Experiences from countermeasures, including the role of driver instruction and training

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1. Introduction

This presentation aims to discuss how driver training may contribute to a greater safety of young and novice drivers. It is structured as follows:
1. Is there an optimal driving age?
2. Then the role of driver training, its efficacy, and scope for improvement are discussed.
3. The presentation is concluded with a discussion on how the inherent limitations can be overcome.

2. Raise or lower the licensing age!

In most countries in Europe licensing age is 18, with the exception of Great Brittain were a learners permit is given at the age of 17, and of France in which accompanied driving is allowed from the age of 16. Also in states of Australia, New Zealand and the United States, licensing ages vary, ranging from 15 yrs to 18 yrs. According to Drummond (1989) the initial choice of licensing age is a historical artifact. However, "Age 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 lines of results in answering the question: Is there an optimal licensing age? Some results indicate that drivers aged 16-18 do not have a worse accident record than the 18 year olds (Cameron, 1972) and that those who commenced driving at the age of 16-17 had most accidents at 18, but less than the 18 year olds who commenced driving at 18 (Pelz & Schuman, 1971). In an Canadian accident study (Laberge-Nadeau et al., 1992) it was demonstrated that experience does not lead to the same effects in male and females, and that driving experience of 1 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 postulated that in males only after 2,5 years driving experience reduces 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 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 16-17 will lead to higher absolute numbers of accidents (e.g. Henderson, 1972). Toomath and 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 a benifit (Drummond, 1986). In the latter study it was concluded that "the additional accidents resulting from allowing persons to drive below age 18 were not offset by their lower accident rates at ages 18-20."

The reported studies are from Canada, United States, New Zealand and Australia. As known so far, no European study has addressed this question. This may be partly due to the fact that within Europe there is less variation is licensing age, and also the licensing age of 18 is rather high in comparison to above mentioned countries. Nevertheless, recent developments such as the introduction of the accompanied driving scheme in France which allows driving at the age of 16, calls for a European discussion on 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 country laws on legal drinking ages are in force.

The studies on accident involvement as a function of licensing age are not conclusive. "In summary, the choice of licensing age is a crucial determinant of the public health outcomes of young driver driving. However, licensing age is often viewed as a given in any jurisdiction rather than a variable with can be manipulated to achieve optimal safety outcomes (Drummond, 1989, p.10)".

3. How may driver training contribute to young driver safety

The question is 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 but drivers learn to drive safely per kilometre as a result of practice c.q. experience. So what can 'experience' do what the current driver training can't do, and may driver training be able to accelerate the acquisition of cognitive and perceptual motor skills? As we saw, accident involvement is not only related to poor driving skills (e.g. poor hazard perception), but also factors as life style, self-assessment, exposure, contribute to high accident involvement. Should driver training only focus on driving performance or also influence these contributing factors?

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. The complexity is of a more 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 cognitive ability needs to be devel-oped. Moreover, its application should also be more or less automatic (De Velde Harsenhorst & Lourens, 1990; Milech et al., 1989). Otherwise, the task of driving may exceed the resources of human attention and awareness. As a result drivers will 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 automations is that it can lead to inadequate behavioural routines becoming 'ingrained'. Erroneous routines will easily creep in, if feedback on the quality of the performance is low (De Velde Harsenhorst & Lourens, 1990). Not only relative simple action routines 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). To prevent errors in these generalizations might be of more importance to traffic safety than to prevent errors in the action routines themselves.

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 an 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 is lacking 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 absence of essential feedback. It is unlikely that learner 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. It 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 structure 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 study known about such effects relevant to the behaviour of drivers. It is recommended to study the effects of 'model behaviour' on the behaviour of young drivers.

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.

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).
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 involvement in accidents. Lewin (1982) used 'mental imaging'. This required students to imagine hazardous situations after the lesson, which resulted in a 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 completion of the course. Veling & Buist (1984) considered the efficacy of the traffic practice area. They did not find any difference with the control group.

Hale (1987) points out that training or education can have a negative effect on the prevention of accidents. Raymond & Tatum (1977) demonstrate this with motorbike 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 indicate 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 applies to male drivers. "Drivers with a dark driving course in phase 2 however had significant 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 surface driving course are probably due to the different aims of the courses and the way the courses were carried out". (Glad, 1988).
Similar effects were obtained with respect to the advanced driving course in Switzerland (Siegrist & Ramseier, 1992). 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 friend or relations had a higher pass rate and were less likely to make errors related to the use of vehicle controls.

C. *How valid are driving tests*
"The purpose of the performance based test is to assess the candidates competency by requiring that he/she demonstrate minimal operating standards. 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, the perceptual,

cognitive and vehicle control skills of the licence candidates" (Mayhew & Simpson, 1990). In an on-the-road test according to McDonald (1987) perceptual and cognitive skills are not readily gauged in on road-tests, while a good test can measure reasonably well a driver's vehicle control skills, and these are a necessary prerequisite for safe driving. That is, bad performance in the driving licence test due to inadequately developed vehicle control skill is associated with poor performance 'in the real world' (McDonald, 1987; cited in Mayhew & Simpson, 1990).
Evaluation of the effectiveness of skill test have correlated test scores with subsequent collision and violation records. As observed by McDonald (1987) as well as McPherson & McKnight (1981) in a review of these studies, the literature shows conflicting findings and investigators generally conclude that the road test lacked sufficient predictive validity to support their use as a screening device in determining who will be permitted to drive.

4. 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.

Cognitive skills

A. *Knowledge and theory*
In most countries, in order to get licenced, 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 could and the violations they make against the traffic code in real traffic (Veling, 1989). However, knowledge of the traffic code may be a necessary requirement in order to facilitate safe behaviour, it is by no means the only one. Novice drivers should also know and understand that safe behaviour is not guaranteed by just applying the traffic rules, and understand that safe behaviour may imply the deviation of 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 locations.
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 Twisk, 1993).

In general, the impression was given that driver education places emphasis on knowledge of the traffic code, and little emphasis on knowledge concerning situations which are potentially hazardous. This discrepancy has to be corrected through practical experience. Research should be directed to a greater extent to the question how should information be structured and presented in order to facilitate safe driving.

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 even these hardly affect the learning process, behaviour is not altered (Rothe, 1987), as drivers believe they did not make a 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 and Crick 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 programme based on the presentation of sequences of road scenes and asking 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 8 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 (Bachli-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 (Bachli-Bietry, 1991) is developing a theory test in order to assess how well the goals of traffic sense instruction have been reached, the goals being:
- 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 low 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" (Hull, 1992).
This test is proposed as a mass screening test for all Victorian 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 test 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 an hazard. So the latter is emphasizing hazard-perception latency. In

a review of research on hazard-perception Elander at al (1993) concluded "The evidence point 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 to switch attention rapidly. With respect 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".

Self-assessment

According to Brown and 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 immediate task and environmental hazards. Safe driving is the monitoring and elimination of this discrepancy" (p. 588).

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). 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 it, up to now we did not find any studies that has investigated how 'self-assessment' can be tested.

Attitudes

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.

5. 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 taking lessons, one may assume that 'learning' as a process does not stop. The novice learns new behaviour and modifies behaviour (De Velde Harsenhorst & Lourens, 1988). Particularly higher order skills, such as taking decisions, develop slowly and require much 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 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, and novice drivers have not 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. But, also a graduated driving licence in which a driver is allowed to drive under gradually more complex conditions has been reported to be effective. 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, not allowed to carry passengers, 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, also in 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.

6. Conclusions

- Licensing age is too much taken for granted, while it can be an effective tool in reducing young driver accident involvement.
- The effectiveness of current practices driver instruction still needs to be confirmed.
- Improvements can be found in the domain of cognitive skills and attitudes.
- Driver training in itself will not suffice in lowering the accident risk of young drivers.
Combinations of measures is necessarily, especially the introduction of a provisional driver licence.

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