

**The accident liability of young/novice drivers
and the effectiveness of driver licensing systems**

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Summary

This report reviews the literature on research into the contributing factors to the high accident liability of novice drivers and discusses the results with particular reference as to how driver training may contribute to greater safety of novice and young drivers.

This literature survey was a part of a larger project, undertaken by the Forum of European Road Safety Research Institutes (FERSI).

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1. Foreword

The forum of European Road Safety Institutes (FERSI) surveys current knowledge and experience with driver training and licensing systems and their effects on road safety in a range of European countries. The work will provide an overview of driver licensing systems in operation in EC and related countries, with more in-depth studies of the way in which these systems are put into practice in four countries. The in-depth studies will highlight particular features of the current systems, which might be of benefit of adopting more widely.

The project does include the following elements:

1. A collation of information on driver training, licensing and testing systems in a wide range of European countries.
2. A preliminary analysis of the accident risk of novice drivers in these countries based on existing national data.
3. A survey of the literature on the effectiveness of different training and licensing systems or particular elements of these systems.
4. A selection of four systems for further analysis, including examples of all the most promising elements identified.
5. In depth studies of the operation of these systems and analysis of existing data which relate to their effectiveness.

The present memorandum presents the results from the literature survey (element 3). It was a part of a larger project undertaken by the FERSI and supported by the Transport Directorate of the European Union (DG7), that aimed to survey the car driver licensing and training systems.

This survey, together with the information on current practices in driver training and licensing (element 1), aims to draw up a typology of systems. The resulting output will be important in guiding the choice of countries and the methodology for the in-depth studies.

The results of this FERSI project were reported elsewhere (Lynam and Twisk, 1995).

2. Factors contributing to the high accident liability of novice drivers and the role of driver training

2.1. Introduction

Since the 1960s it has been acknowledged that young drivers in the 18-24 age group run a greater risk of being involved in an accident. The casualty figures show that in youngsters, death in traffic is the prime cause of death, of which a large proportion are car drivers. These figures call for effective countermeasures, especially in the field of driver training, as this is the prime task, to 'produce' safe drivers. However, to be able to select the most effective measures, it is necessary to know what factors contribute to this high accident risk. Information on accident risk only tells us how large the problem is. Information on driver behaviour tells us more on what drivers do, or fail to do, that might increase their chance of accident.

The nature of accidents involving novice drivers is continually debated, and no single answer has yet been found to the question of what causes the high accident figures. This chapter aims to review the literature on research into novice driver behaviour, to describe the known contributing factors, and to discuss the results with particular reference as to how driver training may contribute to greater safety of young and novice drivers.

The chapter is structured as follows. First, it is discussed how well novice drivers actually drive. Secondly, the question addresses what factors might contribute to the poor 'performance' of novice drivers. Finally the role of driver training, its efficacy, inherent limitations and scope for improvement are discussed. The chapter then concludes with a discussion on how these inherent limitations can be overcome.

2.2. Young/novice driver behaviour

A motorist's participation in traffic can be divided into two aspects, which, in the training stage develop one after the other (Brown, 1982). These are 'vehicle control' and 'road craft'. Vehicle control implies the ability to operate the car, such as changing gears, declutching and steering. Road craft implies the ability to respond adequately to the requirements resulting from traffic conditions. Perceptual and cognitive skills are preconditions for the latter. It is assumed that road-craft will only develop to an optimal extent if the driver is able to control the vehicle. Furthermore, excellent vehicle skills do not guarantee equally high levels of road-craft, as the high traffic accident involvement of racing drivers show (Williams & O'Neil, 1974)

Novice drivers are rather competent in handling the vehicle (De Velde Harsenhorst & Lourens, 1988). However, novice drivers are devoting much of their attention to the vehicle handling routines (Mourant & Rockwell, 1971) and as a result of the limited capacity of human attention (Kahneman, 1973) less attention is available for traffic situations. This shows in their insufficient visual search routines. Novice drivers

primarily look at nearby hazards and their search patterns are more error prone. Expert levels of perception routines will not be reached before three and a half to five years of driving experience (Cohen, 1985). With regard to reaction times to sudden obstacles, novices and experienced drivers do not differ (Olson & Sivak, 1986). But, this is not a very common task in real traffic as it is the driver's prime task to adopt appropriate safety margins which would allow him to stop at all times. Young drivers in cases of blocked view, adopt smaller margins, than more experienced drivers. By driving 'too' fast, they allow themselves only a short period of time to take evasive action (Quimby & Watts, 1981). Experienced and novice drivers did not differ with respect to safety margins adopted in car-following distances. The 'two second rule' was spontaneously adhered to in both groups (Colbourn, 1978a). Although, there is evidence that the cognitive processes involved are more demanding for novice drivers and more sensitive to errors (Cavallo & Laurant, 1988; Cavallo, 1989). Which also may account for the frequent head-tail collisions of novice drivers as reported by Colbourn (1978b). In general young drivers (especially males) drive at higher speeds (van de Velde Harsenhorst & Lourens; Forsyth, 1992b; Schlag et al, 1986). This does not necessary mean that they 'speed', that is, violate the speed limit but that they drive too fast for prevailing conditions (Schlag et al, 1986). Contrary to common believes, young drivers do not drink and drive more frequently than more experienced drivers (Mathijssen, 1990; Markey, 1993).

In conclusion there are marked differences between novice/young drivers. These differences are related to visual search, speed choice, safety margins in situations with high level of uncertainty. In the next part of the chapter explanations for these differences will be discussed.

2.3. Why do they drive in this manner?

2.3.1. *Psycho-biological immaturity*

Human abilities (such as perception, walking, abstract reasoning) develop in the period between birth and adulthood. Th's development is the result of both the maturation of the nervous system and of learning processes. It is often assumed that after the 18th year, no further development of ability occurs.

Based on these findings, it seems likely that the observed differences between expert and novice drivers are not the result of differences in psycho-biological abilities.

Hale & Glendon (1987) in contrast quote findings that show that the 18 year-old has not yet reached the peak of h's 'ability'. Peripheral vision, which is important for the observat'on of speed and movement continues to improve up to 22 years of age (Rumar, 1985; Popivanova, 1986). In addition, 'abstract reasoning' has not yet reached optimum levels at 18 years of age. This becomes apparent in inadequate, hazard percept'ion, and poses problems in integrated 'rule-based' behaviour, required to respond to danger (coping). The ability to detect potential hazard continues to develop during the teenage period and then changes in nature. Although the number of detected hazards remains the same, a shift occurs towards more abstract risks, such as, hazards that are located further into

the future and hazards for which the signs are present in a less concrete form (Sheehy et al, 1985; Martin & Heimstra, 1973). Such patterns of hazard perception have also been found in opinions among youths regarding general health risks (such as smoking) (Lewis, 1985). Lewis' research indicates that in youngsters future consequences of current actions were only to a limited degree foreseen and considered during decision making.

It can therefore be concluded that there is some evidence that cognitive skills and perceptual abilities are still developing at the age of eighteen years in young people.

2.3.2. *Limited hazard perception skills*

According to McKenna and Crick (1990), 'hazard perception' refers to the ability to detect potentially threatening events by the employment of a mental model of the road network. This mental model allows the driver to accumulate information and then run a simulation of what might happen. Furthermore, the use of the mental model enables the experienced and expert drivers to make predictions about future events in that system.

Novice drivers are poor in 'hazard perception' as was shown in the following studies. If a driver is explicitly asked to identify hazards it was found that young/novice drivers spot less hazards and concentrate on non-moving objects (Soliday & Allen, 1972) at close range. Brown (1982) spotted children less often as a source of hazard (Oude Egberink, 1986). Both experienced, and novice drivers, regard a condition as non-hazardous, if the situation is unchanging, the information input is low, and no control action is needed. However, novice drivers mention hazards more frequently when related to the infrastructure such as narrow roads, road conditions, and the presence of intersections. They concentrate less on the other traffic participants (Benda & Hoyos, 1982). Young inexperienced men regard driving at high speeds as less hazardous than more experienced drivers, whereas they considered snow covered roads to be more hazardous, than experienced drivers do (Bragg & Finn, 1982). When young males become more familiar with a route, they tend to lower their hazard estimates (Bragg & Finn, 1982). Familiarity with a route not only affect these estimates, but also the perceived level of control. Young males have lower estimates of hazard as drivers than when they are passengers (Bragg & Finn, 1985). Furthermore young/novice drivers are less able to detect sudden changes in the task condition, which would require a lower driving speed (Wilson & Anderson, 1980).

2.3.3. *Risk acceptance*

Novice drivers seem to accept more risks. Different motives may underlie this risky behaviour.

- a. It may be the result of weighing up of the advantages and disadvantages (risk utility). For example, youths are very much aware that DWI is associated with extra risk. They also know that the likelihood of an accident is relatively small and that they are more likely than not to arrive home unscathed. The observed disadvantage of 'not driving' after consuming alcohol is that with regard to the balance of power within the family, the younger member must admit that he has drunk too much if he arrives home without a car. This is an almost

certain outcome. The parents in that case often punish the fact alcohol was consumed while failing to reward the decision not to drive (Rothe, 1987).

- b. Risk-seeking refers to deliberate risk taking just for the thrill of it. Within the group of young drivers there is a sub group of drivers who are deliberate risk takers. These drivers often have personalities with a high need for sensory stimulation, which generates a search to satisfy this need. About 25-30% of young men are in this group along with 5-10% of young women. They have greater confidence in their own skills, do not think activities are so dangerous, are more often prosecuted for traffic violations and are more frequently involved in accidents (Moe & Jensen, 1993). Deliberate risk-seeking happens most often during, the night, after alcohol consumption and encouragement by friends. Women play a secondary role and are not able to stop men from entering into risk-seeking behaviour (Farrow, 1989).

2.3.4. *Self-assessment*

When asked to assess driving competence, most drivers would consider their own competence to be above average (Svenson, 1987). This also applies to young drivers. Young men in particular attach most value to 'courage and sensation' and 'vehicle control', while these skills contribute little to traffic safety. Furthermore they underestimate the traffic complications, (Moe, 1987; Spolander, 1983; Rolls et al., 1991; Forsyth, 1992b) and overestimate the possibility of correction in an the 'accident process' (Brown & Copeman, 1975). This in contrast to young females who tend to underestimate their skills and overestimate the complexity of the traffic situation (Spolander, 1983). Young men do not modify their opinions of themselves on the basis of accident statistics, but take their personal experiences as a guide (Matthews & Moran, 1986). In males, differences in self-assessment are probably associated with exposure. That is, the more one drives, the more positive self-assessment one has. Females tend to drive less, when they initially have negative selfassessment (Hattakka et al., 1992).

2.3.5. *Overload*

Novice drivers have to carry out new tasks, fast and without errors. After licensing the task complexity in traffic is the same for novice and experienced drivers. In these conditions, task demands may easily exceed the driving capacity of the novice and as a result sensory overload may occur, showing in the missing of significant information and thus making inappropriate responses. Overload can be prevented if the pace of the task can be set by the driver himself. In theory, by choice of speed, and position on the road, the driver can adapt the driving task to fit his capabilities, and the driving task is self-paced (Brown, 1982). This is probably what expert drivers actually do. The novice driver being inexperienced, is in a different class altogether. He has not acquired the necessary skills to anticipate future events and to perceive and encode the relevant signals. It is therefore, unlikely that a novice is able to drive in such a manner that driving is self-paced. Up to now, no study has scrutinized this in more detail and consequently no information is available on how the relevant (yet unknown) skills can be acquired by training.

It may be because of the problem of (cognitive) overload that novice drivers are not able to benefit from any improvement in driver training (Gregerson, 1994), and positive effects of training on accident involvement may only show two years after licensing.

2.3.6. *Exposure*

The risk associated with driving in different circumstances varies. For instance, driving on a motorway is far less risky than driving on a rural road, and driving during darkness is more risky than driving during daylight. Furthermore, the more one participates in traffic, the higher the chance of accident. Consequently the high accident risk may be only partly associated with driving behaviour itself, but more likely with the circumstances under which the young drivers choose to drive, and the number of kilometres driven.

Youngsters drive relatively frequently under the more dangerous conditions, such as, during darkness, for leisure purposes (Weissbrodt, 1989; Forsyth, 1992b; Kampen, 1989), often accompanied by friends (Van Kampen, 1989; Forsyth, 1992b). In Germany young males drive on average more kilometres than more mature men (Weissbrodt, 1989).

2.3.7. *Extra motives*

The previous section dealt with the factors that might contribute to the differences between driving behaviour of young drivers and older more experienced drivers: young drivers have a too optimistic view about their driving ability, and expose themselves to risk by driving under the more dangerous conditions, and indicated that sub groups had a risk-seeking personality. Here the analysis may stop, and it could be argued that this might be enough upon which to base effective countermeasures. However such an approach may miss important factors, e.g., it may not be possible to change certain behaviours if the driver is strongly motivated to perpetuate that behaviour, in other words if he has strong extra motives (Summala, 1987).

a. Identity:

The young adult 'uses' driving to create an image of themselves, with the intention of supplying a particular image of himself to others (Goffman, 1956). Boys, believe driving to be a natural (male) skill; they do not have to learn it, they are born with it. Driving lessons and exams are obstacles that have to be taken in style, in order to eventually be allowed to do what they were always capable of. For boys, it is important to be good 'drivers'. They believe that they should be good at controlling the vehicle, in order to give them status within the peer group (Rothe, 1987). Driving style is important for reputation and identities (Rolls et al., 1992). Other people (members of the peer group) do not actually need to be present, to motivate the driver to show the peer group valued driving style. Thus styles of driving, even when alone reflect individual identities which are to a large extent shaped by social processes (Rolls et al., 1992). Young men in particular consider traffic offences to be associated with little hazard, and so punishment is regarded as disproportionately severe by this group. Social pressure can most effectively be exerted by their peer group (Brown & Copeman, 1975).

Not only is driving style and identity closely related, but also, the way driving style is interpreted by others is influenced by the image that it creates. For example, driving errors made by young female drivers are most frequently seen as a result of incompetence whereas errors made by male drivers are seen as a result of deliberate risk-seeking (Rothe, 1987). A further example shows that young drivers are more frequently breathalysed than older drivers (Markey, 1993; Homel, 1988). While roadside surveys show that youngsters DWI less frequently than older drivers do (Markey, 1993; Matthijsen, 1990; Homel, 1988).

b. Lifestyle

At the individual level, driving style and identity are closely related and both are shaped by peer group influences. One can take this one step further and conjecture whether at group level, particular values, preferences, attitudes and behaviours (lifestyle) are associated with good or poor traffic safety records.

Studies have shown that deviant driving styles may be concentrated in small sub groups (Jonah, 1986b), such as DWI (Elliott, 1987), and that motives for DWI differ so widely that marketing techniques should be used in order to become more acquainted with the target groups in the interest of effective education (Lastovicka et al., 1987). Furthermore, within these subgroups combinations of risky traffic behaviour occur, e.g., no use of safety belts, DWI, high speed. Jonah and Dawson (1987) call this the 'risk syndrome'.

A large scale four-year longitudinal study showed that young people who became involved in motor vehicle collisions were more likely than non-crash involved youth to engage in a variety of high risk, and health compromising behaviours such as drug use, heavy drinking and other negative health behaviours (Beirness et al., 1993). Also a relationship with petty crime was also found (Maron et al., 1986; In Jessor, 1987). A German study failed to demonstrate differential accident involvement, but showed that the presence of extra driving motives was connected with particular lifestyles that differed in leisure preferences, choice of clothes and music choice (Schulze, 1990). A Swedish study managed to relate lifestyle to accident risk. It was shown that between lifestyle groups accident risk (accidents per licence holder) varied from 150% over-risk and 75% under-risk (Gregerson & Berg, 1993). This pattern may be the result of different levels of exposures between the lifestyle groups. It may be concluded that different lifestyles are associated with different accident risks, and that prevention could aim at the underlying personality and environmental factors that predispose particular groups to risk-seeking behaviour. It also implies that preventive measures do not need to be related to traffic and participation in traffic, but may focus on an entirely different field.

c. Culture

Cars and car driving have a symbolic meaning in industrialized countries. The symbolic meaning and the attitudes related to it, are handed down within families to the next generations. The way youngsters participate in traffic drive their cars, their preferences and beliefs, are also a result of their socialization (Evans, 1987; Sheppard, 1987).

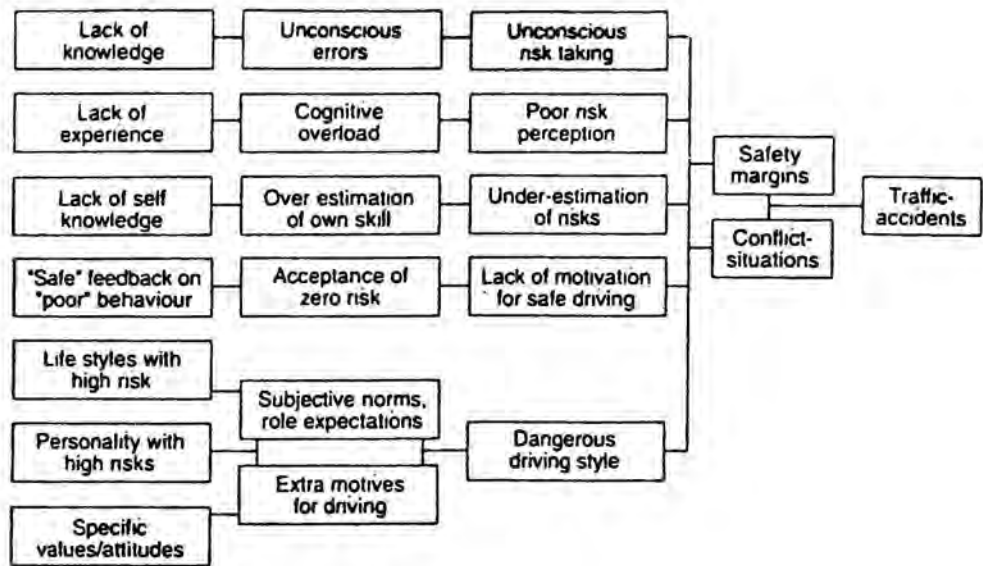
From the socialization process of children within the family it is a small step towards influences from outside the family. Evans (1987) warns against the imitation of driving behaviour shown on television.

Though, Aitkin (1989) having reviewed the literature on DWI and media portrayal, concluded that the socializing influence of TV on risk-related driving behaviour of teenagers is rather modest and mixed in directionality.

Other studies point to the negative influences that sales promotion literature of cars may have, as youngsters are especially interested in these materials (Jung & Huguenin, 1992; Pfafferot, 1984; Huguenin et al., 1985). In contrast, Hale & Glendon (1987) quote studies which show that one learns more from friends, acquaintances and neighbours recognizing hazards in the surroundings than from media messages.

In conclusion:

The contributing factors could be summarized and visualized in the following way.



(Gregerson, 1994 in press)

2.4. How may driver training contribute to young driver safety?

Within the context of driver training, the question is raised as to what role driver training has to play in teaching safe driving routines and in influencing the other contributing factors. Accident data show that the more kilometres someone drives, i.e. the greater the number of years someone participates in traffic, the less often one is involved in accidents. Apparently, driver training does not suffice in creating safe-drivers. Drivers learn to drive safely as a result of practice and experience. So what can 'experience' do, that the current driver training can't do? May driver training be able to accelerate the acquisition of skills? As we saw above, accident involvement is not only related to poor driving skills (e.g. poor hazard perception) but also factors such as, life style, and self-assessment, exposures which contribute to high accident involvement. Should driver training only focus on driving performance or should it also strive to influence these contributing factors?

2.4.1. *What do they need to learn*

Driving is a complex task that requires fast responses to fast changing situations, in which attention should be paid to numerous aspects simultaneously. Driving is not complex in terms of vehicle control, such as steering, braking, shifting gears etc. The complexity of the task is more of a cognitive nature. It implies the ability to detect and evaluate dangers and to foresee that an apparently 'normal' traffic condition, may change in seconds into a 'dangerous' one. This is a cognitive ability which needs to be developed. Moreover its application should also be more or less automatic. Otherwise, the task of driving may exceed the resources of human attention and awareness. As a result drivers may become exhausted after only a short while (Shiffrin & Schneider, 1977).

Furthermore behaviour that is not automatic is prone to errors. This proneness to errors is intensified by stress factors. Stress factors negatively affect driver performance, especially the performance of inexperienced drivers. Examples of stress factors with known effects include haste, tiredness, but also alcohol in low doses.

By experience, that is practice on the task, driving becomes more or less automatic, so that attention can be devoted to other matters. The other side of the concept of automation is that it can lead to inadequate and inappropriate behavioural routines becoming 'ingrained'. Erroneous routines will easily creep in, if feedback on the quality of the performance is low. It is not only routines which have to be trained. It is even more important to teach, to which classes of traffic situations these routines apply. Or to state it more broadly, training experiences in specific traffic situations need to be generalized to other similar traffic situations (Rothengatter, 1985). The prevention of errors in these generalisations might be of more importance to traffic safety than to prevent errors in the action routines themselves.

2.4.2. *The role of driver training*

The above illustrates the important role of feedback with the correct acquisition of new skills. Learning through experience is the adaptation of behaviour as a result of feedback.

In the daily traffic environment, feedback will not consistently 'occur' in every situation. Furthermore as a car driver, one is in a physical and social sense isolated from others. Physical isolation can lead to a driver not noticing signals from outside. Social isolation can lead to feelings of 'detachment' from the rest of the system, and this may reinforce the illusion that one is invincible (Hale & Glendon, 1987). Moreover the novice driver lacks the cognitive ability to identify and evaluate the signals that might indicate inadequate performance on his part.

This indicates that 'learning' on one's own is seriously confined due to the absence of essential feedback. It is unlikely that learners will receive appropriate feedback and this may lead to reinforcement of undesirable driving behaviour.

In contrast, in driver training, the instructor is able to provide immediate feedback and can show the pupil the correct behaviour. This teaches the correct behaviour at the initial stage of skill acquisition, before the bad

habits are formed and ingrained. In this respect it is to be expected that driver training is superior to 'practice on one's own'. Furthermore, the instructor may play an important role in structuring the task of the learner, so that his task load is not so great that it makes him unable to assimilate and process the feedback. He may organize his instruction, so that skill acquisition is built up hierarchically and in modular fashion. First the basic skills must be learnt, after which more complex skills can be trained. The learning process should therefore not simply aim to having the novice imitate the expert's example. He should learn in a stepwise progress, with a set strategy per phase adapted to the level of skill acquired.

Additionally, the instructor may be an influential model (Bandura, 1977) for the transmission of 'safety related behaviour and attitudes'. The small number of studies which relate to the learning of safe behaviour demonstrate that the instructors of security devices represents the most important factor in explaining the difference between groups of students with respect to the use of security devices (Hale & Glendon, 1987). There is no known study regarding such effects relevant to the behaviour of drivers. It is recommended that we study the effects of 'model behaviour' on the behaviour of young drivers. An obvious study in this context could be the 'driving behaviour' of driving instructors.

2.4.3. *Efficacy of driver training: current state of affairs*

Driver training courses have developed on an ad hoc basis. That is to say, no systematic studies have been carried out in order to investigate which components of the driver training course are effective, and contribute to the safety objective. From the safety objective, safe driving should be the criterion variable for efficacy (a). If it is taken that the driving-test tests for safe driving ability, then pass rates are also a criterion (b). However there are some doubts on the validity of the driving-test as a predictor of safe driving behaviour (c).

a. Accidents

In a comparison between countries which offer a different, or even no driver training course, no differences are noted with regard to accident rates (Leutzbach et al., 1988). Gregerson (1994) states that no differences are shown between systems that have mandatory driving schools, and those which don't.

A limited number of aspects of the driver training course were evaluated. Simomnet et al. (1982) compared the results of an intensive training method with those of a less intensive method and found no difference in accident involvement. Lewin (1982) used 'mental imaging'. This approach required students to imagine hazardous situations after the lesson. This produced only minor positive effect on involvement in accidents. Schuster (1978) evaluated a cognitive-avoidance lesson and found a difference in accident involvement in the first year after completing the course.

Veling & Buist (1984) considered the efficacy of the traffic practice area. They did not find any difference with the control group. These studies are examples of studies which should to be carried out to arrive at a functional training system.

Gregerson (1994) demonstrated that when driving school education involved instructor commentary, the integration of driving school education and private practice, plus the introduction of a series of training tasks

where the learner could experience his limitations. This did have a positive effect on accidents in the second year of licensing, whereas no difference with a control group was observed in the first year. This might be due to the learner's limited capacity to benefit from changes during the first of the two years.

Hale & Glendon (1987) point out that training or education can have a negative effect on the prevention of accidents. Raymond & Tatum (1977) demonstrated this with motorcycle riders. Similar effects were found in a Norwegian evaluation of the second phase of the Norwegian driver education. In this second phase young drivers were taught how to control a skid and how to drive in the dark. The results indicated that this group was more often involved in skid accidents on slippery roads, had more accidents in the dark, and had more accidents in general than a control group. The negative effect only applied to male drivers.

"Drivers on a dark-driving course in phase 2 however, had significantly fewer accidents in the dark than drivers without this course. This positive effect only appears in the first couple of years after the course (...)"

"The different effects of the dark driving and the slippery road surface driving course are probably due to the different aims of the courses and the way the courses were carried out." (Glad, 1988)

A recently introduced skid course in Finland (although carefully designed not to result in high self confidence) showed a negative results on attitudes and accident rates in the 18-20 age group, but a positive effect on the 21-50 year olds (Keskinen et al., 1992).

The advanced driving course in Switzerland (Siegrist & Ramseier, 1992) resulted in showing that drivers who had participated in the course did not have fewer accidents than drivers of a control group. This was the case for all age groups and also for both sexes. The authors conclude:

"A possible explanation is connected with the concept of the course concerned, which puts more emphasis on driving skills than on avoiding danger."

b. Pass rates

Forsyth (1992a) studied factors which lead to better performance in a driving test. She concluded that those who have had some professional instruction are at a considerable advantage over those who have not. It also showed that candidates should have as much professional instruction as they feel they need. In addition, those candidates who had practised with friends or relations had a higher pass rate and were less likely to make errors related to the use of vehicle controls.

c. The validity of driving tests

"The purpose of the performance based test is to assess the candidate's competency by requiring that he/she demonstrate a minimal operating standard. While various types of tests are in use, a test is typically intended to measure one or all of three skills judged critical to the safe operation of a motor vehicle and safe driving practices, i.e., the

perceptual, cognitive, and vehicle control skills of the licence candidates." (Mayhew & Simpson, 1990)

According to Macdonald (1987) these tests primarily assess the vehicle control and to a lesser extent perceptual and cognitive skills. The literature shows conflicting findings and investigators generally concluded that the road test lacked sufficient predictive validity to support its use as a screening device to determining who will be permitted to drive.

2.5. Where may improvements be found?

It may be concluded that driver training has a role to play, but that the system is not developed to its full potential. In this paragraph particular elements are described that could contribute to driver training to fulfil that potential.

2.5.1. Vary licensing age?

In most countries in Europe the licensing age is eighteen, with the exception of Great Britain where a learners permit is given at the age of seventeen. A further exception is France where accompanied driving is allowed from the age of sixteen. Between the states of Australia, New Zealand and the US, licensing ages vary, ranging from fifteen years to eighteen yrs. According to Drummond (1989) the initial choice of licensing age is a historical artifact. However, according to Drummond:

"It is age, that plays a central role in novice driver safety, in terms of both absolute safety outcomes and potential strategies for improving novice driver safety. Given its centrality, there have been relatively few studies which have addressed the issue directly."

There have been two levels of results, in answering the question: is there an optimal licensing age? Some results indicate that drivers aged sixteen-eighteen do not have a worse accident record than the eighteen year olds (Cameron, 1972) and those who commenced driving at the age of sixteen-seventeen had most accidents at eighteen years, but less than the 18 year olds who commenced driving at eighteen (Pelz & Schuman, 1971). In a Canadian accident study (Laberge-Nadeau et al., 1992) demonstrated that experience does not lead to the same effects in male and females and that driving experience of one year or more even may have a negative effect. Young male drivers with at least one year of experience have higher accident rates than the ones with less than one year of experience. This difference however may be the result of differences in mileage rather than differences in skills and attitudes. The authors postulate that in males only after 2,5 years of driving does experience reduce the accident rates (that is accidents per thousand licence holders). A French study (Simomnet, 1985) came to similar conclusions, estimating that it is necessary to drive 3,000 kilometres before experience becomes profitable.

The above mentioned studies have used rates (accidents/kilometres or accidents/licence holder) to compute the effects of licensing age. Other authors have argued that in evaluating the effect of licensing age on accident only the absolute number of accidents are valid measures. They

argue that simply because of the fact that more youngsters will drive, licensing at sixteen to seventeen years of age will lead to higher absolute numbers of accidents (e.g. Henderson, 1972). Toomath & White (1982) taking both exposure and accident frequency into account, reported a nett benefit of a lower licensing age, on absolute accidents. However a similar accident study could not establish such a benefit (Drummond, 1986). In the latter study it was concluded that 'the additional accidents resulting from allowing persons to drive below the age of eighteen years were not offset by their lower accident rates at ages eighteen to twenty years. Also a Finish study on accident involvement, shows that older novice drivers could drive the same amount of mileage with fewer accidents than younger drivers, which was especially true for males (Keskinen et al., 1992).

The reported studies are primarily from Canada, United States, New Zealand and Australia. So far, no European study has specifically addressed this question of licensing age. This may be partly due to the fact that within Europe there is less variation in licensing age, and also the licensing age of eighteen years is rather high from a world wide perspective. Nevertheless, recent developments such as the introduction of the accompanied driving scheme in France which allows driving at the age of sixteen years, calls for a European discussion regarding an optimum licensing age. A European discussion might be quite different in content. In Australia and New Zealand the wish to lower the driving age is the result of a need to separate the legal drinking and driving ages. Such a need is not present in Europe as in none of the European countries are laws on legal drinking ages in force.

2.5.2. *Training cognitive skills*

a. Knowledge and theory

In most countries, in order to get licensed, the candidate should possess an adequate knowledge of the traffic code. It has been shown that there is a positive relationship between the knowledge drivers have about the traffic code and the violations they make against the traffic code in real traffic (Veling, 1980). However, knowledge regarding the traffic code may be a necessary requirement in order to facilitate safe behaviour, it is by no means the only criterion. Novice drivers should know and understand that safe behaviour is not guaranteed by just applying the traffic rules, and should also understand that safe behaviour may imply a temporary deviation from the formal traffic rules e.g.:

- the legal speed limit is not always the safe speed limit;
- formal rules with respect to right of way are not always in line with informal rules at specific location.

Furthermore in order for theoretical knowledge to have a positive safety effect, the information should be structured in such a way that the candidate:

- understands to which traffic situations the information is applicable;
- is able to recognize and identify those situations correctly;
- his actions are the correct consequences of the applied rule;
- he is sufficiently skilled to perform the actions (see also Noordzij, 1987).

b. Hazard perception

McKenna & Crick (1992) argue that novice drivers have an under-developed mental model, tend not to anticipate future events, and fail to respond to those events in good time. Novice drivers acquire this mental model by experience.

However there are indications that this is not an efficient way of learning. In traffic, accidents and 'near accidents' are sources with which information about hazard can be obtained. There are indications that these hardly affect the learning process. Behaviour is not altered (Rothe, 1987) regarding traffic accidents. Novices believed they did not make an error and the other party's behaviour was unpredictable. Furthermore becoming involved in an accident without serious consequences may give the person the impression that 'it isn't so bad after all'. The same applies with respect to 'near accidents'. The fortunate outcome of a risky activity can lead to the decision that 'there's no harm in it', so that the risky behaviour is not altered.

McKenna & Crick (1992) postulated that a training programme that concentrated on forcing the novices to develop a more sophisticated mental model by engaging them on anticipation tasks could have positive effects. They developed a training program based on the presentation of sequences of road scenes and asked novices to make predictions about what would happen next. This course was evaluated and the results showed that novice driver who had taken the hazard perception course performed better on a hazard perception test than the control group, which had undergone advanced on-the-road-training. This result indicates that hazard perception skills can be trained in class, and that in-car training is not a necessary requirement.

This study has only analyzed the differences in test performance. A similar Swiss study on the effect of eight hours of training on traffic sense (which included hazard perception) failed to show a positive effect on hazard perception and actual driving performance. However, there was a positive effect on 'attitude'. Those candidates who had followed the training did have a lesser tendency to over-rate their driving abilities, than candidates of a control group (Bachly-Bietry, 1990).

In Europe, no country has a standard test of cognitive skills, which are believed to be a prerequisite of safe driving. Most often, tests are limited to the knowledge of traffic rules. Some countries, are in the process of developing a test of cognitive skills. Switzerland (Bachly-Bietry, 1991) is developing a theory test in order to assess how well the goals of traffic sense instruction have been reached, the goals are as follows:

- expansion of danger cognition;
- training of the ability to perceive and process information;
- the influence of attitudes relevant to safety.

In Victoria (Australia) a new test was developed and introduced on 1 August, 1992. Rather than assessing motor skills and intellectual knowledge of road (law?) and road craft, the new test aims to assess those elements of cognitive functioning which affect the driving task. This test is known as the 'Hazard Perception Test'.

This test is proposed as a mass screening test for all Victoria's drivers wishing to proceed from a Probationary to a full licence. The test would be taken most often by novice drivers between the ages of 20 and 21 after

two to three years of unsupervised driving. Test items have been developed on the basis of the analysis of crashes. Test items are presented as real time moving images on computer screens. The candidate has to assess dangerous situations which are shown on film.

A difference between the different versions of hazard perception tests as described, is the way the candidate has to respond. In the Australian and Swiss tests the candidate has to detect and assess a hazard, while in the McKenna test the candidate has to react as fast as possible on detecting a hazard. So the latter is emphasizing hazard-perception latency. In a review of research on hazard-perception Elander et al. (1993) concluded:

"The evidence points to slower detection of hazards as one source of individual differences in crash frequency but not simply as a result of slower reactions in general (...)."

Hazard-perception latency appears to play an important role, and this may be attributable to generalized abilities to identify visual targets in a complex background and with switching attention rapidly. With regard to hazard assessment the authors conclude:

"There is no evidence to date about whether the perceived level of hazardousness of situations is associated with crash frequency. If younger drivers perceive speeding and tailgating as less risky than older drivers, they would be expected to perform those transgressions more frequently and put themselves at greater risk."

2.5.3. Training of self-assessment

According to Brown & Groeger (1988) hazard perception is not only affected by the identification of potential hazards in the environment, but also by the self-perceived ability of the driver to handle it. In this view:

"Risk perception is the detection by drivers of any shortfall in their ability to avoid realizing the potential of the immediate task and environmental hazards. Safe driving is the monitoring and elimination of this discrepancy."

Young/novice drivers tend to overestimate their driving skills. No information is available on how novice drivers learn to assess their ability. However, formal instruction may have an important role to play in the acquisition of accurate self-assessment skills. There is evidence that it may be feasible to influence self-assessment by training (Brown & Groeger, 1988), and that skill oriented training in comparison to training oriented towards insight into own limitations, produces overestimations of ability without a rise in actual ability. A similar result was obtained in a course in which the young drivers did experience their limitations in controlling their vehicle in certain emergencies (Wittink & Twisk 1990; Vissers, 1990).

Although one might be able to train this, up to now we did not find any studies that has investigated how 'self-assessment' can be tested.

2.5.4. *Attitudes and individual needs*

A neglected area within the driving course is learning activities aimed at attitudes, motivations and emotions, which all relate to the traffic participation of the young driver. To date, recommendations have been given on how to clarify this field (Varvick, 1989), but there are few concrete programmes known which attempt to realise an effective implementation. Varvick even attributes the limited efficacy to the insufficient attention devoted to this area. Veling & Van Lierde (1987; 1989) therefore argue for a cursory approach in the driver training curriculum. As for other courses, theory and practical lessons should be offered as a systematic and integrated package. Within such a formal system, the motivation of the learner driver can be guided.

It is shown that particular subgroup of drivers are more at risk than others, as a result of different skills, personalities and opinions. In driver training a differentiation should be made according to the needs of the candidates. The instructor then, should be able to differentiate between candidates and select the right training scheme for each of the candidates (Glad, Personal communication).

2.6. **The inherent limitations of driver training: how these may be overcome**

A driver training course is subject to inherent limitations. For example, a limitation in time. The skill must be acquired in a restricted number of lessons. Certainly after a limited period of lessons taken, one may assume that 'learning' as a process does not stop. The novice learns new behaviour and so modifies behaviour (De Velde, 1988; Harsenhorst & Lourens, 1988). Particularly higher order skills, such as taking decisions, develop slowly and require much more practice. Aside from limitations in time, a limitation in circumstances is also applicable. Not all critical traffic situations present themselves during the lesson time and so are learnt in practice.

After the driving exam, learning may stop in a 'formal' sense, but informal learning continues. Some studies have addressed the question of how the novice driver responds to this period himself with respect to attitude development, skill developments, and developments in mobility. The results show that:

- the driving style is changing considerably over time: driving speed goes up and errors in driving routines develop (De Velde Harsenhorst & Lourens, 1988, 1989; Forsyth, 1992b; Rolls et al., 1991);
- Driving performance falls below test standards after qualification (Vissers, 1990; Forsyth, 1992b; Rolls et al., 1991).

As learning continuous after licensing, with novice drivers not having reached adequate performance yet, the driving task should be structured such that overload is prevented. In other words a safe learning environment should be created. In this respect there is great potential in the French Accompanied Driving Scheme in which after a formal driving instruction period, a driver is only allowed to drive if he is accompanied by an experienced driver (Chevillot, 1988; Belloc & Ivaldi, 1991). Also, elements of a graduated driving licence in which a driver is allowed to drive under more complex conditions has been reported to be effective

(Hagge & Marsh, 1986; Preusser et al., 1984). The complexity of the conditions is regulated by putting restrictions on the novice drivers. Novice drivers are not allowed to drink any alcohol when driving (a evaluation study did not demonstrate a positive effect (Haque & Cameron, 1987)), they are not allowed to carry passengers, and not allowed to drive during the weekend nights. When the driver acquires more experience, the restrictions are gradually lifted. Furthermore, error free routines should be protected, at the post-exam stage. This may be achieved by introducing a second test after a fixed driving period or by accompanied driving in which the novice is continuously provided with feedback on his performance. Last but not least a safety-oriented attitude should be nurtured in the novice driver, and repeat offenders should be penalized, e.g. by implementing a strict point demerit system for novice drivers (Haque, 1987; Tannahil, 1986; Meewes and Weissbrod, 1992; Scotchmer, 1984).

2.7. Conclusion

Driving performance of young/novice drivers falls short in many aspects, such as adequate speed choice, visual search and safety margins. These limitations may account for the high accident risk of young/novice drivers. There are many factors that are contributing to inadequate performance on the one hand and accident risk on the other hand. These factors are associated with inexperience, immaturity, age, exposure and extra motives and range from technical driving deficits to the role of youth in western society and the value of car driving.

Despite the fact that studies have failed to show its effectiveness, driver training has an important role to play, and improvements may be found in the field of the training of cognitive skills, the emotional meaning of driving and the social responsibility of youngsters.

However the scope of the problem also indicates that simple solutions will not suffice and that only improving driver training will not be sufficient. In addition to the improved driver training, in the post-exam period safe driving circumstances should be created in order to enable to young/novice drivers to gain experience in a safe manner and to stimulate a safety-oriented attitude.

3. Literature

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