and anti social driving compared to older passengers or children. A male passenger was more likely to have a negative influence on female drivers than the other way around. In the focus groups one finding was that passengers could have a constructive role. Strategies involving passengers need to be along the lines of "look after the driver". They also need to be well promoted in order to raise public awareness of the safety impact of carrying passengers. Education also should include these aspects in order to make passengers and drivers aware of their roles in these safety strategies.

In a focus group based study of Danish youngsters, Möller (2002) analysed the underlying meanings of driving. She found that driving, besides being a means of transportation, has a psychological function by influencing the self-image and identity of the young driver. She also found a relation between driving and individual sense of visibility, status, control and mobility. The extent, to which these psychological functions are utilised, differs between individuals, partly as a result of their interaction with peers.

Marthiens and Schulze (1989) have described the relevance of recreational activities on accidents involving young drivers and over-representation of reports on so-called "disco-accidents". Klemenjak and Hutter (1988) found that two main

groups of teenagers visited discotheques: "disco-fans" who spend the entire evening at the disco and those who visit the disco on the spur of the moment later in the evening. The second group is described as the less safe group since they drive long distances and their decision to visit the disco is more often taken after drinking alcohol.

The link between lifestyle and accident involvement was also shown both in a Swedish study (Berg & Gregersen, 1993; Berg, 1994), and in a German study (Schulze, 1990). The Swedish study is a survey which shows that there are special high-risk and low-risk groups in relation to their lifestyle. Typical characteristics of those in the worst-afflicted high-risk group are that they seldom participate in sports activities, they often drink alcohol and get intoxicated, often drive for reasons other than the need for transport and that they are very interested in cars. In addition, they are usually frequent visitors to pubs, discos and parties and lead a generally hectic social life. They are usually men. The study reveals a number of different lifestyle profiles which vary in terms of accident involvement.

The German study on lifestyles and accidents, in which young drivers were interviewed, shows a similar pattern. Although the sample was too small to show any statistically significant linked variation with accident risks, the study identified tendencies which pointed out the high-risk groups as "action-type", "fan-type" and "non-conforming type" people. The results of the two studies conducted in Sweden and Germany coincide on very many points.

The Swedish study also points out a link between lifestyle and driving habits, for example the time of day during which one drives, the purpose of the journey etc. It is this type of link that the authorities are trying to control, for example in many American states, with the imposition of night-time curfews on young drivers. This kind of prohibition has in fact brought about a significant reduction in the number of road accidents involving young drivers (Preusser et al., 1984; Levy, 1988; Williams et al., 1985).

These results were supported by the Beirness and Simpson (1991) longitudinal study of accident involved and non-accident involved young drivers. They conclude that young driver accidents emerge from a more comprehensive pattern of behaviour that encompasses a variety of other risk behaviours. The general pattern of their results were consistent with the Problem Behaviour Theory of Jessor (Jessor & Jessor, 1977), which states that young drivers' accident involvement may represent a part of a more general adolescent problem behaviour that is also manifest outside the driving situation. They particularly point out this phenomenon of several different types of problem behaviour being linked together. Similar results were found by Shope (1997) in a questionnaire study reflecting Jessor's problem behaviour theory, combined with the State's driver history records in Michigan among students in six public school districts. She found that for both women and men, living with both parents was a protective factor and that propensity to use substances was a risk factor for high-risk driving. For women, friends' use of substance and for men, parents' leniency toward teenagers' drinking were risk factors. The availability of substances was a risk factor for both genders. She also found that the combination of substance use and poor school performance were risk factors for high-risk driving.

This emphasises the complexity of both the problem of driving behaviour and that of traffic accidents, and the measures which can be adopted. Jessor (1988) suggests that risk behaviours among youth are not necessarily separate events. They also seem to be related in typical patterns. He states that these interrelations

between problem behaviours are *"systematic and robust enough to suggest that there is a syndrome of adolescent problem behaviour and that it may be useful to deal with it as part of a lifestyle rather than as separate or discrete behaviours."* Youth is a period during which one undergoes a number of processes which make life more intensive and where various sequences follow the same pattern as for example accident involvement, over-estimation of ability and breaking traffic rules. This is part of development and the process of breaking free, where one wants to test the limits and prove the ability to manage on one's own. It is important to realise, particularly if one bears in mind which measures are possible, that driving a car is only a form of expression or a small part of these over-riding, far more complex phenomena. This was shown in an Australian questionnaire study by Palamara and Stevenson (2000) of young drivers' risk of receiving a "traffic infringement notice" during their first 12 months with a licence. They found that male drivers with high scores on risk taking, driver confidence and adventurousness and low on positive health-related behaviours were at highest risk for receiving a speed infringement notice.

In studies by Hasselberg (2000) these results were supported by results where she linked national registers of socioeconomic status and injuries with hospitalisation. Hasselberg found that a young driver whose parents were lower white-collar workers, blue-collar workers, farmers or entrepreneurs had significantly more injuries than those with middle and high level white-collar parents. In another register study by Murray (1998) it was shown that young drivers with low school grades, mainly in theoretical subjects, had a higher accident involvement. Youngsters with blue-collar and farmer parents were also in Murray's study shown to be involved in more accidents than those with white-collar parents.

It should be noted that in most of these studies where accident involvement is related to individual or social factors, the correlations or overrepresentation in accidents are rather weak. No studies have yet been able to use this approach to clearly predict which drivers that are going to be involved in accidents. There is a study on lifestyle factors as predictors of injuries and accidents among young adults by Begg et al. (1999) where this is discussed. In their longitudinal study of the health development and behaviour of a cohort of 1,037 young New Zealand people they found that none of their studied variables were "overwhelmingly" important as risk factors for accidents. They found significant but weak odds-ratio associations. They conclude that focusing on injury prevention efforts on changing lifestyle of young adults is unlikely to reduce overall accident risk and would have little impact on the risk of serious injury. In a study by Berg (2000) where young drivers with and without accident experience were interviewed, he points out that even if the accident involvement of young drivers is a big problem, it is only a small share of them that is involved in accidents. In Sweden, approximately 1–2% of 18–19 years old drivers are involved in injury accidents and 99% are not. This fact underlines the difficulty of predicting who these drivers are. Most studies of the type described in this section are able to find high risk groups with several times overrepresentation compared to other groups, but the relative share is still low.

2.3.9 Individual characteristics and attitudes

The importance of a thorough analysis of target groups has been emphasized in communication research (Linderholm, 1997). A need has been recognized not only of general research on the interaction between message content and target group characteristics, but also of more specific research, such as on how messages aimed at affecting the safety behaviour of various groups of traffic participants should best be formulated.

Those parameters which may have significance for driving behaviour and accident involvement also include the driver's personality. Many studies have focused on personality factors and their relevance to accident risks. The most typical personality traits found to be related to accident involvement and dangerous driving are social deviance, hostility, aggression, impulsiveness, emotional lability and low altruism (see Ullberg, 2002 for an overview). Ullberg (2002) carried out a questionnaire study among almost 6000 adolescents in Norway. The questionnaire comprised five different personality measures; self reported driving behaviour and rating of risky situations. Through cluster analysis of the personality questions he found six subtypes of drivers who differed on self reported risky driving, attitudes towards traffic safety, risk perception, estimation of own driving skills and accident involvement. One of the high-risk groups included mostly men with a low level of altruism and anxiety and high level of sensation seeking, irresponsibility and driving related aggression. The second high-risk group also reported high sensation seeking tendencies, but combined with high level of aggression, anxiety and driving anger. Ullberg concludes that young drivers should not be treated as a homogeneous group with regard to road safety.

Drummond (1989) refers in his literature review to additional studies into the link between personality factors and accidents. In an older study (McFarland et al., 1955), there is evidence of higher accident likelihood among drivers of low intelligence and inadequate social responsibility. In a similar way, several other studies point out other personality factors such as impulsiveness (Schuman et al., 1967), selfishness (Beamish et al., 1962) and immaturity (McGuire, 1976). Typical for these studies is that the links are weak and the personality factors' predictive value is low (Wilde, 1994).

Two personality traits have, however, in accordance with the Ullberg (2002) study, been found to have a stronger relation with accident involvement; sensation seeking and aggression (Arnett, Offer and Fine, 1997). Arnett et al. suggest that high risk behaviour in adolescence is largely explained by these personality traits. They found that driving behaviour such as driving faster than 80 mph, to drive 20 mph over the speed limit, to compete with other drivers, to overtake where forbidden and to drive under the influence of alcohol correlate strongly with these personality traits.

Quite a few studies have been conducted on this aspect and a consistent positive link between sensation seeking and accident involvement has been identified. Jonah (1996) reviewed 31 studies on sensation-seeking and its link with driving style and accident involvement. He notes, among other things, that correlation between 0.30 and 0.40 is common. The most frequently used method of measuring adventure-seeking is Zuckerman's (1979) "Sensation Seeking Scale" which according to Zuckerman himself measures the need for varied, new and complex sensations and experiences and the need to take physical and social risks

for the sake of the experiences. He later (Zuckerman, 1983) studied physiological links and found strong support for the supposition that adventure-seekers have different levels of certain substances (cerebrospinal nor-epinephrine and plasma dopamine-beta-hydroxylase) than other people. Similar results were also presented by other researchers (Ebstein et al., 1996, Benjamin et al., 1996). Furthermore, there is support for the belief that sensation-seeking has a hereditary basis. Eysenck (1983) used studies of twins to estimate that about 70% of variation in the degree of sensation-seeking can be traced to genetic factors.

By using Zuckerman's scale, Moe and Jensen (1990) and others have shown that there is a link between sensation-seeking and the risk of accidents. The same result was obtained by Beirness and Simpson (1991) in their comparison of a group of drivers involved in accidents and a group which was not involved in accidents. In their study, the accident prone group also showed an over-representation of people who smoke and drink, sleep less than 8 hours a night, have a poor relationship with their parents, teachers and other adults, and suffer from other behavioural problems. In a later review by Beirness (1997) it was shown that two different groups of drinking drivers could be identified; the youth and the hard core. He refers to statistics for USA and Canada showing that there has been a major reduction in drinking driving fatalities from early eighties to mid nineties among the young drivers but no reduction among those 25 years or older. In a further analysis of these two groups Beirness points out that an important explanation behind youth drinking and driving is probably the pattern explained by the Problem Behaviour Theory by Jessor and Jessor (1977). Drinking and driving among youth is related to lifestyle, sensation seeking, risky driving, attitudinal tolerance of deviance and influence of peers. The hard core drinkers on the other hand are according to Beirness repeatedly driving with high BAC, their drinking and driving habits are persistent and chronic and they appear to be resistant to persuasive and emotional appeals.

Also in studies by Rimmö and Åberg (1999), sensation seeking was found to be significantly related to accident involvement, intentional errors and certain types of offences. In their study, sensation seeking was studied through Zuckerman's scales for thrill and adventure seeking (TAS) and disinhibition (DIS). DIS was found to be related to violation and alcohol offences while TAS was related to speeding violations.

With a wider approach on how target groups may be defined, Linderholm (1997; 2000) investigated the possibilities to develop a method for the target group analysis of young car drivers and how messages concerning traffic safety should be presented to different target groups. She based this research on theories of life style, individual values, perceived risk, individual characteristics and self-image as well as of attitudes and persuasion.

Linderholm found four separate target groups. These correspond to the four cells in a typology, the two dimensions of which are attitude toward speeding and view regarding the primary source of risk. The four ideal types the groups represent were those of adventurous seekers, risk takers, responsibility takers and security seekers, respectively.

These four groups differed above all in their attitude toward speeding and toward risk. The adventurous seekers and the risk takers were found to be more positive in their attitude toward risk taking, the responsibility takers and security seekers being more aversive to risk. The adventurous seekers felt it was not dangerous to drive fast. They regarded other drivers as the primary source of risk

in traffic. The risk takers shared with this first group the view that driving fast was not dangerous. However, they differed in considering not other drivers but darkness and slippery driving conditions to be the major sources of risk. The responsibility takers regarded it as dangerous to drive fast. They considered, just as the adventurous seekers did, other drivers to be the main source of risk. Security seekers, finally, felt just as the last group did that it was dangerous to drive fast but considered dangerous situations such as darkness and slippery roads to represent the major sources of risk.

2.3.10 Discussion

To summarise, various individual factors such as lifestyle and personality have a significant impact on the type of driver one is, and the likelihood of being involved in an accident. However, these are seldom simple links but rather different types of interaction between components, such as adolescents' lifestyle. In total, these *age-related* factors (as they are sometimes known) may be estimated to account for 30–50% of the reduction in accidents during the first few years after a youth has received his driving licence. However, a lot of research effort remains to be undertaken if we are to fully understand the detailed mechanisms behind how these age-related factors influence driving behaviour and accident risks.

2.4 In-vehicle support systems and young novice drivers

An application of many of the psychological aspects that have been discussed in the previous chapters may be found in studies of behavioural aspects of in-vehicle support systems. In-vehicle systems for car drivers with the aim to inform, give advice, warn or take over in different situations are developed rapidly. Examples of applications of such systems are speed control, incident warning, visibility improvement, navigation aid etc. The purpose of these systems is to increase safety, reduce pollution and/or increase mobility. There is an extensive amount of research on the potentials and possibilities of these systems, but there are still many problems to be solved, which relate to how the driver reacts to and uses the systems (ETSC, 1999). Examples of problems are level of acceptance, adjustment of the systems to differences in driver attributes, impact of driver motives on how the systems are utilized, overestimation of the abilities of the systems etc. (Englund m.fl., 1997). Several of these problems are relevant for drivers in general, but there are also reasons to expect specific problems when young novice drivers use the systems. Several of the problems generally regarded as important for the safety of young novice drivers may also have important impact on the potential of the systems in this group. This relates for example to their high mental workload, overestimation tendencies or typical young driver motives. Gregersen (2003) carried out a literature review with the aim of defining such young novice drivers' typical reactions and use of these in vehicle systems. As far as was found in Gregersen's review, there has been almost no research up to now that focuses on the special benefits and problems connected with the use of these systems by young, novice drivers. A lot of studies have been looking at younger drivers and less experienced drivers, but in all cases found, the group definitions have been too wide to draw conclusions concerning young novice drivers. Since these drivers are among the most accident involved road users, this research is of

the highest importance. New research is needed to understand the combination of in-car support systems and young, novice drivers (Gregersen, 2003).

Many support systems have a large potential for increased road safety, mobility and decrease of pollution of the environment, both with regard to drivers in general and young, novice drivers. Different systems are in several cases specifically focusing on solving problems that are typical for the young and for the novice drivers. Among these are speeding, driving with short following distance, driving without using seat belts and driving under the influence of alcohol or other drugs. They are also inexperienced in interpreting traffic situations and detecting hazards. But the potential of the systems that aim at solving these problems is totally dependent on the driver's ability and motives for using them. If education of the driver, ergonomic design of the driver environment, legislation concerning use of ADAS (Advanced Driver Assistant Systems) and IVIS (In-Vehicle Information Systems) will be able to counteract undesired effects such as dangerous motives, lack of understanding of risks, poor ability to reflect on the consequences of own behaviour and the absence of experience and routine to assess the potential risks in traffic, then we can be certain about the advantages of the systems. Before that, however, the reality is that we don't know to what degree the different systems actually make the situation for young, novice drivers better or worse (Gregersen, 2003, Regan et al., 2001).

These and other behavioural aspects of young drivers are very important for the potential of the systems. Since this is an area without much empirically based knowledge and with many unanswered questions, there is a large need for research.

2.5 References

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3 Used methods and incentives to influence young drivers attitudes and behaviour

by Kati Hernetkoski & Esko Keskinen

3.1 Introduction

This chapter focuses on methods and incentives that have been used to influence young drivers' attitudes and behaviour, especially regarding alcohol, seat belt use and speeding. A thorough presentation of young novice drivers' situation was presented in the previous chapter. Their higher accident risk is connected to various psychological, social as well as situational factors. However, young drivers are not a homogeneous group, but among them there are high risk groups and low risk groups. Taken together the complexity of the phenomena (i.e. several factors that influence young drivers' accident risk) and different subgroups among young drivers, influencing or decreasing the high accident risk of young drivers is at least a complex task. However, driver education offers one possibility to influence young drivers. Thus the first section of this chapter presents a conceptual model of the Goals of Driver Education (GDE model). The second section of this chapter outlines briefly the connections between attitude, emotion and behaviour. The third section presents different kinds of methods and incentives that have been used to influence young drivers' attitudes and behaviour. The chapter ends with the conclusions of possible methods and incentives that could be used while trying to influence young drivers' attitudes and behaviour.

3.2 Goals of driver education, GDE model

The GDE-model is based on the hierarchical definition of drivers' task (Keskinen, 1996). The lowest level in the hierarchy, vehicle manoeuvring, refers to basic handling skills of the vehicle (like braking, shifting gear, keeping the car under control etc.). The second lowest level, mastery of traffic situations, refers to the adaptation of drivers behaviour to other road-users' behaviour and to traffic environment. This means perceiving and predicting other road-users' behaviour as well as making drivers own behaviour predictable to others. Knowing traffic rules and behaving according to them (e.g. use of seat belts, complying with the speed limits), is one important part of these skills. The third level is related to goals and context of driving. At this level drivers decide for what purpose, where, with whom, with what and at what time to drive. This means planning and choosing of driving route, driving state and company of driving. The highest level in the hierarchy, goals for life and skills for living, refers to the motives and goals of the person in a broad sense (Keskinen, 1996). Personal skills for handling different situations in life in general are included at this level.

The four-level hierarchy of driving behaviour (Keskinen, 1996) was expanded (Siegrist, 1999) to the Goals of Driver Education (GDE)-model where knowledge and skills, risk-increasing factors, and self-evaluation (self- assessment) skills were included and linked to the four levels in the hierarchy (Table 2). The model can be used as a basis for evaluating specific driving education methods and for developing new ideas. The cells in the GDE-model are used to define detailed competencies that are needed in order to be a safe driver. It is a description of

driving in general and it is not entirely suitable for describing the behaviour of some particular driver.

Table 2 *Goals of Driver Education-model (Hatakka et al., 2002; Siegrist (ed), 1999).*

Hierarchical level of behaviour (extent of generalisation):	Content of driver education:		
	Knowledge and skills the driver has to master	Risk-increasing factors the driver must be aware of and be able to avoid	Self-evaluation
Goals for life and skills for living (global)	Knowledge about / control over how general life goals and values, behavioural style, group norms etc. affect driving.	Knowledge about / control over risks connected with life goals and values, behavioural style, social pressure, substance abuse etc.	Awareness of personal tendencies re. impulse control, motives, lifestyle, values, etc.
Goals and context of driving (specific trip)	Knowledge and skills re. Trip-related considerations (effect of goals, environment choice, effects of social pressure, evaluation of necessity, etc.).	Knowledge and skills re. Risks connected with trip goals, driving state, social pressure, purpose of driving, etc.).	Awareness of personal planning skills, typical driving goals, driving motives, etc.
Mastery of traffic situations (specific situation)	General knowledge and skills re. rules, speed adjustment, safety margins, signalling, etc.	Knowledge and skills re. Wrong speed, narrow safety margins, neglect of rules, difficult driving conditions, vulnerable road-users, etc.	Awareness of personal skills, driving style, hazard perception, etc. from the viewpoint of strengths and weaknesses.
Vehicle manoeuvring (specific situation)	Basic knowledge and skills re. manoeuvring, vehicle properties, friction, etc.	Knowledge and skills re. Risks connected with manoeuvring, vehicle properties, friction, etc.	Awareness of personal strengths and weaknesses re. basic driving skills, manoeuvring in hazardous situations, etc.

3.2.1 Description of the dimensions of driver education

The following description of the dimensions of the driver education is based on the report done to Vägverket by Peräaho, Keskinen & Hatakka (2003) "Driver competence in a hierarchical perspective; implications for driver education". The report is part of the Vägverket's work on a new national curriculum for driver education, expected to be introduced 2004.

Knowledge and skills

The first column ("knowledge and skills") describes what a good driver needs to know and be able to do at each level in order to drive a vehicle and cope in normal traffic circumstances. This includes how to manoeuvre the car, how to drive in traffic, what rules must be followed (lower level skills), how trips should be planned and how personal preconditions influence behaviour and safety (higher level skills). Especially the lower half of this column is familiar to the traditional notion of driver training, where basic knowledge of e.g. traffic rules, manoeuvring and driving in different traffic situations are typical contents. However, some of the contents on the highest two levels of the hierarchy are not typically included in driver training curricula, although they are increasingly being considered in various post-licence training programs (Advanced, 2003).

Factors that increase risk

The second column ("risk-increasing factors") is closely related to the first but emphasises particular knowledge and skills related to factors that increase or decrease risk. The content in the second column stands in its own right because of the importance of these factors for safety. Typical risk factors are emphasised and described in more detail. Not only do the risks referred to here connect directly to a certain driving situation (e.g. the effects of ice and snow, or worn-out tyres) but also indirectly (e.g. social pressure or life-style). The risks are thus different on different levels of the hierarchy. The frequently used concept "hazard perception" is a good example to be analysed. By using the GDE-model it is easy to see that the traditional idea of hazard perception as "road-craft" appears rather limited. There are potential hazards at all levels of the hierarchy the driver needs to be able to recognise, such as risks related to type of the trip or personal motives or behavioural tendencies.

Self-evaluation

The third column ("self-evaluation") refers to a process whereby an individual tries to get feedback on his or her personal actions from within the self. In the context of driving it is a matter of becoming, or wanting to become, aware of personal preconditions and tendencies as well as skills and abilities regarding manoeuvring, coping in traffic, planning of driving, and life in general. In short, being able to perceive realistically one's own role for the success of a driving situation.

Not only is self-evaluation seen as an important tool in driver training but also in development of driving skill after training. Research on the development of expertise show, that meta-cognitive skills and reflective thinking are essential characteristics of an expert (Kolb, 1984; Mezirov, 1981; Mezirov et al., 1990). However, self-evaluative skills do not develop automatically but should be included as part of training. Abilities for self-evaluation also have relevance for driving behaviour. For example, a driver who is aware of a tendency to doze off during driving, or his limited skills in slippery road conditions, may be able to take these factors into consideration and adapt his driving accordingly. Similarly, on a higher level, a driver is expected to benefit from intrinsic knowledge of what effect personal motives and goals have on behaviour in a driving situation, e.g. poor abilities to resist social pressure.

As a conclusion it can be stated that skills for vehicle manoeuvring and mastery of traffic situations are the basis for successful operation in traffic and

these aspects should be learned well during driver training. Psychomotor and physiological aspects are important as basic requirements for operations at the lowest levels of the hierarchy of driver behaviour. However, these skills are applied under guidance of higher level goals and motives. Failure as well as success at higher level affects the demands on skills at lower levels. This means, that in addition to the training of basic skills, driver training should also be able to deal with these higher levels in the hierarchy and take into consideration the driver's goals and attitudes related to driving. Driver's goals and attitudes have effect on both, as increasing or decreasing the risks. There is a close connection between motives, goals, attitudes and personality. All these factors are connected at the highest level of the hierarchy. That is the reason why they are so influential to the safety: they have effect over all levels.

3.3 Attitudes, emotions and behaviour

As the GDE-model in the previous section described the basis for successful operation in traffic are skills for vehicle manoeuvring and mastery of traffic situations, but these skills are applied under guidance of higher level goals and motives. Driver's motives, goals, attitudes and personality are all connected at the highest level of the hierarchy and thus have effect over all levels.

Attitudes are learned via socialisation process (e.g. Statt, 1994). Attitudes are clearly and deeply connected to emotions, and as such, not easy to change just by increasing information or knowledge. Increase in intellectual or cognitive knowledge might be more easily achieved, but change in emotions is more difficult. One main point in traffic safety issues is how to affect or change behaviour: how to make people drive more safely. In this sense, attitudes, as such, can be seen as subordinate or less important to this ultimate goal.

Behaviour also affects attitudes, not just vice versa (Olson & Zanna, 1993). There is evidence that after some restricting laws (e.g. speed limits or seat belt use) also attitudes change accordingly (e.g. Deshapriya & Iwase, 1996; Laapotti, Keskinen & Rajalin, 2002). Beforehand attitudes may be strongly against the laws, but afterwards they have changed. And the goal of some laws is not only to change attitudes, but especially behaviour.

Fishbein and Ajzen (1975) presented the theory of reasoned action (TRA) which explains the relation between attitude and behaviour. The basic assumption is that the behaviour of the person is rational and goal directed. Behaviour is best predicted through intention of behaviour. Attitude towards the behaviour as well as subjective norms of the person in turn determines the intention of behaviour. Later Ajzen (1985) extended the theory of reasoned action to theory of planned behaviour (TPB), and added a third factor into a model, namely perceived behavioural control (Figure 3). This factor reflects the degree of control the individual perceives himself/herself to have over the behaviour. Perception of the control of behaviour may or may not be correct, but in any case this perception influences the behaviour. If a person perceives him/herself having a high control of the positively evaluated behaviour that usually leads to stronger intention to perform that particular behaviour. Or the other way around, perceived high control of negatively evaluated behaviour usually leads to stronger intention not to perform that behaviour.

Driving the vehicle is one behaviour where individual differences in the perceived control of behaviour exist. For example, Parker et al. (1992) found that

as perceived behavioural control increased, behavioural intentions weakened. Those who felt less in control rated themselves more likely to commit violations. Lower perceived control over antisocial behaviour (e.g. speeding, tail-gating) was associated with higher intentions to commit these violations.

Perceived behavioural control affects both the intention of the behaviour as well as the behaviour itself. Subjective norm and attitude also influence the intention of behaviour. Subjective norm refers to person's perceptions of social pressures to perform or not to perform a particular behaviour. Attitude towards behaviour reflects person's general positive (negative) evaluation of performing that particular behaviour. In practise the more favourable the attitude towards a behaviour is, the stronger is the intention to perform that behaviour. Intentions are also connected to motivational factors of a person, how hard a person is willing to try performing behaviour.

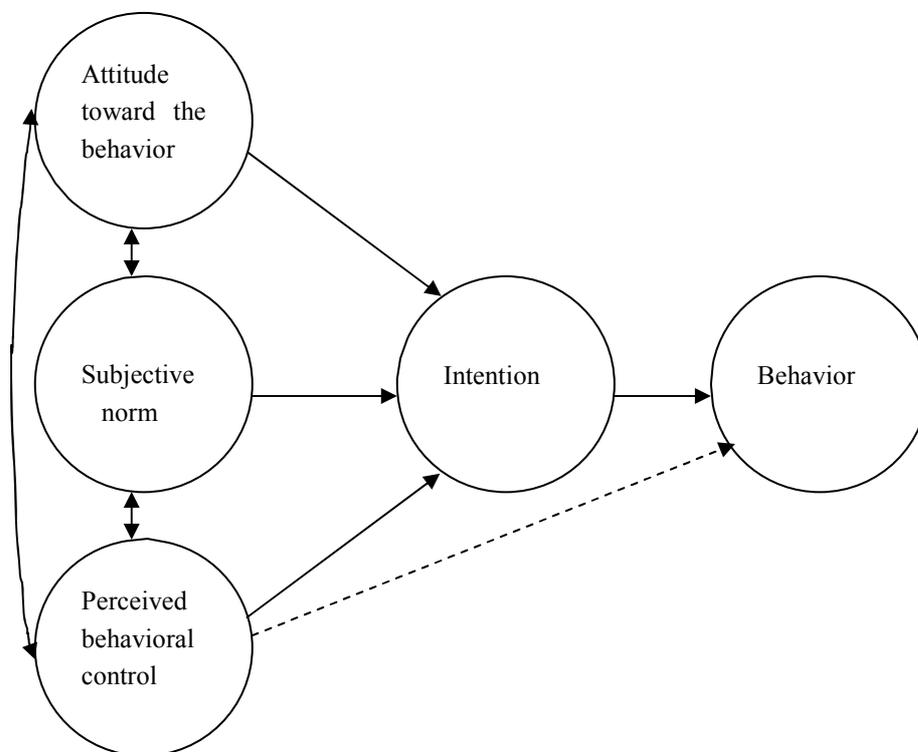


Figure 3 Theory of planned behaviour (Ajzen, 1991).

The role of a subjective norm can be seen important especially in the case of young drivers. It is connected to social pressures for example coming from the friends or peer group, and these factors are more important to young drivers than older drivers (e.g. Gregersen & Berg, 1994; Evans, 1987; Jessor, 1987). If significant others approve (disapprove) the behaviour people are more (less) likely to intend to perform that behaviour (Armitage & Conner, 2001).

There is another important idea that the model (Ajzen, 1985) presents: attitudes are not the only significant factors that influence behaviour, but subjective norm and perceived control of behaviour also have a role to play. Changes in attitudes do not necessarily guarantee changes in behaviour. Considering decision making or intention formation it is also important to notice that not all decisions are based on conscious processes, but also unconscious actions take place.

Besides attitudes, subjective norms and perceived control of behaviour, also emotions influence the decisions people make. Outcome of those decisions influence the emotions people feel. People are usually motivated to avoid experience of regret and disappointment and thus, tend to make decisions that minimises the likelihood of these emotions (Schwarz, 2000). And vice versa: people also make decisions and commit actions in the hope of positive emotions or rewards. Regret and disappointment have been the most studied emotions, even though all decisions involve prediction of involved feelings. Disappointment is felt when the outcome of the behaviour is worse than expected, regret when the outcome is expected but another behaviour would have resulted better result. Those both are negative emotions and related to risky decision making and uncertainty of outcomes (Zeelenberg, van Dijk, Manstead & van der Pligt, 2000). The main point is that possible future emotions are taken into consideration when determining the expected utility of different actions. Thus, anticipated emotions influence the current decision making. This is how anticipated emotions and attitudes are connected to each other.

3.4 The methods used to influence young drivers attitudes and behaviour

On a general level the methods (measures/incentives) to influence driver behaviour can be divided into three: methods that influence directly the driver him/herself (e.g. enforcement, education, campaigns), methods that influence drivers behaviour indirectly via the vehicle (e.g. limitations of speed by technical solutions) and methods that influence drivers' behaviour indirectly via the driving environment (e.g. use of barriers between the opposite lanes in order to avoid collisions) (Laapotti, Keskinen & Hatakka, 2001).

This section focuses on direct driver related methods and incentives that have been used to influence drivers' attitude and behaviour, especially regards to alcohol use, seat belt use and speeding. Methods presented in this section are not limited only to those methods that are specially directed/targeted towards young drivers. Methods targeted to all drivers are also presented, because these also can have an effect to young drivers' behaviour.

There is a great variation among these methods. One way to classify (conceptualise) these is to think that they are located on a continuum starting from the general measures that concern all drivers, for example laws and driver training. However, all drivers do not obey laws and educational measures might not be influential in each and every case. At the other end of the continuum are specific methods that are targeted at small, special groups of drivers, with whom the general measures have failed (e.g. driver improvement courses for drunk drivers).

Besides being general measures, laws and enforcement are at the same time necessary means that create the frames for a safe traffic system. The system (i.e. laws, enforcement) as well as driver training (licensing systems) make the necessary preconditions for successful operation in traffic and should be such that they have a possibility to produce safe drivers. However, besides these necessary frames which laws, enforcement and sound licensing systems create, also additional educational measures and methods are needed.

Different kind of laws (e.g. blood alcohol concentration laws, laws concerning seat belt use, general and specific speed limits) and their effectiveness in

influencing drivers behaviour is presented first (e.g. Jonah & Lawson, 1984; Wagenaar, O'Malley & LaFond, 2001). However, laws cannot be put forward without necessary enforcement. Effects on enforcement are reported next (e.g. Eby, Molnar & Olk, 2000; Ferguson 2003; Shults et al., 2001). Next two sections focus on educational issues. Because chapter five presents and describes driver training and different kind of licensing systems in detail, section 3.4.2. deals with some educational issues that are connected to methods used in driver training and post license training (e.g. Advanced, 2003; Glad 1988; Gregersen, 1996). Broader look is taken into other than driver training related educational measures. Several kinds of educational approaches have been used in trying to influence drivers attitudes and behaviour: general safety campaigns, community based programs, work place programs as well as school based programs or different kind of combinations of these (e.g. Boots & Midford, 1999; Eddy et al., 1997; Shope et al., 2001; Ulleberg, 2001). There exists also a great variation in the actual methods: educational lessons and lectures, informational signs and stickers, different kind of incentives and bonus systems as well as group discussions have been used. Some methods have demanded active participation and personal effort of the participants (e.g. Koivisto & Mikkonen, 1997; Gregersen, Brehmer & Morén, 1996), while others use more of a passive approach (e.g. Cope, Moy & Grossnickle, 1988). There are also differences in the effectiveness of the used methods as well as in the follow-up time of the interventions. Because many confounding factors have had a role to play, it is not easy to determine whether the used method or intervention produced the desired effect or if there was some other factor or combination of factors also influencing the results.

3.4.1 Laws and enforcement

This section concentrates on different kind of laws and evaluations of their effects. Evaluations of enforcement, which is closely connected to laws, are also reported in this section.

Drinking and driving

Laws concerning lowered blood alcohol concentration (BAC) limits for young drivers have been effective in lowering drinking and driving as well as crashes (e.g. Deshapriya & Iwase, 1996; Wagenaar, O'Malley & LaFond, 2001). Lowered BAC limits for young drivers have had effect on drinking and driving, even those had no effect on overall drinking or total miles driven (Wagenaar, O'Malley & LaFond, 2001). Also a zero tolerance for alcohol use in traffic has been proposed. Recent EU project DAN (i.e. **D**escription and **A**nalysis of Post Licensing Measures for **N**ovice Drivers) which analysed European post licensing methods for novice drivers, also concluded that a zero-alcohol limit for novice drivers should be introduced (Bartl, 2000).

Minimum legal drinking age (MLDA) is closely connected to BAC limits and zero tolerance for alcohol. Several studies (e.g. Deshapriya & Iwase, 1996; MacKinnon & Woodward, 1986; Wagenaar, O'Malley & LaFond, 2001; Wagenaar & Toomey, 2002) have shown the effectiveness of raising the minimum legal drinking age in decreasing crashes. The review on methodologically sound (highly qualified) studies on MLDA and crashes (Wagenaar & Toomey, 2002) showed that higher MLDA was related to decreased traffic crashes. None of the reviewed 46 studies found the opposite. Also fatal accidents of young drivers

have decreased after raising minimum drinking age (MacKinnon & Woodward, 1986). The authors carried out time series analyses to find out the impact of raising the drinking age on monthly driver fatalities in 3 states (Illinois, Michigan & Massachusetts). Significant reductions on fatalities among 21 year and younger were observed (MacKinnon & Woodward, 1986).

Shults et al. (2001) reviewed the effectiveness and economic efficiency of selected population based interventions to reduce alcohol impaired driving. This study also showed strong evidence for the effectiveness of .08 BAC laws and minimum legal drinking age laws. Sufficient evidence was found on lower BAC laws for younger and inexperienced drivers, but also sobriety checkpoints were found effective. At these checkpoints police stops all the vehicles, or some selected vehicles and evaluates drivers for signs of alcohol or other drugs. Sobriety checkpoints are not, however, widely adopted in the United States as a strategy to enforce impaired driving (Fell et al., 2003). Those are illegal (because of their intrusive nature) in 12 states and of 37 states allowing checkpoints, only 11 carry out those regularly on a weekly basis. Those states that use frequent checkpoints have active citizen groups (like MADD i.e. Mothers against drunk driving) and also a more general public support for the programs. Random screening (random breath testing or sobriety checkpoints) was found effective in reducing both fatalities and injuries (Peek-Asa, 1999). This review study evaluated 14 studies in the United States and Australia, the inclusion criteria was a random screening program with a control population or baseline comparison. Alcohol related fatalities showed the greatest decreases, significant reduction was also found in crashes and injuries. The reviewed studies discussed also how long the effects of random alcohol screening can be sustained as well as the level of necessary enforcement. Loxley et al. (1992) studied whether random breath testing would change the behaviour of young drivers. Young drivers in two Australian states were compared. One state had had random breath testing for six years and the other had not. Young drivers (under age of 25 years) in a state that had random breath testing were less likely to drink and drive. They were also more likely to believe that their peers would disapprove drinking and driving. The authors concluded that random breath testing changed both the behaviour and possibly also beliefs of young drivers.

Safety belts

Also regarding the use of seat belts, laws have shown their effectiveness. For example, subsequent to the passage of mandatory seat belt laws in four Canadian provinces, the use rates of seat belts increased from 20% to 70% (Jonah & Lawson, 1984). During the next several years the use rate dropped to around 50%, which still was considerably higher than the use rate before the law. Limited reduction in fatality and injury rates suggested that belt use increased primarily among safe drivers.

However, laws alone are not effective, but enforcement of the laws is also needed. Concerning seat belt use strong evidence has been found for the effectiveness of safety belt laws and enhanced enforcement programs (Dinh-Zarr et al., 2001; Eby, Molnar & Olk, 2000). For example the belt use rates increased after the standard enforcement in Michigan (Eby, Vivoda & Fordyce, 2002). Seat belt use rates were 13.4 percentage points higher after the enforcement than before the enforcement. Standard enforcement had also effect on groups that had low use rate such as young people. Also Ferguson (2003) stated that the best

opportunity to increase seat belt use rates among young drivers (and drivers of all ages) is the passage of primary belt use laws and well-publicised enforcement of these laws. At the moment only 18 US states have primary enforcement of the belt use laws (Ferguson, 2003) and analyses of fatally injured teenage drivers confirmed that seat belt use rates were much higher in primary use states (McCartt, Shabanove & Leaf, in press).

Also long term effects of enforcement for increasing seat belt has been studied (Jonah & Grant, 1985). Belt use was significantly higher than the baseline use as well as higher than the use in control community after two years follow-up. Increased belt use declined the casualties also.

Besides having different effect on different age groups (Eby, Vivoda & Fordyce, 2002) laws and enforcement have different effects on males and females (e.g. Williams et al., 1994). The effects on mandatory seat belt use laws on self-reported seat belt use among male and female college students was studied by Tipton, Camp and Hsu (1990). Seat belt use was studied in three occasions: two months before the law went to effect, two months after the law and 16 months postlaw. Reported seat belt use increased significantly for males and females two months after the laws enactment. However, the 16 month follow-up showed that the rate remained high for females but declined almost to prelaw level for males. Women were also more likely than males to attribute their belt use to factors other than the law. Also the study of the effects of three different conditions (warning, fine, fine and prompt [signs, brochures]) in seat belt use showed the same result (Lund, Pollner & Williams, 1987). The study was carried out at the university campus after the introduction of a mandatory seat belt law in New York State. Significantly more female drivers used seat belts in all conditions. Results indicated also that significantly more drivers used belts during the fine conditions as compared with the warning condition and significant difference was not found between fine and fine plus prompt conditions.

Williams et al. (2000) reported a 3 week state wide seat belt enforcement campaign in New York. The campaign included a strong "no excuses, no warning" enforcement message, belt use checkpoints, and publicity about the enforcement as well as feedback of the current belt use rates. The front seat belt use increased and also the public opinion surveys showed the support of program. The campaign demonstrated the effectiveness of enforcement as well as the meaning of community support to such efforts.

Public acceptance as well as publicity of the laws and enforcement is also an important issue. In order to gain acceptance, various methods and combinations of different methods can be used (e.g. Roberts & Geller, 1994; Wells, Preusser & Williams, 1992). For example radio, TV and newspaper advertising on the importance of seat belts were used in a pilot program which aimed to increase the seat belt use in North Carolina (Williams et al., 1994). The program included also intensive enforcement and extensive publicity of enforcement. Telephone surveys showed strong public support and belt use rates among front seat occupants increased. Women and drivers over 25 years of age were most likely to wear seat belts.

Problems related to this method were pointed out by Kaye, Sapolsky & Montgomery (1995). They examined the effects of public information, education programs and increased enforcement on seat belt use. Surveys were carried out in two paired sites in Florida and in one control site at the end of the three month campaign. Two project sites were also surveyed three months later. The project

did not yield overall increase in seat belt use across the two project sites. The authors highlighted two key problems: a failure to enact a plan to carry out the program and to track its progress and also that one shot approaches are unlikely to produce desired effects.

Feedback signs can also be an important supplement to belt use enforcement programs (Malenfant et al., 1996). Well publicised enforcement programs in North Carolina have raised seat belt use to about 80%. To raise belt use further, signs providing feedback on belt use rates were introduced in two communities. There were differences in changes between the communities that can relate to various reasons (initial belt use rates, community size, amount of publicity etc). Also another study by same authors (Wells et al., 2000) showed the effect of feedback signs in increasing seat belt use. This community program was implemented in the context of the enforcement program and contained information on the seat belt use rates as well as posters and fliers giving information about the benefits of seat belt use. Seat belt use increased following the introduction of the program.

Integrated enforcement programs have also been used (Wells, Preusser & Williams, 1992). Aim of the program was the enforcement of alcohol impaired driving and use of seat belts. Used methods were publicised use of sobriety and seat belt use checkpoints, passive alcohol sensors and seat belt law enforcement in the state of New York. The two year follow-up showed the overall reduction of about 39% in the number of drivers who had been drinking and were stopped at police checkpoints. Seat belt use also rose especially at night.

Besides that laws order people to behave in a certain way, those also give message to general public that behaviour restricted by law is not appropriate or tolerable and as such can change public attitudes. A Japanese study (Deshapriya & Iwase, 1996) showed decline in fatal crashes after the enactment of laws concerning drunken driving. However, also the public awareness and tolerance towards drunken driving had changed. Alcohol impaired driving was seen as a socially undesirable behaviour.

Speed

In relation to speed, camera enforcement is one studied area. The general effect has been that speed cameras led to lower speeds (e.g. Corbett, 2000; Keall, Povey & Frith, 2001). Keall, Povey & Frith (2001) surveyed speed and crash data as well as public attitudes after 1 year trial of hidden vs. visible camera programme. The hidden camera and related publicity was associated with net falls in speeds, crashes and casualties both in speed camera areas and on 100 km/h roads generally. Hidden cameras had more general effect on all roads (Keall, Povey & Frith, 2001). In England (Corbett, 2000), a quasi-experimental study on drivers responses to speed cameras was carried out. Speed cameras led to lower speeds. However, drivers who described themselves conforming to speed limits or "deterred" by cameras also approved them most and driver types who "manipulated" or "defied" the cameras were least responsive and respectful to them.

Special speed limits for novice drivers have also been proposed. The idea in these has been to reduce the risk of novice drivers in early stages of driving. However, EU-project DAN stated that specific speed limits for novice drivers or mandatory curfews should not be applied (Bartl, 2000). For example, Menders (1983, in Mayhew & Simpson, 1990) showed that vehicles displaying P-plates

reduced speed by 10–15 km/h, but significantly more vehicles with P-plates exceeded the 80 km/h speed limit than were ordinary drivers exceeding the 100 km/h limit. Special speed limits for young drivers may lead to opposite result as intended. Specific speed limits also bear additional risk factors, because those can introduce large differences in speeds, which is a risk factor itself.

Curfews' preventing driving during night-time has been applied mainly in the United States. Their effect has been positive among young novice drivers (e.g. Preusser et al., 1984; Levy, 1988). However these have been applied mostly to youngest drivers, 16 years of age or even younger. The situation is different whether the driver is 14 years old or 18–19 year old. The European evaluation of the post licensing methods stated that late-night or weekend curfews shall only be promoted on a voluntary basis (Bartl, 2000).

General system connected to laws and enforcement is different kind of penalty point systems. Those are used in several countries (e.g. in Germany, Japan, Australia, United States). The evaluation of these systems is difficult and there are many confounding effects. However, these programs offer clear rules for the drivers: after gaining certain amount of penalty points certain incentives will follow.

For example, in Germany the penalty point scale varies from 1 to 7 points according to the offence severity (Evers, 2000). The systems concern all drivers, not just novice drivers. There are three intervention thresholds at the system: at 8, 14 and 17 penalty points. Reaching a total of 18 penalty points, the driving licence is withdrawn. Penalty points are to be annulled after given periods have expired depending on the severity of the offence(s). The German system has also other measures connected to penalty point system e.g. driver improvement courses, traffic psychological consultation, which are voluntary to a certain point. If an offender voluntarily enlists these offers, he receives a penalty point discount. In Finland a revised penalty system for traffic offences was introduced 1996. The preventive effects of the system were studied during the years 1996–1998 (Hatakka et al., 2000). There were fewer young drivers who had committed more than one traffic offence, which was positive specifically targeted effect. The overall result of the renewal was as intended and especially new (18–19 years old) drivers showed good knowledge of the system and its implications.

In conclusion it can be said that laws and enforcement are effective when trying to influence driver's attitudes and behaviour. However laws alone are not enough, those should be accompanied by enforcement. Several studies have shown the effectiveness of enforcement. Even better results can be obtained when educational methods are combined with laws and enforcement. Education is needed in order to enhance levels of knowledge and credibility of the sanctions (e.g. Pinsky et al., 2001) as well as to change the public opinion and attitudes (Deshapriya & Iwase, 1996). Combinations of different methods have also been effective. Effectiveness of incentives alone, enforcement alone and a combination of both incentives and enforcement in seat belt use was studied in four targets and four control cities in Illinois (Mortimer et al., 1990). All produced significant increases in the use of seat belts, greatest effect was attributed to combined treatment. The effect of enforcement alone had largely decayed in about 6 weeks, whereas incentives retained their effect for up to 3 months when the measurements ended. There is evidence that these laws and enforcement seem to work with safe drivers more often (e.g. Jonah & Lawson, 1984) as well as women (e.g.

Lund, Pollner & Williams, 1987; Tipton, Camp & Hsu, 1990). High risk drivers may not be reached that well with these methods.

3.4.2 Driver training and post licence training

This section presents educational issues and methods that are related to driver training and post licence training. Contents and descriptions of driver training systems and different licensing systems are presented in detail in chapter five.

Skill-based training is one issue that has been raised in the discussion of driver training. For example Glad (1988) reported increase in slippery road accidents after the skid training became a mandatory part of the training. The Finnish results (Keskinen et al., 1992) pointed in the same direction: after the introduction of skid training the larger proportion of young male and female driver's accidents happened in slippery road conditions. The suggested explanation was that the skid training courses were based mostly on exercising of manoeuvring skills and this resulted in overconfidence of one's own skill. Instead of using their better skills in critical situations the students used their better skills in ordinary driving situations and used for example higher speed (Glad, 1988; Keskinen et al., 1992). Also Gregersen (1996b) showed the connection between the training strategy and skill. He compared two types of training and their influence on estimated and actual driving skill as well as the driver's degree of overestimation of their own skill. One type of training was concentrated on skill training and another one on making the driver aware of his/her limited skills in critical situations. The skill-trained group estimated their skills higher than the insight trained group, even though no difference was found in their actual skills. It was concluded that skill based strategy produces overconfidence of one's own skills.

Gregersen (1996a) presented a variety of methods that could be used in driver training and in trying to reduce the overrepresentation of young drivers in accidents. Suggested practical methods concentrate on risk awareness training. Examples of such practises are for example stopping distance meter, assessment of stopping distance in low friction conditions, distance to the car in front or brake application-emergency avoidance manoeuvre in a surprising situation. Idea in most of the presented methods is to give young drivers experience of risk, instead of giving the driver knowledge of the risk. Use of emotions can be expected to be more effective than just knowledge increasing methods. There is no systematic evaluation of the effects of these methods, but on the basis of scientific knowledge of psychology, they seem to be promising methods (Advanced, 2003).

Post licensing measures for novice drivers was evaluated in EU-project DAN (Bartl, 2000). All measures that were applied in EU countries were included in the analysis. The first notion of the project was that there exists a great variation in practises concerning post licensing practises. In some countries there are no post licensing measures, while other countries have a single approach and in some countries there exists a comprehensive system concerning post licensing measures (Bartl, 2000). The authors concluded that empirical evaluations had methodological weaknesses. However, the project concluded several points that should be considered regarding post licensing measures. One point was that a probation period with demerit point systems and feedback of about two to five years for novice drivers should be implemented as well as a central index of traffic offenders. These are the frame conditions to execution of extended learner's period. Besides giving feedback to driver via point systems also discussion as a

means of a feedback is important. Discussion could also be given in group sessions with maximal 10 participants (Bartl, 2000).

Also another EU project Advanced (2003) concluded several recommendations for post licence driver training. Not all the recommendations are based on the evaluation studies, but on the general agreement of the researchers and instructors in the area. In the following paragraphs these recommendations are summarised.

The general recommendations were that courses should focus more on the specific needs of each participant and encourage them to improve their driving style and behaviour. This can only be achieved through more participant-centred methods. Courses should be designed to encourage participants to reflect on their strengths and weaknesses (self-reflection) and to provide the motivation to change. Trainers need stronger coaching skills (for individuals) and moderation skills (for groups). Track based driver courses should focus more heavily on risk awareness than on manoeuvring skills. Comprehensive feedback and discussion sessions should be carried out after each practical exercise has been completed. On-road driver courses should include discussion sessions where personal strengths and weaknesses should be addressed. Trainers require a range of teaching skills to “help the participant to help themselves”. Participants must be convinced that it is in their personal interest to adopt a different driving style.

The report (Advanced, 2003) gave also recommendations concerning the construction and the content of post licence courses. When planning the course construction the orientation of the target group should be considered. Courses should be designed with the participant(s) needs in mind. Target groups may differ for example in their learning style, risk-profile or in confidence to their own skills (overconfidence/underconfidence). To guarantee individual attention and feedback, group sizes should not exceed 10 participants per trainer during exercises in track-based courses. Clear goals should be set for the course (what the course intends to achieve and how), as well as effective delivery and verification of the goals reached. Goals, exercises and methods should be clearly documented. Clear goals in terms of what the course intends to achieve and how it will achieve them will also help the evaluation of the course. Working climate and co-operation between trainer and participants is also an important issue to be considered.

When planning the course content the four different levels of driver behaviour (Keskinen, 1996) should be considered. Skills training should be in balance with risk awareness exercises. Both on-road, track and classroom exercises should be used. Driving simulators, that are becoming increasingly available, needs more improvements before they can be considered useful as conventional training forms for category A and B training. Training must be relevant to real-life situations, exercises and discussions should be related to real scenarios which participants can identify with. Overconfidence should be avoided, it could lead to more risks taken than prior to training. Counter-measures to avoid overconfidence should be used, e.g. demonstrations of risk awareness exercises instead of driving, making sure that participants "fail" (hit obstacles, lose full or temporarily control of the vehicle).

The quality of the trainer and other quality issues were also discussed in the Advanced report (2003). The quality of the trainer is a major factor in the success of a course. A good trainer can make a poorly constructed course a success, but a poor trainer cannot succeed in doing this, even if the course is perfectly designed. The client-trainer relationship seems to have the greatest influence on what will be

changed in the participant throughout the course. The following principles have been established as far as the quality of the trainer is concerned: the trainer should encourage participants to adopt a self-analytical approach. The trainer should be seen as a facilitator who helps participants understand and recognise (based on the appropriate assessment criteria) their strengths and weaknesses related to driving and to their relationship with society in general. The trainer should aim to establish a dynamic relationship with the participants, including understanding of the different needs, experiences, abilities, attitudes and motivations of the participants. Clarity and relevance of message should be considered along four aspects. The first is that the delivery of the course messages should be successfully communicated to the participants during the training. The second point is that the message should not be excessive in detail or disproportionate emphasising only one aspect of training. The third issue is possible questions regarding emergency manoeuvring. Those should be answered and considered carefully, to find out whether the participants have false assumptions on such manoeuvring techniques and sequences. The fourth and last point is that the trainer should constantly ask the participants about their views on the training and what they have learned from the training.

3.4.3 Educational measures and campaigns

This section concentrates on educational methods. Only some specific programs carried out in schools are presented in this section, because a thorough presentation of driver education in high schools is presented in the fourth chapter. Classification of different kinds of educational methods and campaigns is not easy, because there is overlap in several ways (methods, duration, target group etc.). The focus is not solely on young drivers, but also methods that have been targeted towards all drivers are presented. This is because those methods targeted towards all drivers may also have an effect to young drivers as well.

Drinking and driving

Several school-based programs have been carried out in order to prevent drinking and driving related accidents and fatalities among youth. Mann et al. (1986) reviewed these programs. Results indicated that programs based on accurate provision of information (e.g. traditional lecturing of drinking and driving) and non-threatening attempts to change attitudes and on behavioural peer intervention techniques consistently demonstrated knowledge gains. Also in some cases attitude changes and self-reported behaviour change followed immediately after the program. However, these positive effects tended to dissipate with time.

The influence of peer groups has been used as a means to influence young drivers. One result is that education can lead to increase in knowledge, but not to a change in attitude or behaviour. McKnight and McPherson (1986) compared the effectiveness of peer intervention program with standard information oriented program in influencing willingness of students to intervene drinking and driving behaviour of their peers. The standard information oriented program consisted of conventional provision of information (e.g. lessons and lecturing) of the risks connected to drinking and driving. Peer intervention program provided instruction of techniques for intervening in drinking and driving situations. Students also participated in role playing, and prepared themselves possible scenarios and roles. Peer intervention programs led to a significant increase in self reported inter-

vention behaviour but conventional programs did not. Both led to significant knowledge gains, but none of them led to any significant shifts in attitudes.

Clark and Powell (1984) tested the hypothesis that young drivers with an accident record who were exposed to a peer group decision process would shift their attitude toward safer driving and controlled their drinking more. The discussion groups consisted of 14 subjects and 39 friends of these subjects. As control group served 18 subjects who had similar characteristics as those who took part in the group discussions. Pre and post intervention questionnaires were analysed and the results showed changes for attitudes related to driver roles, but not to drinking related. The authors suggest that involvement of peers produces a more substantial change in attitudes and behaviour than fear arousal approach that is used in most safety campaigns.

In a long term follow-up of a high school alcohol misuse prevention program's effects was found that the strongest effect was among the largest subgroup of students: those who were drinking less than 1 drink per week (Shope et al., 2001). There was also an effect in a small group whose parents had not expressed disapproval of teens drinking. The report of National institute on alcohol abuse and alcoholism (2001) presented the results of project Northland, which was a school based program carried out in high risk communities. The overall result was that program appeared to affect those students who had not begun to use alcohol. It had little or no impact on those who were already drinking.

Research in recent years emphasizes the importance of target group analysis and of message strategies. It has also been pointed out that the combination of different measures, e.g. media campaigns, interpersonal communication, enforcements and education have better effects than each of them alone. In 1998 the National Board of Road Safety in Sweden initiated a media campaign to illuminate the drink-driving problem. The aim was to point out the connection between drunken driving and alcoholism. The target group was young road users in the age between 16 and 25 years. The evaluation (Linderholm, 2000) showed that there were only small effects of the campaign. The negative attitude against drink-driving was the same after the campaign and there were only small or no differences in self reported behaviour. Nevertheless, one positive result showed that more respondents after the campaign than before would intervene in cases where friends intended to drink and drive. Linderholm suggests that one reason for the small effects can be the lack of a thorough analysis of the target group and therefore the messages were constructed too broad.

The uses of designated drivers have been studied especially among American college students (e.g. DeJong & Winsten, 1999; Barr & MacKinnon, 1998). DeJong & Winsten (1999) carried out a survey among college students whether they had served as or ridden with a designated driver in the past 30 days. Among those students that have consumed alcohol in the past year 36% said that they had served as a designated driver and 37% had been using a designated driver. Based on the survey the authors concluded that using a designated driver is a well established strategy in the prevention of drinking and driving. However, critical notions have also been raised. For example, Glascoff, Knight & Jenkins (1994) reported that designated drivers do not always abstain from drinking and also nondrivers drink more when the designated driver is available. Also Wagenaar (1992) stated that public health would be better served if more emphasis were placed on preventing intoxication in all situations.

In connection to designated driver programs also the effects of the media related campaigns have been assessed. For example 'Pick- a skipper' – program was carried out to prevent alcohol related injury in a regional Australian city (Boots & Midford, 1999). Components of the program included TV advertising and promotion in night clubs. In night clubs, drivers of two or more passengers were provided free soft drinks. The results of the campaign showed that mass media component was more important in the success of the program than the on site promotion in night clubs. Males were significantly less likely to select a Skipper as well as more likely to undertake high risk behaviour. Inaccurate knowledge about designated drivers was associated with high risk behaviour and accurate knowledge was associated with increased frequency of Skipper selection. The authors concluded that an extensive media campaign can have a significant impact on drinking and driving behaviour.

Media attention, institutional response and health behaviour change was studied concerning drunk driving during the years 1978–1996 (Yanovitsky & Bennett, 1999). The authors considered which changes over time in the amount of media attention to the issue of drunken driving may have contributed to the reduction of drunken driving behaviour. However, they concluded that the direct effect of media on behaviour was no longer significant when the effect of legislation on behaviour was controlled.

In order to prevent impaired driving, server intervention have also been proposed (e.g. Single, 1990; Shults et al., 2001). The idea of these is the training of managers and servers in bars, restaurants and other licensed establishments to the responsible service of alcohol and thus to reduce intoxication as well as drunken driving. These kind of methods are at the passive end of the continuum, where the idea is that the servers are responsible for making the decision if someone should drive or not, instead of the actual driver.

Safety belts

Besides high-school settings several campaigns and educational measures have been carried out in work places and college campuses (e.g. Eddy et al., 1997; Gazit, 1992; Grant, 1990; Weinstein, Grubb & Vautier, 1986). Used methods have been quite passive: they have not demanded active participation. Campaigns have included provision of information, educational presentations, monitoring of the targeted behaviour (i.e. seat belt use) and feedback of it, displays and memos for management, awareness raising, written prompts and pledge cards. One important factor was brought up in a review of the 14 work site based safety belt programs (Eddy et al., 1997). None of the studies used randomised controlled designs and only 4 had comparison groups. It is difficult to draw conclusions about the impact of such programs. Programs seem to increase belt usage while programs are in place. After they have ended, there has been a decrease. However, the relapse rate remained above the baseline rate.

There have also been campaigns of a short duration that have used brief interventions. For example Cope, Moy and Grossnickle (1988) reported of a promotional campaign carried out at a restaurant. Safety belt use was observed after an incentive strategy (providing a large soft drink contingent on safety belt use). Belt use increased from baseline. The use rate declined during follow-up, a verbal prompt was considered ineffective because the stickers providing the prompt were not widely used. Brief interventions have been used also on a college campus setting (e.g. Clark et al., 1999; Pasto & Baker, 2001). Methods used in these

interventions have consisted of for example reminder banners, media coverage, permanent reminder signs, roll over demonstrations, presentation on the need for seat belt use and distribution of seat belt use pledge cards (Clark et al., 1999). Increase in belt use was small, though statistically significant and could represent considerable health care savings. Another brief intervention for increasing seat belt use included public posting of performance feedback and an informational flyer to cars in a targeted parking lot (Pasto & Baker, 2001). Seat belt use increased during the intervention although a trend toward decreasing belt use was noted at the follow-up.

Grant (1990) studied effectiveness of feedback and education in an employment based seat belt program. The six-week program included obtrusive seat belt use monitoring, a feedback sign, an educational presentation, displays and supportive memos for management. Increase in belt use occurred as results of a program in both drivers and passengers. A decline was observed in the follow-up but belt use remained higher than during the baseline period. Attitudes towards seat belts changed a little.

In another study industrial employers participated in 40 minutes safety belt awareness sessions, some of the sessions also included opportunities to sign cards pledging to use seat belts (Kello et al., 1988). Duration of pledge period was varied in three groups: 1 week, 1 month or 3 months. The sessions, alone or with the pledge card yielded threefold increase in safety belt use which sustained over 13 weeks. Pledges did not produce greater increases and pledge duration had no differential effect on belt use. White collar subjects showed higher rates throughout the study. The authors concluded that results suggested that intrinsic control strategy of raising awareness and increasing personal commitment can substantially increase safety belt use.

One idea that has been brought up is that people may fail to take into account their seat belt use and their risk of being injured in an accident (Weinstein, Grubb & Vautier, 1986). The seat belt promotion program was implemented in a large corporation. The goal of the program was to increase belt use making the link between belt use and personal risk more salient. The program included one week active intervention which was composed of stickers on dashboards, signs in the parking deck and signs in the cafeteria. Post treatment observations showed that number of people using belts increased. Six months following the interventions the use rates were still above the baseline.

Another kind of example which Kelly (1987) stated that a brief personal physician-patient intervention may have significant effects on seat belt use. A questionnaire measuring self-reported seat belt use was given to 77 patients while they were waiting for the physician. At the end of each office visit the questionnaire was reviewed and the importance of seat belt use emphasized in a brief statement by the physician. Those (44 persons) who reported that they did not always use seat belts were then given a one-page sheet of "seat belt facts." In the follow-up, 48% of them reported a change in behaviour; of these one-third changed to "always" users.

Also longer lasting interventions have been tried. For example Boyce and Geller (1999) evaluated successive interventions to increase vehicle seat belt use among industry workers over a period of two years. The interventions included successive applications: written prompts, goal setting, goal setting plus feedback and promise card commitments. Only a modest increase occurred when promise card commitment strategy was combined with an incentive/reward strategy. The

authors concluded that repeated attempts to change behaviour with interventions at the same level of intrusiveness will not affect behaviour.

Also parent-teen driving agreements and parent based programs have been proposed (e.g. Beck, Hartos & Simons-Morton, 2002; Hartos, Nissen & Simons-Morton, 2001) Parents are in prime position in implementing their own tailored family policies on adolescents driving and limiting teen driving in high risk conditions (Beck, Hartos & Simons-Morton, 2002; Hartos, Nissen & Simons-Morton, 2001). Influence of parents is, however, strongly connected to the age of the driver. The situation is different whether the driver is a 15 years old teenager or 18 years old young adult who might already have a family of his/her own. This method may tackle only those drivers who are not so problematic. High risk groups may not be reached via parental supervision and guidance.

Speed

Walton & McKeown (2001) evaluated whether the public safety messages concerning speeding effectively reached their target audience. The authors carried out a survey of 113 drivers. The drivers completed a questionnaire, reporting their usual driving speed and the perceived average speed of others. Walton & McKeown (2001) showed that drivers, who have biased perception of their own speed relative to others, are more likely to ignore advertising campaigns encouraging not to speed.

Riedel, Rothengatter & Bruin (1988) studied the combination of publicity campaign and enforcement. The campaign lasted three weeks and included press publication, information leaflets, stickers and posters and personal mailings. Two roads were chosen for research sites, one for experimental site and another for control site. The speeds were measured at both sites, before, during and after the campaign. Additional police surveillance was carried out in the experimental site. The conclusion of the study was that the campaign was very helpful in supporting the police enforcement strategies.

Lourens, van der Molen & Oude (1991) stated that it was difficult to demonstrate any significant positive effects of campaigns although there was some indication that information campaigns may work. They evaluated the reported and actual behaviour of drivers after three local information campaigns. Objectives were to reduce driving speed in residential areas, improve drivers' observational behaviour and increase the subjective risk present in drivers of running into a child.

One result of the campaigns has been that they have had effects on the low-risk groups and the more problematic drivers are hard to approach. For example a safety campaign was carried out among adolescents in two Norwegian counties (Ulleberg, 2001). The main focus of the campaign was accidents caused by speeding, driving off the road and head on collisions. The aims of the campaign were to enhance favourable traffic attitudes, generate more awareness of accident risks and promote safe driving among adolescents. Visiting schools and showing two movies to students were part of the campaign. Teachers were also given a manual, which was the basis of traffic safety projects completed afterwards in the classes. Various reminders of the campaign took place after the campaign teams visited schools (movie commercials, posters, free CD and t-shirts etc.). The campaign was combined also with increased enforcement of traffic rules and special attention regarding the campaign at driving schools. Ulleberg (2001) identified subtypes of young drivers (differing for example in risky driving

behaviour, accident involvement) and how these different groups responded to the campaign. The safety campaign was most appealing to low risk groups and women.

Other pedagogical approaches

Methods that demand active participation and discussion (personal effort) are one form of interventions that can be used when trying to influence attitudes and behaviour. One example of this kind of a traffic safety campaign was aimed at helping drivers to recognise their own weaknesses and strengths and thus, influence their traffic behaviour (Koivisto & Mikkonen, 1997). The target group in this campaign were all men who were in a military service during the experiment, meaning about 30,000 drivers aged at 18–19 years. Several samples were used when recording the actual traffic behaviour and attitudes of the target group. This "message" was mirrored back to the target group. Effects of the campaign were followed up by recording speeds, the use of seat belts and via survey few weeks after the mirroring session. A slight increase in the use of seat belts and significant decrease in highest speeds were observed. Survey opinions supported the interpretation that the mirroring had a positive impact on behaviour and on the attitudes of the target group, even though the effects of certain parallel factors cannot be excluded.

Misumi (1978; 1982) carried out a series of road safety projects in Japanese transport companies. The methods used were group discussions that had a 6 phase structure. The first phase was a warm-up meeting to ease tension among participants. In the second phase the participants were split up into smaller groups and discussion followed to identify the problems at the workplaces. Third phase consisted the meeting with the large group, results of the second phase were reported to them and also a ten item list was produced. The fourth phase was again small group meetings with discussion about the problems identified in the previous phase. The focus of the discussion was which problems could be solved by themselves and which problems the company should try to solve. The fifth phase was a large group meeting where the results of the discussions of the previous phase were reported to the whole group. The sixth phase consisted of discussions in the small groups about measures and changes in driver behaviour. Each driver also made a personal promise to himself/herself about one personal effort to deal with the problem. This promise was just for themselves and they did not have to share it with the group. This method produced a promising result. Bus driver's accidents were reduced considerably and the study was also repeated with similar results.

Also the study of Gregersen, Brehmer and Morén (1996) showed good results produced by the use of Misumi type of group discussion. They studied the effectiveness of road safety improvement in large companies. An experimental comparison of different measures driver training, group discussions, campaigns and bonuses for accident free drivers was carried out. Group discussions and driver training succeeded in lowering the accident risk compared to a control group. The focus of the training program was on insight and risk awareness, not on car control skills in critical situations. Accident costs were reduced in all four test groups but not in the control group.

The study of D'Amico and Fromme (2002) compared the effects of two different programs in decreasing adolescent risk taking, substance use and drunken driving. The study compared the abbreviated version of Drug Abuse and

Resistance Education (DARE A) to a Risk program to Skills Training Program (RSTP). RSTP was aimed to target several risk behaviours and used a brief personalised prevention program in a group setting. DARE-A focused increasing knowledge and understanding the deleterious effects of substance use. 300 adolescents (aged 14–19 years) were randomised to three groups (DARE A, RSTP and control group). Adolescent participation in drinking, drug use, drunken driving and riding with a drunk driver was examined longitudinally. RSTP participants decreased participation in several risk behaviours after two months of the program, but reductions were not maintained at the six month follow up.

More of a therapeutic like approaches has also been used. For example, relaxation and cognitive-relaxation interventions were compared to no treatment control group in the treatment of high anger drivers (Deffenbacher et al., 2002). The participants were 55 introductory psychology students. The cognitive relaxation condition adopted style of Beck's cognitive therapy (socratic questions and behavioural experiments and tryouts) in trying to decrease driving anger. Both interventions lowered indices of driving anger and hostile and aggressive forms of expressing driving anger and increased adaptive/constructive ways of expressing driving anger. The cognitive relaxation intervention also lowered the frequency of risky behaviour. Both also lowered the trait anger as well.

Driver rehabilitation courses for traffic violators were analysed in an EU project ANDREA, Analysis of Driver Rehabilitation Programmes (Bartl et al., 2002). These programmes are addressed to a small group of traffic violators who are responsible for a large amount of serious accidents. Typical clients are alcohol and speed offenders. In these courses it is the aim to support a positive change of participants' personal attitudes as the basis for safer traffic behaviour. Approach in these programs was more of a therapeutic one than traditional education. The programs have been evaluated in several studies. Studies which had a control group and could control for the self selection bias have been carried out in Austria by Michalke et al. (1987) and Schützenhöfer & Krainz (1999), in Germany by Winkler et al. (1990) and Jacobshagen (1997, 1998), in England and Wales by Davies et al. (1999) and in the USA by Jones et al. (1997). These studies indicate that the recidivism rate of course participants is about 50% lower compared to individuals of control groups without a treatment. Driver rehabilitation course seem to be effective if there are about 10 participants per trainer and alcohol offenders are not mixed together with other than alcohol offenders. The courses should last over a few weeks period (not just a weekend) so that the time between the sessions can also have an influence. Course leaders should be psychologically educated and can make use of group-dynamic processes and can motivate resisting clients towards self-reflection instead of merely teaching and can set up a professional client trainer relationship. The content is client centred and not following a fixed programme scheme.

Promising results have been found from the methods that demand active participation, use of personal experiences and reflective thinking. Especially and not so used traffic safety area, while trying to influence attitude and behaviour, is the use of emotions and self-evaluation. First step in change is, however, addressing the need of change, "make" the individual him/herself realise the need and be aware of the need for change. Self-evaluative and self-reflective methods provide tools for this.

The ideas of anticipated emotions (e.g. van der Pligt) may offer promising future directions in traffic related areas. The studies on anticipated regret have

varied from sexual behaviour (Richard, van der Pligt & de Vries, 1996) to traffic behaviour (Parker, Stradling & Manstead, 1996). Awareness that an action can have negative post-behavioural affective consequences is an important factor in producing behavioural change. Richard, van der Pligt & de Vries (1996) carried out a study where three groups of students were "educated" regarding the risk of getting a sexually transmitted disease. One group received information about the risk of getting such a disease, the second group received information about its long-term effects, and the third group was instructed to imagine what it would feel like to wake up in the morning after having had unprotected sex with a temporary partner. A behavioural change, measured later, was apparent only for the members in the third group. This shows that information as such is important but not sufficient if it is not personalised.

Personal experience of an accident or ill health might be expected to challenge young person's sense of invulnerability (Denscombe, 2001). Those incidences could act as critical incidences driving home the message 'it could indeed happen to me' and make the young person more concerned to avoid unnecessary health risks. The study (Denscombe, 2001) investigated how young people 15–16 years of age reflect their personal experiences and the degree to which they believe the experiences have affected them. Based on survey research, a diversity of responses was reported and discussed. The findings indicated that the objective features of critical incidents in themselves are not the crucial factor influencing changes in attitudes and behaviour. More important and significant is the meaning that young people give to those incidents.

Lockwood (2002) reported the meaning of personalised self-reflection. She carried out three studies on downward comparisons of the self. The idea behind downward comparisons on the self is that worse-off others will frighten people to change their own behaviour. Those people who have engaged in irresponsible or risky activities would thus motivate other people to alter their self-definitions and motivate them to adopt more responsible behaviour. This technique has been used for example to exposing teens at risk to prison inmates, idea is that the contact with the inmates will encourage the teens at risk to develop more responsible self identities and discourage them from engaging in criminal behaviour. Other domains have been also promoting safe sex behaviour and not to use illegal drugs. However, Lockwood (2002) showed in her studies that downward comparisons do not exert spontaneous impact on self. If individuals believe to be reasonably safe from experiencing others negative fate the comparison will enhance (not alter) their self-evaluations. But if people believe themselves to be at high risk of experiencing similar fate, comparison will deflate their self-perceptions, but at the same this will boost their motivation to prevent this negative outcome.

3.5 Discussion

This chapter focused on different methods and incentives that have been used when trying to influence young drivers' attitudes and behaviour. Methods targeted to all drivers were treated in this chapter too, because they can have influence to young drivers also. It was found that the variation of these methods is large. In one end of the continuum are general measures directed to all drivers (e.g. laws and enforcement) and in the other end methods and incentives that are directed to a minority of drivers (e.g. driver rehabilitation courses). Driver training forms an

important measure to influence young drivers. Besides driver training there is a wide variety of different educational methods.

Strong evidence exists on the impact of different kind of laws and enforcement when trying to influence driver's attitudes and behaviour. In all three areas (alcohol use, seat belt use and speeding) laws and enforcement have shown their effectiveness (e.g. Deshapriya & Iwase, 1996; Dinh-Zarr et al., 2001; Eby, Molnar & Olk, 2000; Jonah & Lawson, 1984; MacKinnon & Woodward, 1986; Wagenaar, O'Malley & LaFond, 2001; Wagenaar & Toomey, 2002). Those have for example decreased drunken driving and crashes, as well as increased for example the use of seat belts. Speeds have lowered as the result of laws and enforcement (e.g. Corbett, 2000; Keall, Povey & Frith, 2001). Even better results can be obtained when educational methods are combined with laws and enforcement. Education is needed in order to enhance levels of knowledge and credibility of the sanctions (e.g. Pinsky et al., 2001) as well as to change the public opinion and attitudes (Deshapriya & Iwase, 1996).

Driver training is an essential part of influencing drivers' behaviour. Basic handling skills (vehicle manoeuvring) and mastery of traffic situations (section 3.2 in this chapter) form the basis for successful operation in traffic and these skills are usually covered well in driver training. However, these skills are applied under guidance of higher level goals and motives. Driver's motives, goals, attitudes and personality are all connected at the highest level of the hierarchy and thus have effect over all levels.

Skill-based exercises have been found to have a risk-increasing effect in certain circumstances (e.g. Glad, 1988; Gregersen, 1996b; Keskinen et al., 1992). As far as driver education is concerned, a distinction should be made between training of skills and training of risk-awareness. Skill-based training is primarily about learning vehicle control and manoeuvring. Risk-awareness exercises, on the other hand, are designed to increase knowledge, experience and recognition of dangers on the road. Avoidance of overconfidence is therefore one of the main targets of risk-awareness training. Educational methods that might be appropriate when trying to increase driver's skills for self-evaluation include e.g. improved feedback during training, self-evaluation tools like questionnaires and scales, discussions with other drivers about personal experiences and evaluations made by instructors or examiners (e.g. Gregersen, 1996b; Advanced, 2003). The second column of the GDE-model points to these factors (section 3.2 in this chapter). The column contains topics that are essential in so-called "insight" learning courses (Gregersen, 1996b) as well as in courses in "defensive driving".

A wide variety of educational approaches have been used when trying to effect or change drivers' attitudes and behaviour. There exists also a great variation in the effectiveness as well as follow-up time of the effectiveness. Educational measures have varied from traffic safety campaigns, public safety messaging, school and work place based programs to advertising and awareness raising campaigns (e.g. Eddy et al., 1997; Gazit, 1992; Grant, 1990; McKnight & McPherson, 1986; Weinstein, Grubb & Vautier, 1986; Shope et al., 2001, Ulleberg, 2001). Actual methods have varied from knowledge increasing approach, feedback systems, peer groups and peer interventions to more emotional approach and use of personal experiences. Combinations of different methods have been common too. One important aspect in educational methods and campaigning is activity vs. passivity. Campaign in its' simplest form just give information and demand no personal effort or participation on behalf of the target

group. Campaigns may demand participation into some educational situation or in the most active form demand personal effort and active participation. Methods demanding active participation seem promising when influencing attitudes and behaviour (e.g. Denscombe, 2001; Gregersen, Brehmer & Morén, 1996; Koivisto & Mikkonen, 1997; Misumi, 1978, 1982; Richard, van der Pligt & de Vries, 1996).

Methods that demand the use of emotions, personal self-reflection and evaluation offer possibilities also in the traffic safety area. Considering the connections and interplay between emotions, attitudes, motives and goals of the drivers (section 3.3 in this chapter) these factors are important. These kinds of methods should be used as standard procedure in driver training. These methods also are in line with the contemporary view on learning, which emphasises the active participation and role of the learner him/herself, reflective thinking and metacognitive skills (evaluation, assessment of one's own behaviour, thoughts, being aware of one's own mental processes). When taken into consideration the ideas of the GDE-model and the hierarchical view of driver behaviour those also emphasise the role of self-evaluation and personal effort. A person's own understanding is a crucial point when changes in attitudinal factors are intended. A starting point for change is that the person him/herself realises the need of change. Self-evaluative skills offer one possibility to address these factors. Not only is self-evaluation seen as an important tool in driver training but also in development of driving skill after training. Research on the development of expertise show, that meta-cognitive skills and reflective thinking are essential characteristics of an expert (Kolb, 1984; Mezirov, 1981; Mezirov et al., 1990). However, self-evaluative skills do not develop automatically but should be included as part of training. Abilities for self-evaluation also have relevance for driving behaviour. For example, a driver who is aware of a tendency to doze off during driving, or aware of his limited skills in slippery road conditions, may be able to take these factors into consideration and adapt his driving accordingly. Similarly, on a higher level, a driver is expected to benefit from intrinsic knowledge of what effect personal motives and goals have on behaviour in a driving situation, e.g. poor abilities to resist social pressure.

Bringing about changes in attitude and behaviour are much the same as trying to change motives. The idea is the same when we think about driving as a skill or the style of driving. Style of driving is connected more to the two highest levels of driving behaviour e.g. trip planning and skills of living. The same goes with attitudes. They are also connected to other life areas and personality. The meaning of subjective norms in modifying the attitudinal effects is essential. Subjective norms should "go along" with the official norms if the behaviour is supposed to be complying with the rules or laws.

There is no single method or measure that could be used in influencing such a complex phenomenon as young drivers' attitudes and behaviour. A variety of psychological, social and situational factors play a role in this phenomenon. Young drivers' high accident risk is connected both to attitudes, emotions, goals, motives and to the whole personality of the driver. Various efforts are needed, laws and their enforcement, driver training as well as other educational measures are important. Used methods and their effectiveness are also depending on what is the target of education or influence. When learning to brake or change a gear, traditional practising of the skill is useful, but change in attitudes demands other kind of measures.

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4 Driver Education in High schools

by Inger Engström

This chapter is about the effects of driver education and training in high schools. Evaluations of driver education and training in high schools from different countries, mostly from the last seven years, will be presented and some of the results will also be discussed at the end of the chapter. Unfortunately there are not that many evaluations presented because most of the driver education and training in high schools have not been evaluated.

4.1 Introduction

Since the 1950s there has been driver education and training in high schools in America and throughout the world. The first state in the United States to mandate a certified course of driver education was Michigan in 1955. This course was offered by all public schools and the students had to complete the course to obtain a licence (Haworth, Kowadlo and Tingvall, 2000).

The first National Conference on High School Driver Education was held in 1949 in the United States. One of the major recommendations from this conference is still followed today in many driver education programmes. The recommendation was that a minimum novice driver education course should consist of 30 hours of classroom instruction and 6 hours of behind-the-wheel instruction (Ritzel, Shannon and Leitner, 1997). In the beginning, the education and training in high schools was very popular because the evaluations showed that the courses were effective. These first evaluations, however, failed to eliminate important sources of bias. They also failed to show the effects on licensure rates. It was shown that driver education in high schools stimulated to licences at an earlier age than would otherwise have been allowed. There have been discussions about the advantages and disadvantages of driver education and training in high schools. Despite that many states in America and in other countries in the world made high school driver education a fixture in the 1970s. Since then the availability of these programmes has decreased (Vernick, Guohua, Ogaitis, MacKenzie, Baker and Gielen, 1995).

There are many different names, in the literature, for high school education and training. Siegrist and Gregersen (1999) wrote about school-based pre-training education and school-based driver training. The former was an education in road safety for those who were not yet of the age for being a car driver. School-based driver training was about driver training in the school system where there was a driver instructor that teaches the students how to drive a car. Haworth et al. (2000) also made this distinction. It is the latter one this report is about.

Woolley (2000) made a distinction between the words driver education and driver training. Driver training is about teaching people enough skills for controlling and operating a vehicle so they can obtain a licence. Driver education is a broader term, including driver training, but also including knowledge about road laws, general road safety concepts, attitudinal and behavioural characteristics and awareness etc. In the literature the term driver education is used for both courses with and without an in-car component. In this report driver education and training will be used and then the in-car component is excluded from the term education. Training stands for the in-car component.

The outlook of driver education and training in high schools varies between the high schools. For example it varies where into the school system it fits and the amount of driver education and training the students receive. There are high schools that fit the driver education and training into an existing core subject and in that way get a lot of driver education and training for the students and there are high schools that just have a couple of hours of a day. It could be the regular teachers giving the education and it could be driving instructors from commercial driving schools. Some programmes or courses lead to a licence and some do not. Of course the students get very different education and training in this way and the effects of the education will be different. Despite the outlook of the high school driver education and training there will be different kinds of effects. In the next section some evaluations of high school driver education and training and the effects that this education has produced will be presented.

4.2 Evaluations of driver education and training in high schools

4.2.1 Georgia (USA)

The most famous and maybe the biggest experiment and evaluation on driver education in high school is the DeKalb County project. It was an interesting project because the effect of two school-based training operations was experimentally studied and it is one of few such studies. It started in 1978 and was ended at 1981. It has been analyzed and reanalyzed several times since then.

A total of 16,338 high school students were randomly assigned to one of three different groups.

1. Students in this group were taught the existing Safe Performance Curriculum (SPC) that was the best in the nation at that time. The programme was a 72-hour course that included 16 hours of simulator driving, 16 hours of driving-range training, 3.5 hours of practising evasive manoeuvres, 3.5 hours of on-the-road instruction and 32 hours of classroom education.
(SPC could be described as a classical intensive driver-training programme, mainly focusing on the basic driving tasks, such as vehicle manoeuvring.)
2. Students in group number two received a pre-driver licensing course (PDL). This consisted of classroom education, driving-range and simulator training and planned, supervised on-road driving with parents and all this was 20 hours in total. The PDL was designed to provide the minimum training in skills necessary to pass a licence test.
3. Students in the third and last group were the control group. That meant that they got no formal instruction or training in the DeKalb project. They were expected to be taught by professional instructors and parents when reaching the age of 16.

The students had to be at least 15 years of age at the time of taking the course. The study recorded licensure, violation and crash experience for up to four years.

The first evaluation was made by Stock, Weaver, Ray, Brink and Sadoff (1983). They found no significant difference between the groups in crashes and violations per person or per licence holder. But during the first six months of

licensed driving, students who had been in SPC or PDL groups had fewer crashes per licensed driver than the control group but this effect was not significant at the end of the first year of driving. Students assigned to the SPC and PDL groups also had fewer convictions per licensed driver than the control group. This lasted for the first 12 months of licensed driving but after 18 months of driving the effect was not significant anymore. The interpretation of the short-term effect was that students who had participated in the driver education programme obtained their licences earlier, thus resulting in increased exposure to the crash risk.

There was a strong debate and concerns over the findings and the results were used both for criticism and promotion of driver education in high schools. The popularity of in-car high school driver education gradually declined after this study (Woolley, 2000).

Lund, Williams and Zador (1986) made a re-analysis of the DeKalb study and expressed a concern that there were essential differences between the SPL and PDL courses and the control group. Students in the two experiment groups obtained licences sooner than those in the control group and may not have had a need for their licence for personal transport. This made sense to the author's findings, that those students exposed to driver education reported less driving exposure than those in the control group. These effects were considered so strong that the original study seemed to be biased. If the drivers in SPC and PDL groups had had less driving exposure than the control group, then they would be expected to have fewer crashes per licensed driver and the validity of the original study should be questioned.

Lund et al. (1986) concluded that high school driver education stimulates the students to get their licence earlier, expose themselves to the risk of accidents and in this way also be in more accidents than those students who have not had driver education.

Siegrist et al. (1999) mention another re-analysis by Mayhew and Simpson from 1996. They also concluded that all analyses of the DeKalb project showed that this driver education programme did not decrease crash involvement of young people significantly. Differences that were found could be attributed to differences in exposure to the likelihood of a collision. The increased collision rates that were found in different analyses occur because students taking driver education become licensed sooner than those who do not.

4.2.2 Illinois (USA)

In the state of Illinois in the United States there has been an evaluation of high school driver education. The aim of the study was to determine the specific subject areas covered in the courses as well as the amount of time spent on each. To get this information there was a comprehensive literature review of driver education and two questionnaires.

The results showed a list of the subjects that were covered in the programme. The subjects were; social and economic consequences, emotions and driving, rules of the road, physical limitation of other drivers, vehicle dynamics, impaired states of alertness, basic vehicle control, visual scanning, hazard identification and recognition, time-speed-distance-estimates, predicting the actions of others, decision making in traffic situations, speed control, vehicle positioning, handling driving emergencies, handling special situations, vehicle maintenance, self-assessing of driving performance, alcohol and drugs and their effects of driving,

driving responsibilities, occupant protection, having a positive attitude, communication techniques, fuel-efficient driving, vehicle ownership responsibilities and driving in adverse conditions.

When it comes to the time spent on those topics the students who have completed high school driver education programmes and their teachers seem to want more hours devoted to most of the topics. However, students wanted more time spent on the various topics than did the teachers. The median time that was spent or should be spent on each different topic is at least one hour. Both groups wanted more time on social and economic consequences of driving, emotions and driving, vehicle dynamics, impaired states of alertness, hazard identification and recognition, time-space-distance estimates, decision making in traffic, speed control, vehicle positioning, special situations, self-assessing of driving performance, driving responsibility, occupant protection and communication techniques. There was one topic that both teachers and students wanted a lot more time spent on and that was alcohol, drugs and driving (Ritzel et al., 1997).

4.2.3 Kentucky (USA)

A questionnaire was sent to all high schools in the state of Kentucky. The aim of this study was to obtain information on current and desired traffic safety related programmes for high schools. A representative of each high school was asked to list the activities given at their own high school. They should also note the effectiveness of each given programme and the rating of effectiveness should be given as the effect the activity had on the traffic safety of participating students. The ratings were no opinion, not effective, somewhat effective and very effective.

The results showed that there were 15 different activities given at the high schools. The most common activity with the most participation, with 85 per cent of the schools indicating they were involved, was Red Ribbon Week. The aim of this activity was to create a drug free future for youth. This was done by some communities that created unique and innovative strategies for drug prevention for one week once a year.

The most effective activities rated by the participating schools were Project Graduation and driver education. About 80 per cent of the schools rated them as very effective and none of the schools rated these activities as not effective at all. The aim of Project Graduation was the same as Red Ribbon Week namely to provide an alcohol and drug free environment for the participating students. This event was also once a year but it was related to the graduation so it involved mostly the senior classes. The event included auctions, games and other activities.

Driver education was designed to train new drivers in the procedures and skills to be able to safely and efficiently drive and to develop positive attitudes towards safe and responsible driving in young drivers. The programme included classroom activities as well as behind-the-wheel activities. In the classroom the students learned about traffic laws, defensive driving, occupant protection, risk-taking, driver perception and decision-making judgement. The behind-the-wheel activities were a practical application and practice of driving skills (Agent and Pigman, 1996).

4.2.4 South Australia

In South Australia there was a Youth Driver Education Program (YDEP) in high schools delivered by SA police officers. They travelled to high schools in the state and held a two-hour session on road safety and road laws for students in year 11. In 1998 an evaluation of this YDEP programme was conducted.

The evaluation was made through observations, measurement of attitudes and reported behaviours with focus groups and telephone interviews. The result focused on changes in attitude, behavioural intentions and self-reported behaviours by those students who attended the YDEP course during the evaluation period.

The results showed that the students were satisfied with the course. 70% of 282 interviewed student said that they discussed the course with their friends afterwards and 35–40% discussed it with their parents. There did not seem to be any single main message interpreted from the sessions but drink driving and obeying the road laws seemed to be the subject that featured strongly. Many students also said that they had become aware of the potential for accidents to occur when not at fault. However the YDEP course would not have an effect on road safety since the students reported no effect on self-perceived driving attitudes and behaviour (Woolley, 2000).

Woolley (2000) also mentioned that it should be observed that it is a small sample size and that the students had limited driving experience and therefore the results should be interpreted with some caution. Despite that the SA police officers (SAPOL) have realised the limitations and changed focus from changing attitudes and behaviour of the students to making the community more aware of road laws, risk and risk management.

4.2.5 Tasmania (Australia)

The road safety education in Tasmanian high schools consists of two parts. The first part is a series of 12 one-hour lessons which includes theory of defensive driving. Examples of topics are how to start the vehicle up, moving off, following and stopping etc. The second part of the course is also a series of 12 one-hour lessons but these consist of developing those skills and attitudes leading to more responsible road user behaviour, where one topic is drink-driving. Some schools offer only the first part and that culminates in students taking a classroom-based test on the theory of defensive driving and/or the learner licence test. Other schools offer both parts and successful students could count the course as an official School Certificate subject. Regardless of whether the schools offer one or two parts some may supplement the lessons with behind-the-wheel driving training. If they do, the time behind the wheel rarely exceeds thirty minutes (Langford, 1997).

There was an evaluation carried out of the driver education in high schools in Tasmania. The aim of the study was “to determine whether enrolment in a school-based pre-driver training or education programme is associated with a decreased probability of having a road accident during the first three years of driving” (pp. 79 Langford, 1997).

The study went on from 1987 to 1991 and all students in Tasmania who were in year 10 during these years were allocated to one of three groups. The three groups were:

- group one were students who studied driver education as a formal School Certificate subject;
- group two were students who only took the first part namely the defensive driving training;
- group three were students who received neither driver education nor driver training.

These three groups were compared in terms of their accident involvement up until mid-1996.

The results showed that students who had enrolled in driver education as a formal School Certificate subject were less likely than both other groups to have been involved in an accident after three years of driving. After the first two years the differences were statistically significant compared with students with no driver education and at the end of the third year it was still on the edge of significance.

Students in group two (only defensive driving) were also less likely than drivers with no driver education to have been involved in an accident after three years. Although the difference was not significant at the end of the first two years, it strengthened and by the end of the third year it was significant.

When the two driver education programmes were compared there were no significant differences in rates of accidents after three years.

4.2.6 Victoria (Australia)

Haworth et al. (2000) compared the effects of pre-driver education programmes at rural secondary schools which have an in-car driver component (driving a car in an off-road environment) with the effects of such programmes that did not have this component. Students who had the pre-driver education programme with an in-car component were cases and they were compared with the controls who were students who had pre-driver education without in-car driver training. The control group were a mixture of drivers who had not undertaken a pre-driver education programme and drivers who had but did not get the in-car driver training part. The study measured the net effects of the in-car component of these programmes.

For measuring the effects a questionnaire was sent to 2000 people aged 18 to 29. Answers to the questionnaire were received from 687 respondents i.e. 34%.

The results showed that those students who had the pre-driver programme with an in-car component obtained their learner's permit and probationary licences at a lower average age than those students who did not have this education. Even if the group with the in-car component had their learner's permit and probationary licence earlier they did not have the learner's permit for a longer time than the other group and the two groups obtained the same amount of experience during this period.

Those students who had completed the programme with the in-car component did not have a reduction in accidents and did not have an increase in the amount of traffic offences. There were no significant difference between the two groups in measurements of driving-related attitudes and behaviours. The explanation for this could be that only accompanied driving was allowed during the training part.

4.2.7 Sweden

A new kind of driver education in Sweden was tested in 1994. The aim of the education was to change the students' attitudes and knowledge with a different kind of teaching. Instead of the traditional kind of teaching the objective was to have a more reflecting traffic education. After the education the students should have come to a deeper insight of the risks in traffic, what the reasons for young drivers' accidents are and some understanding for defensive driving. There were 87 students in the first year of high school that got 30 hours of education, theoretical and practical. To evaluate the programme, there was a survey and interviews with the students.

The results showed that the students' awareness about traffic risks had been affected to a high degree and that the students' knowledge about traffic laws had been considerably improved. The results also show that the students thought that it was necessary to have some behind-the-wheel lessons. Some changes in attitudes could be seen but to get a higher degree of changes some more time would be required (Ekblad, 1996).

In 1995 there was another education programme developed for high school students in Sweden with the aim to change the attitudes among students about traffic safety and to increase the students' respect for the risks in traffic. The programme's focus were the laws of nature, the human's limited capability as a road user and the risks in traffic. The aim was not to teach the students how to drive a car or to give them knowledge of traffic laws.

The programme was carried out through half a day. It began and ended with a knowledge test and between there were some demonstrations. The aim of the demonstrations was to give the students some experience of what can happen in different traffic situations.

Most of the students thought that the day was good and they realized what can happen in different situations. They thought they could have some use of the course in the future (Stockholm Trafiks akerhetsf orening, 1995).

4.2.8 Other studies

Vernick et al. (1999) analysed studies about high school driver education. They wanted to determine if high school students who enrolled in driver education courses had fewer crashes and violations than those students who did not enrol in such courses. They also wanted to determine if the participating students were more likely to obtain a driver's licence than those students who did not enrol in driver education and training.

There were nine studies that met the specified criteria that the authors had set up. All of these nine studies were from before 1990, several of which concerned the DeKalb study. Those criteria were that the included studies had to show the effects of driver education courses for high school students and there had to be other measurements than self-reported data like driver licensure rates or motor vehicle-related violations or crashes. Also there had to be a comparison group (with no intervention) and if it was a controlled trial the participants had to be assigned randomly to the treatment or control group. Finally there had to be adequate control for confounding variables.

According to Vernick et al. (1999) the analysis of these studies showed that availability of driver education and training in high schools made the students obtain their licence earlier and give a higher crash involvement rate. There was no

evidence that high school driver education and training would reduce motor vehicle crash rates, either at the community or individual level. Vernick et al. (1999) concluded that even if there are few evaluations of driver education and training courses in high school and there is no evidence that this education would reduce the accident rates, there have to be other ways of getting a reduction for crash involvement for young people and they suggest the graduated licensing system as a possible solution.

4.3 Discussion

This literature review shows some negative and some positive effects of high school driver education. Since scientific studies on driver education in high schools started to emerge there has been a debate about the effects these studies have shown. It has been the driver education in high schools that has been questioned rather than the negative effects. According to Woolley (2000) the reason why there has been a debate is that there are problems in judging the effect that driver education and training in high schools can have on road safety outcomes. These effects will be discussed here.

4.3.1 Choice of dependent variables

After the DeKalb study in 1977 the high school driver training in the United States and other countries declined. The DeKalb study has been the most comprehensive and largest evaluation of driver education and training in high schools and the result showed that the courses yielded no net benefit compared with no training at all (Woolley, 2000). Other studies have shown the same result i.e. those courses in driver education and training in high schools do not lead to reduction in crashes (Haworth et al., 2000). Much of the criticism consisted of the availability of driver training in high schools which leads to earlier licensure at a younger age and also increased licensure rates. These factors lead to more inexperienced young drivers on the road and they have an increased likelihood of crash involvement (Woolley, 2000; Langford, 1997; Vernick et al., 1999).

These results showed no crash reduction but maybe this is not the right measurement for determining the effects of driver education in high schools. Since accidents are quite rare and it is difficult to get a crash reduction out of different actions, the effects should be measured in other ways. Woolley (2000) also mentioned that there is disagreement on which criteria would be used for measuring the effects of driver education and training in high schools. Maybe these effects could be seen in people's behaviour, attitudes, thinking and reasoning about being in the traffic.

4.3.2 Overconfidence

According to Saunders (1998) there is one reason why there are no good results of driver education and training in high schools and that is that it has not been changed for a very long time. There was a recommendation at the first National Conference on High School Driver Education in 1949 about a minimum of 30 hours of classroom instruction and 6 hours of behind-the-wheel instruction at a novice driver education course in high school (Ritzel et al., 1997).

Since the aim of driver education is to get the student to pass the driver test and the students are more interested in getting a licence and mobility than in becoming a safe driver, the high schools often offer a minimum of instruction in order to

pass the test (Haworth et al., 2000). Consequently there is only a few hours behind-the-wheel for the students (of course it varies between different high schools) and this could create some overconfidence (Gregersen, 1996). The students think they are better than they actually are and they drive over their capacity. This often means big risks and they get into situations they can not handle.

New drivers need a certain level of skill in order to pass the licence test and driver education supports this need and in this way also supports the new drivers' need of mobility. To avoid this risk of overconfidence and to improve the safety performance of novice drivers more work has to be done. Haworth et al. (2000) suggested that the students should get some basic behind-the-wheel experience before they get training in safe driving skills, that the training should be self-paced and spread out over an extended period of time, that the training should include all types of driving situations that a new driver would encounter and that the young peoples' natural risk-taking tendencies should be taken into account. The students should be educated in motivational factors and to be aware of driver confidence so it would not be too high. There are many factors that would be involved in becoming a safe driver which includes motivation, responsibility, perceptive abilities and some self-assessment about the driving skill.

Another aspect of this overconfidence problem is to know whom to choose to take high school driver training and whom to choose to go to driving schools. Maybe it is those students who are most prone to high risk taking behaviour who have driver education in high school because this is a quick way to get a licence. It is important to know if these two groups of students differ in some way (Woolley, 2000).

4.3.3 Topics of driver education in high school

There is an expectation from the community that driver education and training should have a considerable impact on road safety despite the evaluation results. Since driver training is seen as a panacea it is very difficult to argue against it. According to tradition in-car high school education has armed the students with skills for driving the car but in spite of this there is no connection between skills based training and crash involvement (Woolley, 2000).

Traffic safety experts agree that driver education is one of the key factors in solving the crash problem of young drivers, but there are many differences as to the way that it should be done. Which topics are important to cover, what amount of time should be spent on each topic and which teaching strategies should be used are questions that are discussed. These experts also agree that there are some absolutes in driver education programmes like knowledge of basic traffic laws and basic vehicle handling skills but this is not enough to get competent and responsible drivers (Ritzel et al., 1997). Haworth et al. (2000) suggested that there should be emotional and cognitive components in driver education in high schools as well as real-world experience. It could be useful to let the students, for example, hit road cones and cause an inexpensive crash and then hopefully realise their own shortcomings. Ritzel et al. (1997) agreed with this by saying that driving is a risk-taking activity and therefore it should be focused on decision-making, risk perception, risk-taking and risk acceptance followed by practical application of these topics to driving situations instead of focusing on information about skills of driving, traffic laws, driving in different environments etc.

According to Haworth et al. (2000) the methods for teaching have to be developed. Since this is about driver education in high schools there would be a good opportunity to use the small groups of peers, who know each other well, in the learning situation. The group could be used for discussions about for example peer group norms, lifestyle/life situation, personal values and other life-goals and personal tendencies that could affect driving behaviour.

Stutts and Thomas (2002) wrote that to be most effective driver education should, as an alternative to high school education, be an integral part of a graduated licensing system. This system would be used to motivate students to be safe drivers in a way that the two-stage driver education programme would emphasise safe driving strategies as well as vehicle handling skills. They also mentioned that it would be better if the number of students in the classroom were limited, sessions were shorter over longer periods of time and behind-the-wheel practice were closely integrated with classroom instruction. Another important link between driver education and a graduated licensing system is the parental involvement. This has been identified as a target area for improving teen driver education. Public institutions will never fully have enough time or money to train a novice driver. The need of additional supervised oversight during initial training will always be there and parents have a great potential there (Stutts et al., 2002).

4.3.4 Methodological issues

Other problems that make it difficult to assess the effects of driver education and training in high schools are methodological. One of these problems is that of statistical power. There are small numbers of students undergoing the driver education and training in high school and there is a low probability of a crash occurring. It is therefore difficult to find statistically significant effects. This problem is especially aimed at driver education with an in-car training part because the numbers of students undertaking this type of training are often small and therefore any statistical study is inconclusive. Another problem is to know the exposure for the different groups being compared and to obtain exposure data.

Since there are almost no well controlled follow-up studies, according to Siegrist et al. (1999), it is hard to see what effects road safety education in high schools has on future behaviour of car drivers. It is difficult to expect this education to produce safe 18-year-old drivers when there are two years from this kind of education until the young one is a driver.

It is hard to find strong evidence supporting driver education and training in high school and therefore it is argued that it should cease. But in Woolley (2000) it is suggested that the role of driver education and training should be seen as a supportive one and constitute part of a holistic approach to road safety in high schools. It is unrealistic to expect large and immediate effects from such activities.

The current approach, as far as evaluated, has not shown the benefits that could be expected from education and training in high schools. It is thus of the highest importance to develop new strategies since the high school environment provides good possibilities to reach youngsters with safety issues that are not normally covered by driving schools or parents.

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5 The impact of different licensing systems on young novice drivers' safety

by Anders Nyberg

This chapter will focus on evaluation results of different licensing systems. It is obvious that each country has its own system, but in this chapter the systems will be discussed on a general basis. Therefore, different countries' systems have been classified as single-phase systems, systems with a probationary licence, two-phase systems or graduated licensing systems. The classification is based on the work done by Gregersen (1999) in the EU project GADGET. Even this broad classification makes it hard to classify each country's system correctly. For instance, Luxembourg has a two-phase system with a probationary licence, while Finland has a two-phase system with a provisional licence. Also, graduated licensing systems have components that are included in other systems and vice versa. Only countries that have systems that have been evaluated will be described in this chapter and the focus will be on evaluations published from 1995 and forward. The reason for this cut off point is that there already are extensive literature reviews available covering studies done before 1995 (e.g. Drummond, 1989; Mayhew & Simpson, 1996; Gregersen, 1998). Each general system will be described separately including a general description of the components of the system. Thereafter, countries/states/provinces with their system evaluated will be described, each one separately, followed by available evaluation results. The chapter ends with a discussion regarding the pros and cons of different components in the systems.

5.1 Single-phase systems

5.1.1 General system description

These systems have one phase of theoretical and practical training which ends with the written test and the driving test. When the learner driver has passed both tests he/she has become a fully licensed driver and therefore is treated in the same way as more experienced drivers.

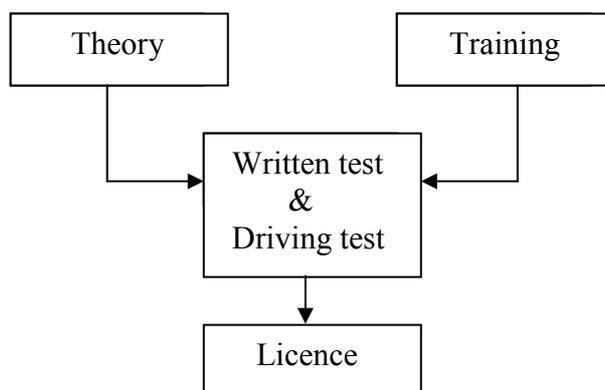


Figure 4 A description of the single-phase system.

The single-phase system is quite common in Europe and is used for example in Belarus, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Moldavia, the Netherlands, Poland, Romania, Slovakia, Spain, Switzerland and the United Kingdom. Of these countries a variation of the above system is found for example in Belgium and Hungary. Here the candidate must pass a knowledge test before being allowed to start driving. However, evaluations of the single-phase system are available only from Denmark and France.

5.1.2 Denmark

In October 1986 new rules for driver training were introduced in Denmark. According to the new rules, the training should follow a specific and very detailed education plan, which described in great detail the individual manoeuvres and other car driving skills that were to be learnt. Changes were made in form as well as content of the training. One main change was to introduce defensive driving and hazard perception, which was also made a theme at the driving test. The Danish system does not allow lay instructed training. The trainee must attend at least 26 lectures of theory and 20 sessions of practice at a driving school. The candidate is allowed to start practising car driving at the age of 17 years and 9 months and the licensing age is 18.

The Danish system has been evaluated in several studies by Gitte Carstensen. In an accident statistics study, developments in police reported injury accidents were analysed six years before and six years after the change (Carstensen, 1996; 2002). Accidents were analysed for 18–19 year olds (new licence holders) and 24–54 year olds (experienced). The results were compared with general accident trend and changes in population size, number of licence holders, annual mileage, weather conditions and drink driving habits. The second study was based on questionnaires sent to randomly select new licence holders two years before (1985–1986) and two years after (1988–1989) the change (Carstensen, 1999; 2002). The samples, 1,000 drivers in each, received questionnaires shortly after licensure, after 1.5, 3.5 and 5.5 years. The questions in the first covered the training process, driving habits and attitudes. In the other, questions were added about exposure and accident involvement.

The accident analyses showed that the accident involvement among the 18–19 years old drivers decreased after 1986. The reduction in the number of accidents was approximately 20% larger than among the older drivers. The analyses of confounding factors general accident trend and changes in population size, number of licence holders, annual mileage, weather conditions and drink driving habits showed that none of these could explain the difference in development of accident involvement between the two groups. The findings were supported by the results of the questionnaire studies (Carstensen, 1999; 2002). The decrease in accident involvement was also found in these results and was found to be concentrated to the first year of driving, among multiple vehicle accidents and manoeuvring accidents, while the number of single accidents did not change. As a consequence of the results of the accident analyses, it is reasonable to believe that the changed content of the training has had an effect on the accident involvement. The actual size of the effect is estimated to somewhere between 21% and 7%, where 21% is the observed difference between the younger and older groups and 7% is the remaining difference after fully compensating for the changes in the

population size of the two groups. Annually, this is equivalent to 50–150 saved injury accidents per year.

The questionnaire study also showed that the respondents in the before group drove a little faster and to a greater extent expressed that they like to compete in traffic than the after group (Carstensen 1999; 2002). Both of these factors were related significantly to a higher accident risk. The questionnaire study also showed that the respondents in the after group judged their own driving skill better, even though this difference was only significant when it came to defensive driving skills. This could indicate that the hazard perception/defensive driving components introduced in the new education had led to a more watchful attitude in traffic, even though the author gives other explanations that can also explain this outcome.

The answers from the process related questions in the questionnaire study (Carstensen, 1999) showed that most of the students, although not all, had carried out the practical parts of the new curriculum. Starting on a closed driving range was done by 90%, motorway driving was practised by 90% and driving in darkness was experienced by 80%. It was also found that there were several difficulties in co-ordinating the theoretical and practical parts and adjusting practice to an increased degree of difficulty. There was also a relation found between the content of the training and the accident reduction showing that trainees who followed the stipulated curriculum well had a larger reduction than those who did not meet all requirements.

Since the introduction of the change in Denmark there have been complaints about teachers not following the curriculum. In addition to the effect studies, a conference was therefore held with 46 trainers with the purpose of elucidating existing conditions for driving schools to comply with the new rules (Carstensen, 1997). In the conference discussions with trainers it was found that there were several problems related to the driver education in Denmark. As the predominant problems, the participants pointed out the keen competition among driving schools, cheating to make profits and doubts concerning the interpretation of the curriculum. This study is, however, not representative for all trainers and should according to Carstensen be regarded as an indicator of existing problems, not how common they are. Concerning the problems that were detected in the conference with trainers, the conclusions were that there was a need for increased control of the driving schools, development of better guidelines and improvement of the education of driver instructors. To make the parents more involved and informed about the content and importance of good instruction was also concluded to be important since this would improve their possibilities to evaluate the offers from the driving schools.

5.1.3 France

In the late 80s a new opportunity for novice drivers was implemented in France. This opportunity – l'Apprentissage Anticipé de la Conduite (AAC) – made it possible to start driver training at age 16, while the licensing age remained 18. However, if the candidate wishes to start driver training at age 16 a contract must be signed between the candidate, a supervisor and a driving school. The contract includes:

- 20 hours of training in a driving school and a theory test
- to drive at least 3,000 km under supervision
- the candidate and the supervisor must attend two lessons at a driving school together
- speed restrictions (max 110 km/h on motorways with a speed limit of 130 km/h, max 100 km/h on motorways with a speed limit of 110 km/h and max 80 km/h on secondary roads instead of 90 km/h).

Also, there are some pedagogical controls included to monitor the candidate's progress and if the candidate is successful, he or she can obtain reductions in insurance premiums. The supervisor must be at least 28 years of age and have held a full licence for at least 3 years. If the learner driver does not start driver training at age 18, the candidate can get a full licence by following the old system's rules. This means start practising at age 18, a minimum of 20 hours of training at a driving school and passing a driving and theoretical test before receiving a full licence.

Page (1995) performed two evaluation studies of the l'Apprentissage Anticipé de la Conduite (AAC). One of these studies compared drivers (under the age of 25) who had or had not utilised the AAC and their accident proneness. The probability of having an accident was calculated using insurance data from three different insurance companies and logistic regression was used to model the probability of an accident. Only accidents giving rise to civil liability were used in the analysis, which means that all accidents not causing damage to another were excluded. Data from 3,882 young drivers under age 25 were included in the study (1,477 ACC drivers, 2,331 drivers with traditional training and 74 drivers that were undetermined). In a summary of the study results available at www.drivers.com, Page (1997) writes;

“Students have fewer accidents than workers or unemployed; youngsters driving fast cars have more accidents; teenagers with less than one year's experience have a higher probability of accidents; teenagers with a used car more than 10 years old have fewer accidents. The initial driver training (AAC or non-AAC) does not affect the accident probability. Therefore for our population of youngsters who took car insurance, the influence of AAC on accident risk is far less than expected, and than has been reported by the newspapers (6 or 7 times fewer accidents).”

The other evaluation study performed by Page (1995) compared drivers who had or had not utilised the AAC as regards infringements of speed regulations. A questionnaire was given to 1,113 young drivers (76 had taken AAC) under age 25 stopped by the police for speeding offences. No statistical difference between

AAC drivers and drivers using the traditional training (TT) regarding speeding were found. The author makes a remark that there was a slight over involvement regarding speeding among 18-year old drivers with TT. This could mean that TT drivers aged 18 could have a higher risk level with a new licence than AAC drivers who already gained experience during two years of driving before getting their licence.

Chatenet & Leroux (1999) conducted an interview study (semi directive discussions) with 30 candidates who had utilised l'Apprentissage Anticipé de la Conduite (AAC), 30 candidates who had taken the Traditional Training (TT), 30 supervisors of candidates using AAC, 15 adults of novices using TT, 30 driving instructors, 9 driving examiners, 9 insurers, 6 education officers, 3 officials, 6 correspondents on road safety and 3 head teachers. They also conducted observations on 15 pedagogical theoretical meetings. The results show for instance;

- The AAC receives wide support in principle. In spite of this, it does not seem to be particularly attractive to be able to start training at age 16, since only approximately 20% of the novices currently use the opportunity.
- In the beginning it seems that parents of candidates using the AAC were attracted by the system because of its safety and educational benefits. Now, it seems that it is persons who want to benefit financially (reducing their insurance costs) who make use of the system.
- Institutional actors have doubts about AAC's positive effects, which could be one of the explanations for the lack of promotion of the AAC.
- A hypothesis is that the only pedagogical factor distinguishing AAC and TT is the requirement to drive 3,000 km for candidates utilising the AAC.
- Usually, the AAC candidate drives on journeys already decided to be performed by the family, meaning that extra journeys with the purpose to only practise are rare.
- More training is needed for instructors and parents if the AAC is to be effective.

5.2 Systems with probationary licence

5.2.1 General system description

These systems are very much similar to the single-phase systems, but in the probationary licence systems the candidate must complete a period with a probationary licence before becoming a fully licensed driver.

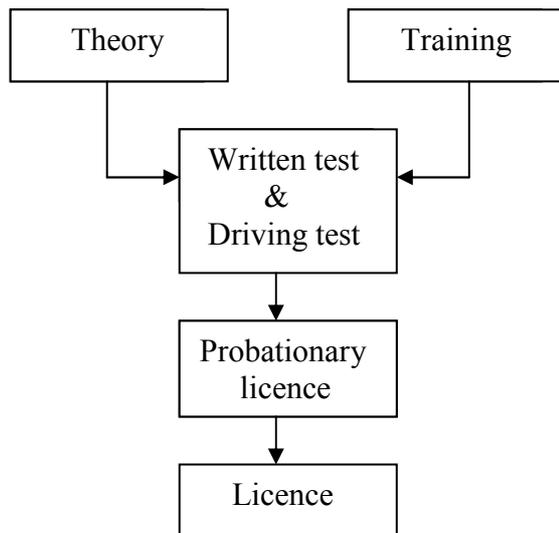


Figure 5 A description of systems (single-phased) with probationary licence.

There are both single-phase and two phase systems (see chapter 5.3) with probationary licence in use. Examples of countries where these systems are used are Austria, the Czech Republic, Germany, Iceland, Norway, Portugal and Sweden. Evaluations are available for the systems (at least some components) in Austria, Germany, Norway and Sweden.

5.2.2 Austria

In Austria it is possible for the candidate to

1. Take all training at a driving school (minimum 40 hours of theory training and 20 hours of practical training). The candidate must be 17½ years of age to start practising. A probationary licence can be held from age 18.
2. First take training in driving school (minimum of 8 hours of theory training and 8 hours of practical training) followed by training with a non-professional supervisor. The candidate must be 17½ years of age to start practising. A probationary licence can be held from age 18.
3. Complete theory and practical training at a driving school (40 hours of theory training and 20 hours of practical training) combined with educational training drives with a non-professional supervisor. During the supervised driving the candidate must drive at least 3,000 km and has to obey some speed restrictions (80 km/h on secondary roads and 100 km/h on highways). The candidate must be 16 years of age to start practising. A probationary licence can be held from age 17.

For options 2 and 3 there are some conditions that must be fulfilled by both the supervisor and the candidate:

- the supervisor must have held a full licence for a minimum of 7 years and no serious traffic offences should have been committed
- BAC 0.1‰ for both the supervisor and the candidate
- a learner's permit is required and the candidate must present a certificate of medical fitness.

To be able to do the practical test, the theory test must have been passed and also a logbook must be shown which proves that driving has occurred on motorways, secondary roads and at night. When the practical test has been passed a probationary licence is held which is valid for two years. The BAC limit is the same during the period with a probationary licence as during the learner period. If the candidate exceeds the BAC limit or commits other traffic offences, he/she has to participate in a psychological driver improvement course and the period with a probationary licence is extended by one year. The authorities can prolong the probationary period three times.

In a study by Bartl et al. (1998, referred in Bartl & Stummvoll, 2000) probationary licence holders were compared to all other drivers. The analysis was performed on the number of car drivers involved in accidents which had led to personal injuries and fatalities. The results showed that accidents for probationary licence holders decreased by 32.5% (after taking into account the declining number of novice drivers the reduction was 18.7%), while the decrease among all other drivers was 8.9% for the period studied. Also, alcohol involvement in accidents leading to personal injuries and fatalities decreased for the probationary licence holders by 30.9% (16.8% after taking into account the declining number of novice drivers). For all other drivers the reduction was 5.9%.

Christ (1999, referred in Bartl & Stummvoll, 2000) evaluated V-courses (driver improvement courses for other offences than alcohol), whose intention for example is to give participants insight into dangerous behaviour and specific risks in road traffic. To measure the effect of the course the design included questionnaires measuring attitudes (before and after the course), an assessment of every individual attendant by psychologists and after the course the attendants' driving record (including accidents) were collected. 989 course participants were included in the analysis, but for the follow up analysis concerning the occurrence of recidivism 378 cases could be included. To test the relation with recidivism correlation and parametric statistics were performed. The results showed that there was a total recidivism rate of 14% (6.9% a repeated offence other than alcohol and 7.1% an alcohol offence) among V-course participants. The factor "reflection on personality in general" was most efficient in reducing the recidivism rate. There were very few relations found between characteristics of the course participants and their relation to recidivism. The same was found when characteristics of the group course were analysed. When the participants' feelings while attending the course were analysed it was found that the more optimistic the participant was at the end of the course, the higher the recidivism rate. Finally, the results point in the direction that psychologists are better at forecasting recidivism than changes found in attitudes (both road traffic and safety attitudes). However, as is pointed out, the good forecast by the psychologists is mainly due to their

ability to detect future alcohol offenders, not people who will again commit other traffic offences.

Lager (1995, referred in Bartl & Stummvoll, 2000) conducted a questionnaire study to get feed back of so called A and V driver improvement courses. In short, A-courses are driver improvement courses for alcohol offenders and V-courses are driver improvement courses for other offences than alcohol. The study showed that the clients were pretty satisfied with the courses and generally gave positive feedback. It was found that only 3.3% of the participants in the A-courses were female (96.7% men) compared to 20.2% females in the V-courses (79.8% men).

5.2.3 Germany

It is only permitted to learn how to drive through a driving school in Germany. The candidate has to take at least 28 theory lessons (of 45 minutes) and 12 practical lessons (4 hours on the motorway and 3 hours at night are obligatory) before being allowed to take the practical test. After the theoretical and practical test is passed, a probationary licence valid for two years is issued. If one serious (e.g. driving over red light or exceeding the speed limit by more than 20 km/h) or two less serious (e.g. turning left against oncoming traffic or operating a car with defective tyres) traffic violations are committed during the probationary stage, the candidate may be subjected to some corrective or selective measures by the local competent administrative authority. That is, to participate in a driver improvement course, getting a written warning or withdrawal of the licence and possibly a medical and psychological report ordered by the authority. If one of these measures is put in use, the probationary period is automatically extended by two years. Also, there is a penalty point system valid for all drivers with a licence in Germany. This means that a driver who reaches a certain number of points may have to take a driver improvement course to be able to keep the licence.

In a study by Hansjosten and Schade (1997, referred in Evers, 2000) a random sample of 22,602 persons with a probationary licence were analysed to determine the traffic behaviours of novice drivers. It was found that 40% of the offences committed with a probationary licence are coupled with an accident. Further, the results show that 14% of the novice drivers get recorded in the Central Index of Traffic Offenders while driving with a probationary licence. On average, men are recorded 3.5 times more than women. For men the overrepresentation gets even bigger when alcohol and speed offences are considered as well as driving fines. 29% of the drivers who have been recorded in the register get another entry within two years of the first offence. People who enter the probationary stage at a higher age (more than 25 years of age) have more alcohol offences than drivers entering the stage at an earlier age. However, for all other offences the older drivers have better results than younger drivers.

Jacobshagen (1997; 1998, referred in Evers, 2000) evaluated NAFA courses, which is driver improvement courses for alcohol related offences committed during the probationary stage. 1,445 participants in NAFA courses were compared with a control group of another study, even though it was not possible to get a proper control group consisting of drivers under the old law (no driver improvement). The NAFA participants had a significantly lower rate of relapses compared with the control group after a 3-year period of observation (14.4% vs. 31.6%), which means that the expected relapse rate is reduced by 54% on average. The relapse rate of the NAFA participants increased with higher age compared with

the control group, which had the opposite trend. Also, participants' acceptance of the course was investigated in a post test after the last session. The participants mainly gave positive answers even though most of them thought the course fee was too high. 18 months later a subsequent study was conducted. 315 of the originally 1,445 participants answered and they still judged the course positively.

5.2.4 Norway

In October 1994, the age limit in Norway for on-the-road training was lowered from 17 to 16 years (while the licensing age was maintained at 18), as one element in a more comprehensive change in the regulations for driver training and licensing. At the same time all geographical restrictions on lay instructed driver training were removed. One aim of this reform was to allow the learner drivers better opportunity to achieve driving experience before starting to drive on their own. In Norway there is a free choice for the candidate between lay instruction and driving school tuition and how to combine them. The requirement to be allowed to practise with a lay instructor is that the lay instructor is at least 25 years old and has held a driving licence uninterruptedly for at least five years. There is a mandatory skid training course and a mandatory course in night-driving, which are approximately 3 and 1½ hours long respectively. There is also a demand that the candidate must have practised car driving for at least 5 hours (excluding the mandatory parts) in a driving school.

The aim of a study performed by Sagberg (2000) was to compare crash risk among novice drivers obtaining a licence before and after the reform was introduced, and to interpret to what extent such differences may be due to the reform. A questionnaire about accidents, exposure, driver training, and background factors was mailed to a sample of 20,700 drivers aged 18–20 years, who had passed the licensing tests in the period from April 1998 through March 1999 and had held their licence between 1 and 17 months. About 10,000 drivers returned the questionnaire. The data for this group were compared with previously collected data from two additional groups of drivers who had got their licences in 1994 (before the reform) and 1995 (immediately after the reform) respectively. The age span was the same for all three groups. In addition to self reported data, analyses were carried out on police reported personal injury accidents among novice drivers. The three groups were termed “Before group” (1994), 17-year group (1995) and 16-year group (1998–99). The only difference between the two latter groups was the opportunity of driver training from the age 16 in the 16-year group, whereas the drivers in the 17-year group were 17 years or more when the reform was introduced, and thus could not benefit from the change. The “before group” differed from the two other groups in several respects, the main difference being that they had more mandatory training in a driving school and a shorter licensing test and were subjected to certain geographical restrictions regarding lay instructed training. Comparisons of the 16-year group with the 17-year group show effects of the reduced age limit alone whereas comparison with the “before group” shows effects of the total reform.

Significantly more drivers in the 16-year group than in the 17-year group had been involved in a crash during lay instructed training. This is, however, explained by the increased driving distance and there is thus no significant difference in crash risk. Significantly more drivers in the 16-year group than in the 17-year group were involved in a crash during the first few months after licensing.

At the same time there has been a considerable increase in the average distance driven, so that the risk was not significantly different. The month-by-month risk development after licensing was very similar for all three groups.

A comparison of the post licensing risk was made between drivers with different amounts of lay instruction. In this comparison data from all three groups was pooled. An inverted U-relationship was found between post-licence crash risk and driver training, implying that drivers with an intermediate amount of driver training had a higher crash risk than both drivers with little or no lay instruction and those who had most training. The same relationship with risk appears for the total amount of driver training, i.e., the sum of lay instruction and driving school lessons. It was hypothesised that the low risk among those with little training is due to insecurity resulting in careful driving, whereas those with the highest amount of training have a similar low risk due to better traffic skills. The intermediate group is supposed to have got sufficient experience to reduce their insecurity, resulting in less careful driving, but not sufficient experience to master difficult situations. This interpretation is supported by the finding that the inverted U-curve is prominent only for the first months (months 1–6) after licensing and disappears more or less during the following months (months 7–17). In the analysis of the involvement in police reported accidents during the first year after licensing, three cohorts of licence holders 18 years of age from 1994, 1995 and 1998 were compared. Data from the questionnaire on driving distance was used for calculation of risk. No significant differences in crash risk were found between the cohorts.

Sagberg (2000) also reports that more than half (54.5%) of the novice drivers in the 16-year group had begun their driver training before their 17th birthday. Slightly more than 90% had some lay instruction in addition to the mandatory training in a driving school – this is a small increase compared with the other groups. The proportion driving more than 50 trips with a lay instructor had increased from 23% in the 17-year group to 30% in the 16-year group. The average number of trips with the lay instructor was tentatively estimated to be 54 for the 16-year group compared with 46 in the 17-year group. The total distance of driving with a private instructor was estimated at 1,153 km per driver on average for the 16-year group, 1,027 km for the 17-year group and 914 km for the “before group”. Considering both that the available time for driver training before the licensing age was doubled – from one year to two years – and that the geographical restrictions were removed, the increased amount of lay instructed driving was surprisingly modest. According to Sagberg, such a small increase gives little reason to expect any substantial effects on the post-licensing crash risk. As a conclusion it was stated that lowering of the age limit for driver training from 17 to 16 years has resulted in a rather small increase in the amount of lay instructed training.

5.2.5 Sweden

Through a reform implemented in September 1993, the age limit for practising car driving was lowered from 17½ to 16 years while the licensing age remained 18. The purpose of lowering the age limit was to give the learner drivers an opportunity to acquire more experience as drivers before being allowed to drive on their own. In Sweden there is a free choice for the candidate between lay instruction and driving school tuition and how to combine them. The requirement

to be allowed to practise with a lay instructor is that the lay instructor is at least 24 years old and has had a driving licence uninterruptedly for at least five years. The only mandatory part is a skid training course, which is approximately 4 hours long. Before receiving a full licence (probationary licence valid for two years, but no other rules, regulations or restrictions is imposed than is in use for drivers with a full licence) the candidate has to pass a written as well as a driving test. If offences leading to withdrawal of the probationary licence are committed during the probationary stage, the candidate has to take new tests to get the licence back.

In the accident analyses performed to evaluate the reform, the whole of the national population of young drivers from the accident register of Statistics Sweden and the Swedish National Road Administration's driving licence register has been used (Gregersen et al., 2000a; 2000b). The evaluation was based on a main design where comparisons were made between youngsters making use of the 16-year age limit and two control groups, one from before the change in 1993 and one which, after the change, nevertheless waited until the age of 17½ before starting to practise driving. A two-way comparison of this type increases certainty when drawing conclusions about the effects. To gain control over the social trends that may influence young people's behaviour as car drivers, trend analyses of accidents and attitudes, etc. have been carried out.

The analysis of police-reported accidents during the first two years after gaining a driving licence showed that the reform as such, i.e. in a comparison before and after the lowering of the age limit, led to a reduction of approximately 15% in the accident risk among new 18–19-year-old drivers. It was also found that those who in fact made use of the 16-year age limit had an approximately 46% lower risk/km than those who learned to drive before the age limit was changed. Compared with the other control group, i.e. those who, after the change, chose to wait until the age of 17½, the corresponding figure was also approximately 46%. After controlling for the effect of the general accident trend, differences in social background and the fact that the 16-year age group obtains a driving licence earlier, there remained a difference of approximately 40% in the accident risk between the situation before lowering the age limit and those who practise driving from 16 years of age, while it decreased to approximately 24% between those who made use and did not make use respectively of the new opportunity after it was introduced (Table 3). The differences in the type of accidents in which the drivers were involved show that those who made use of the lower age limit were involved in fewer accidents in complicated environments, such as junctions and urban traffic.

Table 3 Differences in health risk and accident risk between trial group and control groups with and without controlling for confounding factors.

Compared groups: 16=trial 17½b=control before 17½a=control after	Differences according to national register data		Differences after controlling for confounders	
	Accidents per 1,000 drivers	Accidents per 10 mkm	Accidents per 1,000 drivers	Accidents per 10 mkm
16 – 17½b	-48.2%	-45.9%	-42.3%	-39.8%
16 – 17½a	-45.5%	-45.8%	-27.1%	-23.9%
16+17½a – 17½b	-20.8%	-17.2%	-18.7%	-15.1%

In a more recent study (Gregersen & Nyberg, 2002; Gregersen, Nyberg & Berg, in press) a cost-benefit analysis was performed to evaluate the solution of the “experience paradox”, i.e. to gain experience through supervised practice by comparing the costs in terms of driving practice accidents with the benefits of this experience in terms of reduced accident involvement after obtaining a licence. In order to perform this comparison, the results from the previously published evaluation of the reduced age limit for driving practice to 16 years of age (Gregersen et al., 2000a) have been used. The analysis shows that the benefits in terms of accident reduction per 1,000 novice licensed drivers are 34 times higher than the costs in terms of accidents per 1,000 learner drivers during practice.

Gregersen & Nyberg (2002) also analysed all police reported training accidents (regardless of age) during the years 1994–2000 and performed in depth studies of fatal accidents. Also, the situation concerning training accidents has been compared with the situation during the first two years after obtaining a licence. It was considered important to calculate the size of the public health problem resulting from the training accidents, since 444 injury accidents were reported during the 7-year period 1994–2000. In these accidents, 827 persons were injured and 22 killed. This means that each year, an average of 63 persons were injured and 3 were killed. In comparison, 13,657 injury accidents were reported among novice drivers (regardless of age) during their first two years with a licence for the same period. In these accidents, 21,669 persons were injured and 382 were killed, which is an average of 1,951 injured and 55 killed per year. The problem with accidents during practice may thus be regarded as relatively small in a country the size of Sweden with a population of 9 million. It is also small in comparison with the situation among novice drivers with a licence. Expressed as a health risk (accidents per 1,000 drivers), it is 33 times higher among novice drivers than among learner drivers.

It was found that men face a higher risk as novice drivers than women during the first two years with a licence (men were involved in 76.9% of these accidents, women in 23.1%). However, among learner drivers there was no difference between men and women (men were involved in 50.4% of these accidents, women in 48.2%). The well known overrepresentation of men in young drivers’ accidents is thus absent during practice. The reason for this is not clear, but may lie in limitations for practising men to make their own decisions about where, when and how they should drive since they are accompanied by their supervisors.

Another purpose of the study was to describe the types of accidents that occurred during practice and to compare them with the situation among novice drivers. Among novice drivers, single accidents and accidents with vehicles on an intersecting course are over-represented. Among learner drivers, head-on accidents, rear end collisions, overtaking accidents and accidents when turning onto another road are overrepresented.

Sixty-four of the 444 accidents among learner drivers during 1994–2000 occurred in driving school cars and 380 in private cars. This means that 85 % of all accidents during practice are related to lay instructed practice. All of the fatal accidents and over 90% of the severe injury accidents occurred during lay instruction.

15 of the 16 fatal accidents during practice were analysed in depth and were divided into two main groups; one where primarily something happened with the learner’s car and another where other people primarily have acted in a way that caused the accident to happen. Eight of the accidents were of the first type, of

which five occurred on a high speed road with low friction surface, where the car skidded into the opposite lane. The other three seem to be related to a lack of attention by the learner and/or the supervisor. The other seven accidents were of the type in which the other party acted unexpectedly, so that the learner for various reasons was unable to avoid an accident. In four of the cases, an oncoming car has suddenly changed lane into the learner's lane, with a head-on collision as consequence. In the remaining three accidents, unprotected road users have suddenly and unexpectedly entered the road.

In the evaluation of the 16-years limit (Gregersen et al., 2000b), the results from the questionnaires one and two years after obtaining a driving licence showed no great differences between the groups in self-assessment of driving ability or in attitudes. Nor was there any difference found in a knowledge test between persons who had utilized the reform and persons who had not taken advantage of the opportunity to start practising from 16-years of age. The behavioural measurements in the specially instrumented car of VTI showed that the persons in the 16-year age group drove at a somewhat lower speed except on arterial roads, that they drove with somewhat lower longitudinal forces on motorways and arterial roads, and that they experienced a lower mental workload when driving (Gregersen et al., 2000b; Nyberg & Nolén, 2000). Also, an experiment on a closed driving range showed that persons in the 16-years group experienced a somewhat lower mental workload during the driving trials (Gregersen et al., 2000b; Nolén & Nyberg, 2000).

A process analysis of how, when and where lay instructed training takes place, was performed in a study by Gregersen & Nyberg (2002). The process analysis describes the content and structure of the training and was carried out with interviews (n=10), questionnaires (n=546) and diaries (n=723) filled out by the learner drivers and their lay instructors. The average practising time is 112 hours under lay instruction and 14 hours under professional instruction. These figures are approximately the same as in the earlier published evaluation of the 16-year age limit for practising (Gregersen et al., 2000a). The amount of practising thus appears to be approximately the same in 2000 as during 1994–1996 when the 16-years evaluation was carried out.

Results from questionnaires and diaries suggest that it is relatively unusual to start driver training in a driving school. Driving school training is something that is postponed until the end of the training period. There is a gender difference in that women appear to attend driving schools more than men. For lay instruction, the situation is the opposite. The total amount of training is greater among men than among women. The results also show that the amount of practice increases towards the end of training. Furthermore, it is clear that most lay instructed training is carried out in connection with other errands. Driving practice is seldom planned in advance. Initially, however, it is fairly common to drive with the sole aim of practising. Lay instructed training takes place on all weekdays, but at weekends the amount increases and is also more evenly distributed over the day. The main reason for not practising in certain weeks is a lack of time. Practice is most common under favourable conditions such as little traffic, dry roads, daylight and good weather. However, the results also show that there is a significant amount of training in unfavourable conditions such as darkness, rain and wet roads. Little training takes place on roads with low friction caused by ice and snow. More training takes place in dense traffic towards the end of training. It is rare to actively make plans for what should be practised during a drive or to

make any reference to the theory book. However, the theory connection is sometimes taken up while driving. The national curriculum is used by only 8%. Also in the case of referring to theory there is an increase towards the end of the training period. Most learners have two supervisors, mother and father. The supervisor is on average 48 years old and has driven approximately 20,000 km per year. However, there is a large variation concerning the age of the supervisor. Very few report co-operation with driving schools, which may be explained by the fact that the first visit to a driving school is postponed until very late in training. Approximately 40% report that they have intervened in the learner's driving. In most cases, this has only consisted of shouting a warning to avoid an obstacle, but in a significant number of cases it has involved using the handbrake or grabbing the steering wheel. Almost 3% have also reported involvement in accidents, mostly with very slight injuries or minor damage to the car. Opinion on introducing a mandatory dual braking system for private cars used in training is fairly evenly distributed between positive and negative. Over 80% of the lay instructors consider that it has been easy to act as supervisor, but a significant proportion (54%) would like additional information or education in order to improve the situation further.

5.3 Two-phase systems

The first phase in these systems is very similar to the earlier mentioned systems. The candidate receives a provisional (in Finland) or probationary (Luxembourg) licence after he/she has passed the written and driving test which ends the first phase. The provisional or probationary licence is valid for a certain period which confirms the right to drive unaccompanied but requires further theory and/or training before the full licence is issued. However, the candidate does not need to pass any more tests before getting the full licence.

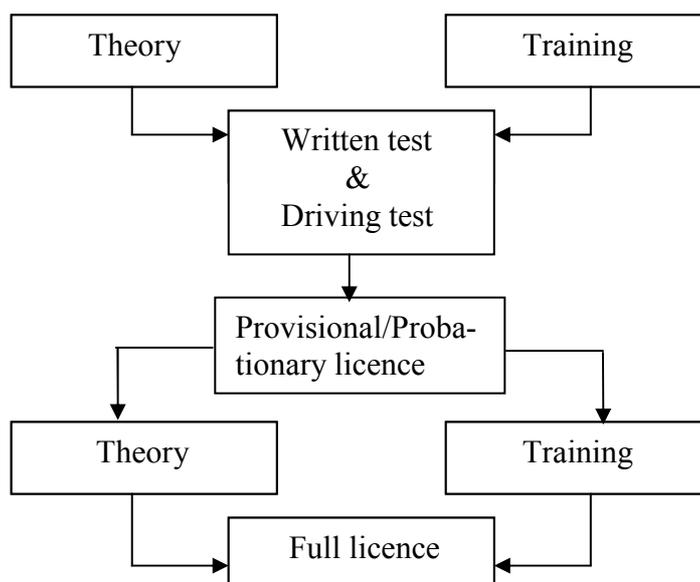


Figure 6 A description of two-phase systems with provisional or probationary licence.

These types of systems are currently used in Finland and Luxembourg. The system has many similarities with a graduated licensing system, even though the latter has more restrictions on for example where and when the candidate is allowed to practise car driving. Both the Finnish and Luxembourg systems have been evaluated and a description of their system and evaluations follows below.

5.3.1 Finland

In the Finnish system the candidate can begin (phase 1) practising car driving at the age of 17½ years. During this phase the candidate can choose to do the training in a driving school or with a lay instructor, but cannot combine them. If private instruction is chosen, the lay instructor must be a family member who has had a driving licence uninterruptedly for at least three years. Also, it is compulsory to have a dual brake pedal in private cars during lay supervised practice sessions. In phase 1 it is mandatory to at least go through 20 x 45 minutes of theory and 30 x 25 minutes of practical driving (in a driving school or privately). The demand is at least 6 months of supervised driving and it is compulsory to attend courses in skid training and driving in the dark before proceeding to the second phase. From 18 years of age the candidate can receive a provisional licence after passing a written as well as a driving test. After receiving the provisional licence, the candidate is allowed to drive on her/his own (second phase). The provisional licence is valid for two years and during this second phase there are no more tests in which the candidate can fail. However, after 6–24 months the candidate has to attend an extension course (second phase), which includes driving in real traffic for one hour, three hours training on a driving range and 4 theoretical classroom lessons. The candidate can receive a full licence at 20 years of age if the above is fulfilled and he/she has not been convicted for traffic violations during the period with a provisional licence.

In the Finnish evaluations different methods were used to collect data, but the design was always a before/after design. 30,000 questionnaires were used to collect data on accidents and annual exposure and accident data from all Finnish insurance companies were used to evaluate the long term effects of the new system (Keskinen et al., 1999). No immediate effects were found during the first 1½ years, i.e. no change was found considering the total number of accidents per driven kilometres. However, accidents in slippery road conditions had increased during this period for drivers between 18–20 years of age, but among drivers over age 20 this type of accidents had decreased. As for long term effects on accidents it was found (after looking into the fact that the general accident rates decreased about the same time as the new system was introduced) that there was no effect during the first year with a licence. However, during year 2, 3 and 4 there was a reduction in accidents per 1,000 licensed drivers. For the four year follow up time there was a 50% decrease in accidents per licensed driver for male novice drivers over age 20. For 18–20 year old males the reduction was 25% and for females of the same age the reduction was 18%. For females over age 20 the accident rates remained at the same level as under the old system. For all novice drivers there was a significant reduction for accidents under slippery conditions. For males 18–20 years of age the reduction per licensed driver was 17%, for males aged over 20 (76%), for females aged 18–20 (12%) and for females over age 20 (39%). There was also a reduction found in night time accidents per licensed driver four years after licensing. This applied for males aged 18–20 (20%), males aged over 20

(54%) and females aged 18–20 (12%). However, for females aged above 20 there was an increase in accidents.

Questionnaires were used to gather information about drivers' self-evaluations (immediately after licensing, after ½–1 year with a licence and after 4–5 years with a licence). These questionnaires were sent to the same drivers of which half had received their training under the old system and the other half under the new system (Keskinen et al., 1999). The self confidence of drivers regarding their skills to drive under slippery road conditions increased during the first year with a driving licence. After 4 to 5 years driving with a licence, it was found that females with training under the new system trusted their skill to control a car under slippery conditions more compared with females under the old system. This increase was not found among male drivers.

Peräaho, Keskinen, Hatakka & Katila (2000) evaluated what the pupils thought of the content of the teaching in the first phase and second phase training in Finland. Questionnaires from 3,021 first phase pupils and 3,765 second phase pupils were analysed. The focus of the study was on differences between the sexes. Both first phase and second phase students rated their training positively. The pupils therefore seem to feel that they gain something from well organised instruction. The results also show that training, even post-licensing training, can be made compulsory without being viewed negatively by the pupils. Females were more satisfied with the second phase training than males, even though they also gave positive ratings. The authors therefore discuss if the second phase training should be differentiated for males and females, since the instruction used now seems to cover topics that particularly females find useful. Finally, the analysis shows that pupils are interested not only in learning how to handle the car, but also want to know about more cognitive and social aspects of their own driving.

In another study Peräaho, Keskinen & Ojanen (2001) investigated learner drivers and lay instructors' experiences of using the dual brake pedal, installation of which in the car is compulsory if training is undertaken privately in Finland. About 12 to 13 per cent of all new licences taken in Finland are taken by drivers who had had their driver education privately. 10 driving instructors and 12 lay instructors were interviewed and based on themes found during the interviews questionnaires were formulated and sent to 1,000 newly licensed privately trained drivers and their lay instructors separately. The analysis is based on responses from 487 newly licensed drivers and 582 lay instructors. The lay instructor was generally found to be a middle aged man with pretty high education who had recently been a lay instructor for the second time. In 90% of the cases the pupil was the instructor's own son or daughter. On average the education usually took place during 4 months where they drove for approximately 1 hour 2–4 times per week, which summed up approximately 1,700 km driven on average per pupil. The training was usually done in connection with another errand. Most of the lay instructors had been forced to use the dual brake in one or more risky situations. Usually this happened at crossings (52.2%), when the pupil parked the car or was reversing (36.6%), conflicts with pedestrians or cyclists (19.4%) or when the pupil almost struck another vehicle from behind (15.7%). The dual brake was used more frequently when the pupil was a female. 79.5% of the lay instructors had used the dual brake in a risky situation at least once when the pupil was a female (for male pupils the figure was 64.3%). However, more accidents happened with male pupils. 16 (13 with male pupils and 3 with female pupils) of 582 lay

instructors reported accidents. In all cases except one it was minor accidents which usually happened because of mistakes made during parking or reversing. No personal injuries were reported and the dual brake had a little effect on the accident. The authors find it hard to say if these results can be generalised, but according to statistics available in Finland not a single fatality accident has happened during lay instruction for the last 20 years. They also found it hard to say anything about how many of the reported risky situations could have led to an accident if the lay instructor had not had the dual brake and intercepted. Altogether it seemed that female pupils benefited most by the dual brakes' safety effects. Almost 90% of the lay instructors were of the opinion that the dual brake increased their feeling of security during practice. The female pupils reported to a larger extent than male pupils that the dual brake gave them a feeling of security and that they drove more calmly. In spite of these opinions, most (58.8%) of the male lay instructors thought that they very well could have managed the training without dual brakes. This view was stronger the more times the dual brake had been used. However, the female lay instructors had the opposite opinion. The majority of the lay instructors meant that the dual brake made it possible to perform a more all-round training and to drive in more complicated environments (e.g. city traffic) at an earlier stage of the training. Overall, the authors came to the conclusion that the benefits of the dual brake are much bigger than the few problems reported in the study.

5.3.2 Luxembourg

To learn how to drive the candidate has two options:

1. To take all training at a driving school, the minimum amount is being 12 hours of theory training and 16 hours of practical training.
2. Take the training described above followed by training with a non-professional supervisor. To be able to train with a supervisor not only the training at a driving school has to be taken. The candidate must also be 17 years of age, have passed a theory test and received a learner's permit valid for one year from the test date. This permit is not renewable. The supervisor has to have held a driving licence for at least 6 years, have trained at least 2 hours with the candidate under supervision of a professional instructor and received a special permit, have no traffic offences convictions, not been disqualified to drive during the last 5 years, to be related to the candidate and to hold a special identity card valid for the training period. Also, during supervised driving it is not allowed to tow a trailer, the speed limit is 75 km/h on secondary roads and 90 km/h on motorways and driving is not allowed between 11 p.m. and 6 a.m.

After passing a written and a practical test a probationary licence valid for two years is issued. Between month 6 and 24 during this stage, the candidate has to attend a one-day training course at a special training centre. This training consists of both theoretical and practical parts including skid training. The same speed restrictions as during the learner stage apply for probationary licence holders until they have taken the above special course.

Peräaho, Hatakka, Keskinen & Katila (2000) evaluated the impact of the second phase driver training in Luxembourg. The data were collected with questionnaires filled out by drivers as they collected their full licence at the

Ministry of Transport. The questions were concerned with the second phase training and included questions about accident involvement. One aim of the study was to see if there was a difference in accident involvement before and after the mandatory second phase training. The results show (even though the authors point out difficulties in comparing accidents before and after the training) for instance that 20.7% of the male drivers had been involved in at least one accident before the second phase training compared with 15% after training. For females the corresponding figures were 13.5% before training and 11.2% after training. The decrease in accidents was significant for males (a 33.4% reduction) but not for females (even though the reduction was 17%). However, the exposure dropped more than the reduction in accidents for both males and females. Further, males had a reduction in loss of control accidents from before the training (11.9%) to after training (6.7%). The corresponding figures for females were 4.4% before training and 3.8% after training. The reduction was only significant for the male drivers. Another aim of the study was to collect data on how the drivers thought they were as drivers. Males rated skills in vehicle handling higher than females. The opposite results were found for skills for careful driving and the importance of anticipatory skills. Both sexes considered the skill to have quick reactions as very important, even more important than knowledge and observance of regulations. A third aim of the study was to see if the drivers appreciated the second phase training. The evaluation gave positive results from the drivers (higher ratings for the practical parts than for the theoretical parts), but the fee was considered too high. About 33% of all drivers reported being involved in situations after the training where they found knowledge from the training had been useful.

Pannacci & Margue (2000) describe several studies conducted to evaluate the second phase driver training in Luxembourg. For instance they found when comparing two three year periods (before second phase was introduced 1993–1995 vs. after second phase was introduced 1997–1999) that fatal accidents dropped by 34.3% on average for novice drivers during the probation period. The reduction for all drivers for the same periods was 24.2%. Another study is described which is based on questionnaires filled out by novice drivers at the end of the second phase training. The results are based on data collected during the years 1998 and 1999. For 7,795 evaluated questionnaires it was found that during the first 6 months (when novice drivers are not allowed to take the second phase training) with a probationary licence, 912 of 3,872 males had at least one accident. 534 of 3,923 females had at least one accident during the same period, which means that females had 42% fewer accidents during the first 6 months with a probationary licence. It was also found that the first month with a probationary licence was the most critical time and that the number of accidents increased again around the time when the novice driver had held the probationary licence for one year (that is for drivers who had not yet gone through the second phase training). Yet another study is described which is based on questionnaires filled out by novice drivers when collecting their full licence at the Ministry of Transport. The results are based on 1,321 questionnaires. Among other things it was found that 23.2% of the males had at least one accident before the second phase training, while the figure after training was 17.6%. For females the corresponding figures were 11.6% and 10.4%. The authors consider that the difference in accidents between sexes may be due to the fact that males drove approximately 40% more kilometres than females over the two year probationary

period. It is also reported that 16% of all accidents happened during the first two months with a probationary licence and that the accident rate rose again to a high level about one year after the novice driver had got the probationary licence, irrespective of whether or not the driver had gone through the second phase training. The increase after one year was more visible for females. However, it is also stated that accidents involving males are more severe. It was also found that 28% of the males and 10% of the females had one or two fines during their probation period.

Pannachi & Margue (2000) also reports (based on a questionnaire) that novice drivers were satisfied with both the second phase training and the instructors. The training was judged useful and most of them could consider going through a similar training once again. However, the participants thought the fee was too high.

5.4 Graduated licensing systems

This system includes three stages. The first stage is a supervised learner's period (which ends with a written and a driving test), the second is a provisional licence stage which allows the candidate to drive unsupervised but not under certain conditions, and finally a full licence stage. There is no test required when the candidate leaves the second phase and gets a full licence.

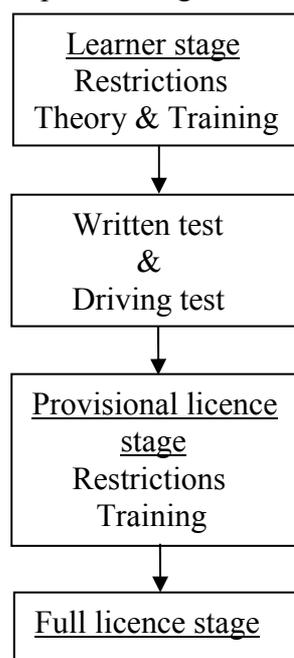


Figure 7 A description of graduated licensing systems.

This type of system is nowadays in use in one form or another almost everywhere in USA and Canada. Also, the system is used in Australia and New Zealand. No country in Europe is currently making use of the system. There are many variations in the different systems that states/provinces/countries claim to be a graduated licensing system (GDL). Examples of differences are at what age one is allowed to start practising, length (if any requirement at all) of the learner's phase, restrictions (both how many and under what circumstances), amount of supervised driving, age when full licence can be held etc. Therefore it is very hard to define what should be incorporated for a system to be called GDL. However, there are

examples of reports that suggest best practices that should be included in a good GDL. One example is a report by IIHS & TIRF (2003). The main recommendations suggested in this report for stage 1 (the supervised learner's period) are;

- Maintain the starting age for practising at 16, or raise it to 16.
- Require adult supervision and restrict driving at the discretion of the supervisor. It is acceptable to phase in more difficult driving.
- Require 30-50 hours of certified driving, some of which should be allocated to night time driving.
- Establish a minimum 6-month learner's phase.

The main recommendations for stage 2 (the provisional licence or intermediate stage) are:

- Do not permit any unsupervised driving before age 16½.
- Restrict unsupervised night driving by newly licensed drivers. Examine the pattern of night time crashes in the age group to which graduated licensing will apply to decide when this restriction should begin; optimal starting times are 9 or 10 p.m. Exempt appropriate activities from the night driving restriction.
- Limit teenage passengers to none or just one during some or all of the intermediate phase, absence of adult supervision.
- Hold beginning drivers in the intermediate stage until at least age 18. Both inexperience and immaturity contribute to the high crash rate of young drivers, and graduated systems can address both by delaying the age of full-privilege driving until 18.
- Consider an exit test to ensure competence prior to full-privilege licensure.

During the last couple of years several evaluations of GDL have been conducted. Descriptions of the GDL evaluated in these studies and the evaluation results are given below.

5.4.1 California (USA)

Learner stage

A learner's permit can be held from age 15 after passing knowledge and vision test. The permit must be held for at least 6 months before moving to the next phase. The minimum amount of supervised driving in this stage is 50 hours, 10 of which must be at night. The supervisor must be at least 25 years old and fully licensed. A driver education course must be completed and a minimum of 6 hours' professional driver training is required. To move to the next stage a driving test must be passed.

Provisional stage

A provisional licence can be held from age 16. During the first year in this stage, the candidate is only allowed to drive between midnight and 5 a.m. if accompanied by a driver at least 25 years of age. During the first six months in this stage it is not allowed to carry any passengers under age 20 unless accompanied by a driver at least 25 years old. During months 7–12 the same restriction is applied but only during the hours between midnight to 5 a.m. BAC<0.01 for all drivers under age 21. Also there is a driver improvement

programme if the candidate does not behave in traffic. It is possible to get a full licence at age 18.

Evaluations of the California GDL system have been reported in two studies (Automobile Club of Southern California, 2000; 2001). The evaluations are based on a before/after design (number of fatal and injury crashes and property damage crashes where a 16 year old driver was at fault and teen passengers' deaths and injuries in vehicles driven by 16 year olds) of 16 year old drivers compared with 18 to 19 year old drivers in California. In the second report only comparisons with results for 19 year old drivers are reported (Automobile Club of Southern California, 2001).

The reported figures for the first year since GDL was implemented (Automobile Club of Southern California, 2000) showed a 19.7% decline in the number of fatal and injury crashes where 16-year old drivers were at-fault (among 18 to 19 year old drivers there was an increase by 5.8%). For property damage crashes the decline was 15.1% (for 18 to 19 year old drivers there was an increase by 4.3%). Also, the teen passengers' deaths and injuries in vehicles driven by 16 year old drivers declined by 21.4% (for 18 to 19 year old drivers there was an increase by 5.4%).

The reported figures after the first two years since GDL was implemented (Automobile Club of Southern California, 2001) showed a 24% decline in the number of fatal and injury crashes where 16 year old drivers were at-fault (among 19 year old drivers there was an increase by 23%). For property damage crashes the decline was 17% (for 19 year old drivers there was an increase by 20%). Also, in vehicles driven by 16 year old drivers teen passengers' deaths and injuries declined by 40%. For 19 year old drivers there are no figures reported in this matter.

Williams, Nelson & Leaf (2002) examined what parents and pupils thought of the California GDL programme. They found that almost 80% of parents with children subject to the GDL programme strongly favoured the programme. Approximately the same proportion of parents answered that their pupils had driven at least as much as the programme requires (50 hours) and fulfilled the minimum amount of driving during night (10 hours). As for the pupils subject to the programme, more than 80% favoured the requirement to hold the learner's permit for 6 months and almost 90% were positive to the requirement that parents have to certify at least 50 hours of supervised driving. In all the study showed that pupils subject to the GDL programme drove and practised more with parents as well as holding their permit for a longer period than pupils not subject to the programme. However, some problems with following the night time restriction could be seen, since about 40% occasionally drove under the restricted hours. Also, more than half of the pupils violated the passenger restriction frequently. This action was often approved by their parents.

5.4.2 Connecticut (USA)

Learner stage

A learner's permit can be held from age 16. Only supervised driving is allowed. Driving on limited access highways is prohibited for the first 90 days and 8 hours of behind-the-wheel instruction is required. To obtain a full licence the 16 and 17 years old must have held the learner's permit for 6 months (those with a home

training certificate) or 4 months (those with a commercial or secondary school certificate).

Provisional stage

There is currently no provisional licence stage in Connecticut, so it is really questionable if their system is a GDL system or if it just has a few of its components.

In a before/after study by Ulmer, Ferguson, Williams & Preusser (2001), crash involvement rates of 16 to 18 year old drivers in Connecticut compared with 16 to 18 year old drivers in six New York counties are reported. For 16 year old drivers in Connecticut there was a 22% reduction in the fatal and injury crash involvement rate. No significant changes were found for 16 to 18 year old drivers in the New York counties or for 17 and 18 year old drivers in Connecticut.

5.4.3 Florida (USA)

Learner stage

A learner's permit can be held from age 15. The permit must be held for at least 12 months before moving to the next stage. There are night time driving restrictions which do not allow driving between 7 p.m. and 6 a.m. for first three months, thereafter no driving between 10 p.m. and 6 a.m. is allowed. There is a suspension of driving privilege if the learner receives 4 or more traffic conviction points, which restricts driving to business purposes only for 12 months. At least 50 h of supervised driving is required, 10 of which must be at night. There is also an alcohol restriction, BAC $\geq 0.02\%$.

Provisional stage

A provisional licence can be held from age 16. There are night times driving restrictions also in this stage. Drivers aged 16 are not allowed to drive unsupervised between 11 p.m. and 6 a.m. Drivers aged 17 are not allowed to drive unsupervised between 1 a.m. and 5 a.m. There is a suspension of driving privilege if the learner receives 4 or more traffic conviction points, which restricts driving to business purposes only for 12 months. There is also an alcohol restriction, BAC $\geq 0.02\%$, for all drivers younger than age 21.

Ulmer et al. (1999a; 2000) performed a before/after study (crash involvement rates) of 15 to 18 year old drivers in Florida compared with 15 to 18 year old drivers in Alabama (no GDL). For 15 to 17 year olds combined in Florida there was a 9% reduction in the fatal and injury crash involvement rate. For 15 year olds the reduction was 19%, for 16 year olds 11% and for 17 year olds 7%. No significant reductions were found in any of the age groups in Alabama or among 18 year olds in Florida. Also, greater reduction among white than non-white teenagers, a greater decline in urban than in rural areas and finally a greater reduction during night time than day time crashes were found.

In a before/after study using questionnaires to measure any changes in 16–18½-year olds' behaviours and attitudes following adoption of GDL, McCartt et al. (2001) found that teenagers licensed after GDL was implemented were more likely to obtain permits (and at a younger age) prior to licensure, hold the permit for a longer time and practise more prior to licensure. Also, the number of students who expressed strong opposition to each specific provision of the GDL law declined. Further, a reported decline was found among licensed teenagers

regarding drinking and driving (including riding with friends who had been drinking). The effects were generally seen in urban and suburban areas. The same results regarding drinking and driving were found in another study specifically examining the 0.02% BAC driving restriction (McCartt, Leaf, Preusser & Farmer, 2000). The results show that reported drinking and driving declined by 16% due to the restriction, but also riding with friends who had been drinking declined. In another study Williams, Ferguson, Leaf & Preusser (1998) found that 90% of parents supported the night time restriction for 16 and 17 year old learner drivers. When asked about the system's restrictions taken together (night time restriction, minimum learning period and passenger restriction) 74% of the parents supported the system.

5.4.4 Kentucky (USA)

Learner stage

A learner's permit can be held from age 16. Only supervised driving is allowed and the accompanying driver must be licensed and be at least 21 years old. The permit must be held for a minimum of 6 months. There is a night time driving restriction from midnight to 6 a.m. There is a 6-point violation limit, i.e. drivers age 18 or less who accumulate more than 6 driving violation points will have their permit/licence suspended. BAC cannot be more than 0.02mg/dl.

Provisional stage

There is no provisional stage, since the minimum licence age is 16½ years. However, if one receives a full licence at a younger age than 18, one has to complete a 4 hour course on safe driving within 1 year of receiving the full licence. Also, the driving violation limit is the same as in the learner stage until 18 years of age and the BAC limit is also the same as in the learner stage for all drivers under age 21.

Agent et al. (2001) did a before/after study (crash rate, total and per 1,000 drivers, and calculation of costs). A "learner stage" group (age 16 to 16½) and a "provisional stage" group (age 16½ to 17) were compared with a 19 year group and a group of all drivers over age 19.

It was found that 16 year old drivers' crash involvement decreased in the after period by 33%, for all other groups there was an increase (highest among the 17 year olds). For injury crashes there was a reduction among the 16 year group by 34.1%. All other groups had small increases in this type of crashes. The 16 years group also had a 27.6% decrease in fatal crashes, but the 17 year group had an increase in fatal crashes by 35.5%. The per-driver crash rates showed a decrease among the 16 year group by 32%, an increase by 5% for the 17 year group, an increase by 1.9% for the 19 year old control group and a decrease by 1.3% for the over 19 year group. In another analysis it was shown that violations and crashes per 100 drivers decreased by 76.1% and 88.1%, respectively, during the first six months after acquiring the permit. In the following 6 months the decrease was just 3.5% and 3.9% for the same measures. It is also shown that there was no long-term reduction in crash rates for teens beginning to drive under the new licence programme. There was a 72% reduction in night time accidents for the "learner stage" group. However, there was a problem that drivers do not obey the programme's restriction since 23% of the crashes in the "learner stage" group

happened without an adult supervisor in the car and 15% of the groups' crashes happened during the hours of the night time restriction.

In a study by Steenbergen et al. (2001) it was for example found out that knowledge of the system's restrictions was bad and that there was a need to get parents to understand the restrictions and also to get them to increase the enforcement of the restrictions on their children.

5.4.5 Louisiana (USA)

Learner stage

A learner's permit can be held from age 15. All drivers under age 17 must go through an approved driver education course consisting of 30 classroom and 6 behind the wheel hours to obtain a permit. If the person is over age 17 an educational programme must also be completed, but this programme does not include behind the wheel training. The permit must be held for at least 3 months.

Provisional stage

A provisional licence can be held from age 16. The candidate can only drive between 11 p.m. and 5 a.m. if accompanied by a supervisor. The candidate can only carry passengers during this time if they are members of her/his immediate family.

In Louisiana a before/after study (crash rate and fatal and injury crash rates per 10,000 individuals) was performed by Ulmer et al. (1999b). 15 year old drivers in Louisiana were compared with 15 year old drivers in Mississippi and 16 year old drivers in northern Florida. The system change led to a 33% reduction in 15 year olds becoming licensed. The number of people becoming licensed among 16 year and 17 year olds was steady during the examined period. The crash rate ratios for Louisiana 15 year olds was about 20% lower in the after period. In the other age groups and states the rates were unchanged or increased. The crash rate ratios during the restricted night time driving hours decreased by 47% in the after period for the 15 year olds in Louisiana.

5.4.6 Michigan (USA)

Learner stage

A learner's permit can be held from age 14 years and 9 months. To receive the permit the candidate has to pass a vision test and health standards, get a written approval from a parent or legal guardian and candidates younger than 18 years old have to go through a driver education consisting of 24 hours of classroom lessons and 6 hours of behind the wheel driving. When all this is fulfilled the candidate receives a permit which allows supervised driving with an approved licensed driver at least 21 years old. To be able to move on to the provisional stage the candidate has to be at least 16 years old, have completed at least 6 months of driving with the permit, have driven at least for 50 hours with a supervisor (including 10 hours at night), have been violation/crash free the previous 90 days, passed a road skills test and if under 18 years old have completed a driver education consisting of 6 hours of classroom lessons.

Provisional stage

A provisional licence can be held from age 16 if all that is listed in the learner stage is fulfilled. At this stage unsupervised driving is allowed, the only restriction

being that there has to be a supervisor (at least 21 years old with a licence) present if the candidate drives between midnight and 5 a.m. To receive a full licence the candidate must be at least 17 years old, have held a provisional licence for a minimum of 6 months and be violation/crash free the previous 12 months. However, there is a 3-year probationary period for all new licence holders, which includes <0.02 BAC for drivers under 21 years old.

Shope, Molnar, Eliot & Waller (2001) made a before/after study (crash rates/1,000 population by severity, time of day, type and alcohol-related) of 16 year old drivers and comparisons with 25 years or older drivers in Michigan. The overall crash risk for 16 year old drivers was significantly reduced (after adjusting for population wide trends) by 25%. Significant reductions in risk were also found for nonfatal injury crashes (24%), combined fatal and injury crashes (24%), crashes during the day (24%), during evening (21%), night crashes (53%), single vehicle (29%) and multivehicle crashes (23%).

In Michigan it was found that pupils subject to the GDL programme drove more than the minimum stipulated 50 hour of supervised driving during the learner stage (Waller, Ok & Shope, 2000). Pupils drove on average 75 hours under supervision and more than 70% of the parents surveyed reported that they had driven more than the minimum stipulated 10 hours during night with their pupils. Also, there was high support for the GDL programme's restrictions for unsupervised driving.

5.4.7 North Carolina (USA)

Learner stage

A candidate can hold a learner's permit from age 15 after completing driving education and passing written, sign and eye test. The candidate must spend at least 12 months at this stage and during the first 6 months it is only allowed to drive between 5 a.m. and 9 p.m. Only supervised driving with an adult with a licence is allowed. Only as many passengers as there are seat belts are allowed and all persons in the car must wear seat belts. To move on to the next stage, the candidate must have been violation free for the last 6 months and also passed a road test.

Provisional stage

A provisional licence can be held from age 16. This stage allows unsupervised driving except between 9 p.m. and 5 a.m., which must be supervised by a licensed driver. Also, there is a <0.02 BAC limit for drivers under age 21 and if the driver is under 18 years of age, all passengers must wear seatbelts. To receive a full licence the candidate must be at least 16½ years old and have a minimum of 6 continuous months with no traffic violations.

Foss, Feaganes & Rodgman (2001) reports a before/after study (number of crashes, by severity, time of day, type, alcohol involvement, driving environment/10,000 population and crashes per licensed drivers) of 16 year old drivers compared with drivers between age 25 and 54. Among 16 year olds all outcome measurements showed a decline in crashes after the implementation of GDL. For example, all crashes declined by 23% (27% when adjusting for the overall crash trend), fatal crashes by 57%, nonfatal injury crashes by 28%, crashes with no or minor injuries by 23%, daytime crashes by 20% and night time crashes by 43%. Also, crash rates per 10,000 licensed drivers decreased by 19%. In another study

(HSRC, 2001) it was found that there was no proof that implementation of GDL would result in great inconvenience for persons living in rural areas, which is a concern often argued when implementation of GDL is discussed. In a survey by Foss et al. (2002, referred in Foss & Goodwin, 2003) it was found that 17% of the young drivers had driven without a legal supervisor.

5.4.8 Ohio (USA)

Learner stage

A learner's permit can be held from age 15½, and the permit must be held for at least 6 months if the candidate is under the age of 18. To receive a permit the candidate has to pass a written and a vision test. Only supervised driving is allowed. The candidate is required to take driver education courses consisting of 24 hours of classroom lessons and 8 hours of behind the wheel training before moving to the next stage. This is required for candidates under age 18. Also, 50 hours of supervised driving is required, with at least 10 of those hours at night. Finally, seat belts must be available for all passengers and everyone must be buckled up if the driver is under age 18.

Provisional stage

A provisional licence can be held from age 16 after passing driving and manoeuvrability tests. If under age 17 unsupervised driving is prohibited between 1 a.m. and 5 a.m. Also, seat belts must be available for all passengers and everyone must be buckled up if the driver is under age 18. There is also a special suspension system for young drivers, which allows courts to intervene with young drivers early if necessary.

A before/after study (crash rates/10,000 population and/or registered drivers, convictions and suspensions/10,000 registered drivers) of 16 to 17 year old drivers and compared with a reference group of drivers aged 25 to 54 is reported by Office of Governor's Highway Safety Representative (2001). The involvement crash rate (per 10,000 registered drivers) decreased by 23% (24% for fatal crashes, 21% for injury crashes and 23% for property damage only crashes) the at-fault crash rate decreased by 1% (7% for fatal crashes and 4% for property damage only crashes). For at-fault injury crashes there was an increase by 3%. The involvement crash rate (per 10,000 population) decreased by 60% (69% for fatal crashes, 59% for injury crashes and 60% for property damage only crashes) and the at-fault crash rate decreased by 35% (38% for fatal crashes, 32% for injury crashes and 36% for property damage only crashes). Alcohol crash rates (per 10,000 registered drivers) decreased by 27%.

There was a decrease in crashes for all hours of the day (1%–35%), except for crashes occurring at 3 a.m. (an 8% increase). The total conviction rate was 15% less in the GDL group than in the pre-GDL group. There was a 261% increase in total suspensions (per 10,000 registered drivers) in the GDL group.

5.4.9 Pennsylvania (USA)

Learner stage

A learner's permit can be held from age 16. Before receiving the permit the candidate has to pass a physical examination, vision screening and knowledge test. It is mandatory to hold the permit for at least 6 months. The supervising adult must be at least 21 years old with a licence. A minimum of 50 hours of supervised

driving is required. There is a night time driving restriction between 11 p.m. and 5 a.m. For drivers under age 18 it is not allowed to have more passengers than the number of seat belts available in the vehicle. Also, there is a demerit point system for drivers under age 18, which will lead to suspension for 90 days if the candidate exceeds 6 or more points or is convicted of a single high-speed violation. To move to the next stage a road test must be passed.

Provisional stage

A provisional licence can be held from age 16½. No driving between 11 p.m. and 5 a.m. and the same restrictions for passengers and threat of being suspended applies for drivers under age 18 as during the learner stage. Generally, the candidate must be 18 years old to receive a full licence. However, a full licence can be held earlier (from age 17) if the candidate has maintained a crash and conviction-free record for 12 months and completed an approved driver's education course.

Among 16 year old drivers there was a decrease in crashes by 27%, injuries decreased by nearly a third and fatalities by 58% (Nissley, 2001 referred in Shope & Molnar, 2003). All reductions were between 1999 and 2000. Another study (Commonwealth of Pennsylvania Department of Transportation, 2002 referred in Shope & Molnar, 2003) reported a decrease in fatalities from 1999 to 2001 by 45%.

5.4.10 Nova Scotia (Canada)

Learner stage

The Nova Scotia GDL applies to all novice drivers and not just to young novice drivers. A learner's permit can be held from age 16. The learner stage lasts for at least 6 months before the candidate can do a road test to move to the provisional stage. However, the learner stage can be reduced from 6 to 3 months if the candidate completes an approved driver training or a driver education programme. The following restrictions are valid during the learner stage. The candidate is only allowed to drive under supervision of a licensed driver, no other passengers are allowed and there is a zero BAC limit. Also, if the candidate gets one speeding or two minor moving violations, he/she will be subject to suspension under a demerit point system for 6 months.

Provisional stage

A provisional licence can be held from 16 years and 3 months. This stage lasts for 24 months and the following restrictions are valid. Only one front seat passenger and as many back seat passengers as there are seat belts is allowed, no unsupervised driving is allowed between midnight and 5 a.m. and there is a zero BAC limit. Also, if suspension or revocation occurs during the 24 months, the candidate must do 24 new months before being able to get a full licence. To get a full licence completion of a 6-hour defensive driving course or a driver education course is requested.

Evaluation of GDL in Nova Scotia is reported by Mayhew, Simpson & Des Grosellier (1999) and Mayhew, Simpson, Des Grosellier & Williams (2001). They made a before/after study (number of crashes, injuries and fatalities/10,000 population) of 16 to 17 year old drivers. They also used three external control groups from different jurisdictions and an internal control group (drivers aged 25

and older). Time series analysis was performed as well as an evaluation of GDL effects on all novice drivers regardless of age. After the first full year of the GDL programme there was a 23.8% reduction in total crashes for 16 year old drivers and 33.9% reduction in injury crashes. After two years with the GDL programme the reductions were 35.8% and 48.1%. The time series analysis showed a decrease by 37% of the total crashes and 31% of the injury crashes during the first three years of the GDL programme. Also, a decrease of 19.4% in crash rate was found for all novice drivers, regardless of age. There were no significant decreases found among the 17 year old drivers after the first full year of the GDL programme. However, after two years the decrease among 17 year old drivers' overall crash ratio was 11% and their injury crash ratio declined by 17%.

In a more recent study Mayhew, Simpson, Williams & Desmond (2002) examined the relative contribution of each stage (learner stage, provisional stage and full licence) of the GDL programme. It is a before/after study (crashes per 10,000 novice drivers/licensed drivers) where a pre GDL group is compared with a GDL group. During the first six months of driving (comparable to the learner stage) there were 50% lower collision rates for the GDL group (all ages). During the following six months (when most novices had moved up to the provisional stage and were allowed to drive unsupervised) the collision rates increased for both groups. However, the GDL group still had a 12% lower collision rate than the pre GDL group. For the whole first year the collision rates were 28% lower for the GDL group. This pattern was consistent even if one only looked at 16–17 year old novices or novices 18 years and older. To get knowledge about the effects of the provisional stage (24 months) six months intervals of the whole period were examined for 16–17 year old drivers. For both groups the collision rates declined for each interval, which is in line with earlier findings that collision rates decrease when the driver gains more experience. In all intervals the GDL group had lower collision rates, but the lower rates were only significant for the first and last intervals (a 14% difference in both cases). The positive results were not found for drivers 18 years and older. Instead, for these drivers the collision rate during the second year was 24% higher for the GDL group. The authors conclude that this suggests that the provisional stage only has positive effects for the youngest drivers. Also, to see if the positive effect for the younger drivers in the GDL group was a result of reduced exposure (due to the night time restriction), collision rates during the restricted and unrestricted hours were examined for both groups. During the restricted hours there were significant reductions (45–60% lower collision rates) in all intervals for the GDL group. During the unrestricted hours significant reductions were only found during the first interval (11% lower collision rate for the GDL group). It was also shown that drivers (under the GDL programme) who had received a time discount by taking driving education had higher collision rates than drivers (also under the GDL programme) who had not taken the education. During the first year the GDL group without driver education and time discount had 20% lower collision rates. The collision rates for the GDL group with driver education and time discount were comparable to the pre GDL group. As for long-term effects of the GDL programme it was found that during the first year with a full licence there were no differences in collision rates between 16–17 year old drivers in the pre GDL group compared with the GDL group. However, among drivers 18 years and older the collision rate of the GDL group was 32% higher than in the pre GDL group.

95% of parents reported that their pupils had practised on public roads since receiving a permit to practise (Mayhew, Simpson, Ferguson & Williams, 1998). It was most common to practise 2–3 days per week, 70% reported practising at least once a week, 7–15 miles practising per week were most commonly reported and more than 75% of the pupils reported gaining the most experience on streets close to their home. Only 60% reported getting experience of driving during the night. It was also found that there were problems with compliance with the night time restriction. About 40% reported that they occasionally had broken this restriction and driven during the restricted hours.

5.4.11 Ontario (Canada)

Learner stage

A learner's permit can be held from age 16, after passing a knowledge and a vision screening test. The learner stage lasts for at least 12 months and the "learner licence" is valid for 5 years. However, if the candidate completes an approved driver education course, the learner stage can be reduced to 8 months. To move to the next level the candidate must pass an on-road driving test. All driving must be performed with a supervisor, who must be fully licensed with minimum 4 years' experience and BAC<.05. Only the supervisor is allowed to ride in the front seat, as for other passengers only as many as there are seat belts in the rear seat are allowed. The candidate must maintain zero BAC and there is no driving allowed between midnight and 5 a.m. Also, there is a prohibition to drive on freeways and urban expressways.

Provisional stage

In this stage, which lasts for at least 12 months, the candidate may only carry as many passengers as there are seat belts, must maintain a zero blood alcohol level, but is allowed to drive without a supervisor. To get a full licence the candidate must pass an advanced on-road driving test which is twice as long as the earlier on-road driving tests.

Boase & Tasca (1998) made an evaluation of Ontario's GDL system. They performed a before/after study (collision rate and fatal and injury collision rates per 10,000 licensed novice drivers) of all novice drivers. A 31% lower overall collision rate per 10,000 licensed novice drivers was found in the after measure (male drivers 29% lower and women 36% lower). In the general driving population the drop was just 4% (male drivers 3% drop and women 6% drop). The reductions for the novice drivers were most pronounced for injury (24%) and property damage only (33%) collisions. The reduction for fatal collisions was 6%. The reduction in the overall collision rate was highest for 20–24 year old drivers (42%) and higher among women (34%) than among men (19%). When just fatal and injury collisions were analysed, there was a reduction in these accidents by 24%. When the impact of the system's different restrictions was analysed, a total reduction in alcohol related collisions of 27% was found. The total reduction for the night time restriction was 62% and the reduction for collisions on 400 series highways was 61%.

Mayhew, Simpson, Ferguson & Williams (1999) did a survey among parents and pupils concerning how they practised during the learner stage. For example it was found that over 90% of both parents and pupils reported practising on public roads, where most practising occurred on residential streets (55%). It was also

found that 2% reported practising on freeways, which is a violation of the highway restriction. The pupils practised at least once a week during the learner stage. This amount of practice was reported by 85% of the parents.

5.4.12 Quebec (Canada)

Learner stage

A learner's permit can be held from age 16 after passing a knowledge test. The permit must be held for at least 12 months. However if an approved driving course is completed the learner stage can be reduced to 8 months. Only supervised driving is allowed during this stage and the supervisor must have had a full licence for a minimum of 24 months. Also, there is a zero BAC limit and there is a 4 point demerit points system.

Provisional stage

There is no provisional licence stage. Instead, there is a probationary stage where the candidate may get a probationary licence issued at the age 16 years and 8 months. This licence is valid for two years and is mandatory only for all new drivers under age 25. During this stage there is a zero BAC limit and a 4 point demerit points system, but it is allowed to drive unsupervised. A full licence can be held from age 18 years and 8 months.

A before/after study (number of fatalities/injuries and fatalities/injuries per 100,000 licence holders) of all novice drivers and a control group of all drivers (18–24 years old) with a regular licence was performed on Quebec's GDL system (Bouchard et al., 2000). The net impact (after adjustment for fatalities and injuries in the control group) of GDL on the number of fatalities involving young drivers affected by the reform was a 4.9% reduction. For number of injuries the net impact was a 14.4% reduction. When the net impact of the reform per 100,000 licence holders was examined the reduction was 7.4% for fatalities and 16.7% for injuries. For fatalities and injuries together the net impact per 100,000 licence holders was 16.5%. Also, a reduction was found in the number of fatalities, injuries and fatalities/injuries together for night time (9 p.m.–6 a.m.) single accidents involving young drivers. The net impact for this type of accident was 36.7% for fatalities, 8.3% for injuries and 8.9% for fatalities and injuries together.

5.4.13 New Zealand

Since May 1999 the GDL in New Zealand has changed, but since no evaluation of this new system is available the old system is described below.

Learner stage

A learner's permit can be held from age 15. The GDL system applies to all new drivers aged 15–24. To receive the permit the candidate has to pass a vision test and a written as well as an oral theory test. The permit must be held for a minimum of 6 months, even though this period may be shortened to 3 months if an approved driving course is taken. During this stage only supervised driving is allowed and the supervisor must have a licence and be at least 20 years old. A blood alcohol limit of 0.03 mg% is valid during this stage. To move to the next stage, a driving test must be passed.

Provisional stage

A provisional licence can be held from 15 years and 3 months (if the approved driving course had been taken during the learner stage). The licence must be held for a minimum of 18 months, unless the candidates take a defensive driving course or an approved advanced driving course. If so, a time discount of 9 months is given. Therefore, it is possible for persons to receive a full licence shortly after their 16th birthday. In this stage it is not allowed to drive unsupervised from 10 p.m. to 5 a.m. If the candidate drives unsupervised during this stage, he or she is not allowed to have passengers younger than 20 years of age. Also, the blood alcohol limit of 0.03 mg% applies here as well. If the candidates do not follow the conditions of GDL, they could be penalized by extensions of up to 6 months to the licence currently held.

Langley, Wagenaar & Begg (1996) have carried out an evaluation of the New Zealand GDL. They analyzed crash data based on New Zealand Health Information Services over the period 1979–1992. The data were broken down into 3 age groups; 15–19, 20–24 and 25 years of age and older, where the first group were compared with the other two. Also, two non traffic injury comparison groups were included. Exposure was controlled using time series analysis through monthly statistics on licence holders. It was found that 15–19 year olds reduced their involvement in crashes leading to hospitalization by 23%. The older drivers also reduced their crash involvement, but by 12% for 20–24 year olds and by 16% for 25+ year olds. After having discussed the influence of certain confounding factors, the authors conclude that a conservative estimate would be 7% crash reduction due to the new system. The likely effect of the New Zealand GDL is thus somewhere between 7 and 23%.

In a study by Begg, Stephenson, Alsop & Langley (2001) the proportion of crashes happening during circumstances included as restrictions (night time curfew, passenger restrictions and alcohol limit restrictions) in the New Zealand GDL was investigated. Comparisons were made of 15 to 19 year old drivers (pre GDL, restricted GDL and full GDL) for each GDL restriction mentioned above. Results show that restricted GDL drivers compared with pre GDL drivers had a significantly smaller proportion of crashes that occurred during the night time curfew, that involved passengers of all ages and when alcohol was suspected. No significant differences were found for crashes involving young passengers. Full GDL drivers had a significantly smaller proportion of night time crashes than pre GDL drivers. As for the other restrictions, no significant differences were found between these groups.

In a similar study, Begg, Alsop & Langley (2000) compared pre GDL drivers with three GDL groups (learner licence drivers, restricted licence drivers and full GDL drivers) regarding night time curfew, passenger restrictions and alcohol restrictions. It was found that restricted licence drivers had significantly fewer crashes at night and fewer involving passengers of all ages than pre-GDL drivers. However, no effects were found for alcohol related crashes between these two groups. It was also shown that learner licence drivers had a higher proportion of crashes involving passengers. No differences were found between the pre GDL group and full GDL group.

In a recent article by Begg & Stephenson (2003), the following is stated regarding the results of the New Zealand GDL:

“In the 12 years from 1987 to 1998 (inclusive), the number and rate (per 100,000 population) of fatality or seriously injured motor vehicle occupants aged 15–24 years of age has nearly halved. While factors other than GDL will have contributed to this result, there is little doubt that GDL has been the most important factor influencing this outcome”.

Pupils in New Zealand reported violating the night time restriction, the alcohol restriction and the passenger restriction, the latter were violated most often (Begg, Langley, Chalmers & Reeder, 1995). At the same time, the pupils were positive to the different restrictions.

5.5 Discussion

5.5.1 Restrictions

In all systems there are some sorts of restrictions. It can be restrictions regarding how old the pupil or supervisor must be, the time the pupil must hold the learner’s permit, minimum requirements for practising or number of theory lessons, curfews or obligatory parts etc. Restrictions are one of the (if not the most) important features in GDL programmes. As shown earlier in this report, restrictions in GDL programmes have been very successful in lowering crash involvement and severe crashes during the learner stage. Of the different restrictions, night time restrictions seem to be the most effective in reducing learner drivers' accidents (e.g. Ferguson et al., 1996; Agent et al., 2001; Ulmer et al., 2000; Shope et al., 2001; Begg et al., 2001; Foss, Feaganes & Rodgman, 2001; Mayhew et al., 2002; Office of Governor’s Highway Safety Representative, 2001; Williams and Preusser, 1997; Begg, Alsop & Langley, 2000; Boase & Tasca, 1998; Bouchard et al., 2000).

There are also reported effects of alcohol restrictions (e.g. McCartt et al., 2000; McCartt et al., 2001; Begg et al., 2001; Foss, Feaganes & Rodgman, 2001; Office of Governor’s Highway Safety Representative, 2001; Boase & Tasca, 1998) and passenger restrictions (e.g. Begg, Alsop & Langley, 2000; Begg et al., 2001). As for passenger restrictions, there is less evidence that this restriction has as much effect as night time or alcohol restrictions. But the idea behind passenger restrictions is sound, since research has shown that a great proportion of passenger injuries among teenagers happen when they are travelling in a car driven by a teenager (e.g. Preusser, Ferguson & Williams, 1998; Chen, Baker, Braver & Li, 2000; Doherty, Andrey & MacGregor, 1998; see also section 2.3.8).

However, it should be pointed out that violations of different restrictions are quite common, as reported in several studies (e.g. Williams, Nelson & Leaf, 2002; Steenbergen et al., 2001; Simons-Morton & Hartos, 2003; Agent et al., 2001; Begg et al., 1995; Harre, Field & Kirkwood, 1996; Foss et al., 2002 referred in Foss & Goodwin, 2003; Mayhew et al., 1998; Mayhew, Simpson, Ferguson & Williams, 1999). Also, some researchers (e.g. McKnight & Peck, 2003) state it is even doubtful that the requirement considering minimum hours of practising is fulfilled by all learner drivers. Therefore, these types of restrictions could have an even greater potential if only it were possible to find some measures to increase people obeying the restrictions, including making all involved parties more aware of the restrictions, but also ensuring that enforcement of violations is implemented. Enforcement does not have to be in the form of the police, but could also be executed by parents encouraging compliance with the restrictions (Foss &

Goodwin, 2003). Also, further research is needed to be able to draw safe conclusions about these restrictions' effects on accidents during the first years with a full licence. If restrictions save lives and reduce injuries during learning it is good, but if the restrictions do not also lead to fewer accidents after licensing something more is needed to be done to reduce the high accident risk of novice drivers.

5.5.2 Professional driver education

Often it has been argued that professional driver education has no safety benefits or at least no better results compared with lay instructed/private training (e.g. Mayhew & Simpson, 1996; Spurkeland, 1997; Christie, 2001; Ferguson, 2003). However, this statement is in most cases based on rather vague results when the types of professional education that have been evaluated are taken into account. For instance, the evaluations of GDL in Ontario (Boase and Tasca, 1998) and in Nova Scotia (Mayhew et al., 2002) examined the impact of driver education taken by pupils to get a time discount for the learner period. Both studies showed higher accident rates for pupils taking advantage of the time discount by going through a driver education. Therefore, it is possible to conclude that one day of driver education can not make up for the loss of 4 (Ontario) or 3 (Nova Scotia) months of experience gained under supervised driving. But, these types of results should not be used to conclude that driver education has no safety benefits. The most probable cause for this outcome is that the driver education required as a substitute was too short, but other explanations are also possible. For example, that the driver education offered had a poor content or focused on the wrong aspects. If the expectation is that a driver education lasting for one or just a couple of days should produce a safe and excellent driver, then the probability that driver education has large safety benefits is low. However, it seems strange to have this expectation on driver education, since this demand does not exist for education in other areas (e.g. Nyberg, Engström, Nolén & Gregersen, 2002; Waller, 2003). Also, there are examples of studies showing good results of driver education, both for short interventions e.g. the second phase training in Finland or driver improvement courses for drivers who have committed traffic offences, e.g. in Germany and Austria and longer, such as the Danish system. Considering the last years' research and findings regarding what is missing in today's traditional driver training (e.g. Lynham & Twisk, 1995; Hatakka, Keskinen, Gregersen & Glad, 1999; Hatakka et al., 2002, or what is written in chapter 3 in this report), it seems more than likely that professional driver training – if this knowledge is put into use – has great potential to be one of the measures that will contribute to the goal of reducing young novice drivers' accidents.

5.5.3 Supervised practising

Most of the evaluated systems have the component of supervised practising. The reason behind using this component can at least be twofold. First, by allowing supervised practice it is assumed that the pupils can get more and necessary experience behind the wheel before being allowed to drive on their own. Secondly, this experience is believed to be gained under safer conditions compared with gaining the experience as a novice driver. Several studies show that supervised driving has many advantages. For instance, it has been shown that accidents during supervised practice are quite rare (e.g. Williams, Preusser,

Ferguson & Ulmer, 1997; Gregersen et al., 2000a; Gregersen, Nyberg & Berg, in press; Mayhew, Simpson & Pak referred in Mayhew, 2003; Baughan & Simpson, 2002), especially compared with accident involvement during the first period with a licence (e.g. McKnight & Peck, 2002; Williams, 2003; Gregersen, Nyberg & Berg, in press). It has also been shown that drivers who have gained a lot of experience before getting a licence have fewer accidents during the first period with a licence than drivers who have not gained this amount of experience (e.g. Maycock & Forsyth, 1997; Gregersen et al., 2000a; Gregersen & Nyberg, 2002; Gregersen, Nyberg & Berg, in press).

However, research also shows that gaining a lot of experience during practice is not enough to solve the problem of over involvement in accidents during the first years as a novice driver. Therefore, it seems that supervised driving is a very good component, but its potential is not fully explored. For example, it is most likely that the effect of supervised driving would be much greater if it could be structured in the correct way. Today, most systems allowing supervised driving have no structure whatsoever, it is up to the supervisor and pupil to practise as they please. Of course objections to this reasoning can be raised, since many systems (especially the GDL systems) have different restrictions for the supervised driving. But these restrictions do not tell the supervisors or pupils anything about how they shall practise; they just stipulate some conditions under which they are not allowed to practise. Several evaluations also show that some pupils practise a lot and under different conditions, but other pupils practise very little (e.g. Maycock & Forsyth, 1997; Preusser, Ferguson & Williams, 1999; Gregersen & Nyberg, 2002; Mayhew, Simpson, Ferguson & Williams, 1999; Catchpole & Coutts, 2002). A solution as suggested by Gregersen & Nyberg (2002) is to impose some sort of structure for supervised training. It is not an easy task to solve, the main problem being how to check that the structure is being followed. But on the other hand this problem already exists for example in systems with driving restrictions, the problem being how to check that the restrictions are obeyed (see earlier discussion regarding violation of restrictions). The need for structure is also obvious, since research shows that just gaining experience is not enough to solve the accident problem during the first years as a novice driver. It is reasonable to assume that the effect will be greater both considering accidents happening during supervision and during the first years as a novice driver, if the necessary experience has been gained in a structured way. There is a vast amount of research available to use whether structure is considered important. One example on how to structure the supervision is to manufacture aid material for the supervisors. Simons-Morton, Hartos and Leaf (2002) found that parents and learner drivers participating in the "Checkpoint Programme", which is a programme consisting of materials that will aid parents to restrict their children's early driving, were indeed reporting more restrictions than a group not participating in the programme. Another issue concerning the accidents that do happen during supervision is if a dual brake pedal would help in reducing these types of accidents. This is only compulsory in Finland, but the results in the evaluation by Peräaho, Keskinen & Ojanen (2001) seem to be positive.

In many studies it has been shown that there is support for the restrictions imposed in GDL systems, both by parents and pupils (Ferguson & Williams, 1996; Vance, 1996; Foss, 1996; Mayhew et al., 1998; Williams, Nelson & Leaf, 2002; Ferguson et al., 2001), even though as for instance Lin & Fearn (2003) point out, there is greater support for night time than for passenger restrictions. Of

course, no one knows if for instance obligatory components in a driving system will be received as positively by parents and pupils, since these types of components will cost a certain amount of money. However, pupils usually rate professional courses positively, even though the amount of money they cost is regarded as negative. In connection with the discussion of professional driver education, it seems that a system that includes the combination of structured supervised driving and a professional driver education with a relevant content has the biggest potential to reduce accidents during both practice and the first years as a novice driver.

The money issue seems to be the main problem when proposals for new driving systems are put forward. In Sweden for example, a proposal to the Swedish Government about a new structured driving system was delivered in 1999 (Swedish National Road Administration, 2000). The system which can be described as a graduated driver education system (not a graduated licensing system) was based on the idea to combine the good things of the graduated licensing systems with a structured and staged system of education where the benefits of professional education and the lay instruction were optimised. The proposal has not been approved by the Swedish Government, mainly due to the fact that some media exaggerated the increasing costs for the individuals who, according to this debate, would also increase the inequality concerning the possibilities to obtain a licence if the system should be put in use (Nyberg, Engström, Nolén & Gregersen, 2002; Linderholm & Bergman, 2002).

There was, however, awareness that a reconstruction of the Swedish driver training was needed. In 2001, a development of a new national curriculum was started. The idea for this new curriculum emerged from two sources. One was the fact that the old curriculum was old-fashioned and did not give the necessary support to the instructors and supervisors. The other was the work done by Hatakka et al. (2002) in developing the GDE-matrix (see chapter 3 for description of the matrix). The matrix clearly pointed out that the necessary competence for becoming a safe driver covers much more than was covered in the traditional curriculum. From being a detailed description of more than 400 tasks of driving, the new curriculum will be goal oriented and more general in its approach. The basis of the four levels of the GDE-matrix is represented as four paragraphs in the curriculum. The overall purpose of the training for each of the levels is described as follows:

1. The aim of the part "Manoeuvring, vehicle maintenance and environment" is that the candidate shall learn how to manoeuvre the vehicle in a safe and environmentally friendly way. The candidate shall also develop a realistic assessment of own ability to do this. Embedded in this is to learn how the vehicle is functioning, the different protection systems in the car and the correlations between driving style and pollution. In addition, the candidate shall develop the ability to reflect over situations that occur during training.
2. The aim of the part "Driving in different traffic environments" is to develop the candidate's ability to drive the car in a safe and environmentally friendly way in cooperation with other road users, in different traffic situations and under different circumstances. The part also aims at development of the candidate's ability to be anticipating, detect hazards and to drive with such safety margins that are needed to avoid becoming involved in critical situations. To exercise these abilities is thus of central importance. In

addition, knowledge and understanding should be provided about why traffic rules exist and how they shall be followed.

3. The aim of the part "Travelling with the car under special conditions" is to give the candidate knowledge about the importance of planning the journey with regard to e.g. where, when, how, under which circumstances and why a trip should be carried out. This knowledge shall be used to make trips as environmentally friendly as possible and to avoid travelling under dangerous circumstances such as dense traffic, low friction, bad weather, driving under influence of alcohol or tiredness etc.
4. The aim of part 4 "Personal preconditions and goals" is to provide understanding for the candidate of how different personal and social preconditions influence the role as a driver. The candidate shall realise how driving behaviour and accident risk are correlated with factors such as age, gender, personality, lifestyle, socio-economy, education and peer groups. By understanding these relations the candidate is expected to have a better opportunity to adjust driving in a way that takes into account his/her own preconditions.

The new curriculum has been commented upon by all interest groups and is currently waiting for approval at the Swedish National Road Administration. No approval from the government is needed for this change. It is expected to be introduced in 2004. However, if the curriculum will be approved, it is clear that the driver education system as such must also be changed. Otherwise there will be a curriculum that will be impossible to follow and fulfil for all involved parties (pupils, lay instructors, driving schools and examiners). A good starting point for a new system is found in the old proposal, even though recent research findings must be taken into account to rewrite some parts.

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6 Conclusions

6.1 General conclusions

- The high accident involvement among young novice drivers is partly an effect of lack of knowledge, insight, risk awareness and experience and partly an effect of age-related factors such as lifestyle, peer groups, socialisation process and maturity.
- The acquisition of much experience is a crucial ingredient in driver education and training. The evaluations of lowered age limit for practising in Sweden and of GDL systems in many countries have shown that if experience is gained under supervision and under safe circumstances, the accident involvement after licensing is reduced compared with gaining the experience alone, together with peers after having obtained a full licence.
- In order to be a safe driver, it is not enough to be able to control the vehicle well and in accordance with the traffic rules. A safe driver must also be able to plan the trip safely with regard to mode of transport, with whom, route choice, etc. It is crucial to be able to decide when to avoid driving, such as under the influence of alcohol, other drugs or fatigue. It is also important to have a realistic assessment of own ability to control the vehicle, to drive in traffic and to be aware of what motives and preferences govern own behaviour and own choices. The knowledge about where risks in traffic may occur is crucial and how they are avoided through large safety margins and well developed hazard perception. All these aspects are covered in the GDE-matrix (described in Section 3.2).
- Young drivers are especially over-represented in certain types of accidents such as single accidents, loss-of-control accidents, accidents related to excessive speeding, alcohol, fatigue, night-time and weekends. Accidents where seat belt has not been used and accidents with young passengers are also over-represented among young drivers.
- Certain youth groups are involved in more accidents than others. Male drivers have a higher accident risk than female drivers (even if young women also are over-represented compared with older women). There is also a difference between male and female drivers in terms of accident types where male accidents more often lead to serious injuries. It is possible to identify high-risk groups through analyses of personality, lifestyle, or socio-economy (economy in the family, parents' education and occupation, school grades, criminal records etc.). None of the currently available tests, however, is good enough to predict who will be involved in accidents.
- If high-school driver education is to be introduced, it should be arranged in a way where earlier licensing with thereby following higher accident risk is avoided. The content of the high-school education should not focus on vehicle manoeuvring and control but more general aspects belonging to the higher levels of the GDE-matrix.
- Second-phase education and other education countermeasures where the upper parts and the right columns of the GDE matrix are covered are beneficial for safety. In driver education risk awareness methods should be used on a regular basis and as a standard procedure to gain changes in attitudes. Educational methods that might be appropriate to increase drivers' skills for self-evaluation include e.g. improved feedback during training, self-evaluation tools like

questionnaires and scales, discussions with other drivers about personal experiences and evaluations made by instructors or examiners.

- Restrictions in GDL systems have proved to be successful for lowering crash involvement during the learner stage. These conclusions apply to night time curfews, rules for lower BAC levels and passenger restrictions.
- The introduction of short professional courses in exchange for a reduction of general practising periods has not been proved to be beneficial for safety. The extended practice that is achieved during this period seems to give more safety benefits than the currently evaluated courses.
- There is a need for structure of the supervised practice. Research shows that just gaining experience is not enough to solve the accident problem during the first years as a novice driver. The effect will most likely be greater both considering accidents happening during supervision and during the first years as a novice driver, if the necessary experience has been gained in a well structured way.
- A system that includes the combination of structured supervised driving and a professional driver education with a relevant content has a potential to reduce accidents during both practice and the first years as a novice driver.
- Laws and enforcement are effective in influencing the behaviour of drivers, not just young drivers. Examples of positive laws and enforcement effects are the decrease in drunken driving, the increase in the use of seat belts and the lower speeds. Besides these effects, laws and enforcement have decreased crashes. However, certain groups of young drivers and males are harder to influence.
- Laws and enforcement can produce even better results if the acceptance and support of the general public is gained. But there must be awareness and knowledge of laws which could be reached via campaigns and enforcement. Another way to get people to follow the laws is to have a penalty point system. A system that gives strict rules for behaviour.
- Despite laws, enforcement, good driver training, educational measures and campaigning, there are drivers who are not reached via these methods. These high risk drivers often have problems other than those directly related to their driving behaviour. Driver improvement courses and driver rehabilitation can offer possibilities when dealing with these drivers.
- Campaigns and educational methods have not been very successful in changing drivers' attitudes and behaviour. Some of the campaigns have been more promising than others, but long lasting effects seem to be hard to get. This does not mean that they are unnecessary or a waste of time and money. It means that campaigns should be conducted on a regular basis and more often.
- Campaigns and educational methods are also essential and important in maintaining the present situation. Their meaning is also essential because there will always be new cohorts to educate as new generations of young people enter traffic.
- Attitudes are closely connected to motives and emotions and they have connections to all levels of a person's behaviour because they operate on the highest levels of the driver behaviour hierarchy described in chapter 3.
- Attitudes affect behaviour, but behaviour also affects attitudes. Attitudes are connected to behaviour but they do not determine it, there are also other important factors such as motives and emotions.

- Safety increasing laws concerning alcohol are for example lowered blood alcohol levels for novice drivers, minimum legal drinking age, sobriety checkpoints etc.
- Laws need enforcement to be effective and effects of laws and enforcement can be supported by media campaigns. Combinations of different methods give the best results.
- Knowledge gains are easier to produce by campaigns than changes in attitudes and behaviour and effects are bigger in low risk groups.
- Short term effects of brief intervention campaigns for increasing the use of safety belts are often found. Campaigns should be repeated regularly.
- Safety promoting methods using active participation of drivers have had positive results concerning safe behaviour.

6.2 Recommendations with special relevance for the Swedish licensing system

The following recommendations for the Swedish driver education system are partly based on the results of the literature review and partly on the facts of how the Swedish system is designed today. There is a need for a new national curriculum, in which the whole GDE-matrix is covered. A prerequisite for all educational measures is that there must be a harmony between the goals of the curriculum, the content of the education and the design of the licensing test. As a consequence of introducing a new curriculum, a number of additional changes will be necessary.

- The lay instructed training in Sweden is extensive and should be maintained and strengthened.
- The education should be structured in accordance with the goals of the curriculum.
- The professional instructors and the lay supervisors should have the necessary competence for their respective role in the education process.
- There are accidents during practice, which lead to fatalities and injuries. In accordance with the Swedish “Vision Zero” the Swedish driver education system must be changed in order to avoid these accidents in the future.
- The lay supervisors need an introductory education in order to understand the risks during lay instructed practice and the need to adjust the practice in order to avoid these risks. The education should also provide knowledge about how to structure the training in a correct way.
- Professional driving instruction should have a stronger role in the education, mainly for two purposes; to support and structure the lay instructed practice and to cover aspects from the curriculum that lay supervisors or students cannot be expected to handle themselves. Mandatory training is thus necessary for parts that lay supervisors cannot be expected to manage such as driving in darkness, overtaking and environmental friendly driving.

The literature review has clearly shown that there is much knowledge about driver behaviour, road safety and educational methods that has not yet been applied in the Swedish driver education system. It is thus suggested that an experiment is launched where new methods and structures are tested on a large scale basis.