Project TRAINER: Major findings relating to driving simulators

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This paper presents the results of the project TRAINER by describing the survey of existing training methodologies and driver instructor needs, all in the area of driving simulators. The main approach of the project is described.
Trainer developed two types of cost-effective driving simulators (a static and a semi-dynamic one) for driving school, able to support the driver in understanding the basic control actions, learn to drive in an economic and ecological way, acquire the right visual cues patterns and to provide him/her some didactic feedback on situation with enhanced risk (i.e. low visibility, friction due to rain, fog or snow, obstacle avoidance manoeuvres, including interaction with vulnerable road users and animals, simulation of drunk driving etc). The semi-dynamic one supports on enhanced visual field and simulates also lateral forces effect to make its use more realistic. Major findings of the project will also be traced.

The TRAINER project intended to enlarge novice drivers´ skills by improving their training using novel methodologies and tools, and aimed to contribute to technological progress by providing high quality software tools. The main goal of the TRAINER project was to develop a new cost-effective pan-European driver training methodology that is constituted on computer based interactive multimedia and simulator technology. In another words, TRAINER intended to develop a new, improved training curriculum for driver trainees, using modern training tools and innovative educational scenarios, which intend to enhance risk awareness and permit a safe use of on-board driver assistance systems.
CDV was additionally invited to take a part within this project, but without provision finance from EU. CDV conducted questionnaire for companies developing or using driving simulators.

TRAINER project has developed an interactive, multimedia training tool and two modules of a driving simulator (static and semi-dynamic one), paying attention to their cost-effectiveness. To facilitate to take-up of the project results, TRAINER provided practice guidelines for the deployment of the proposed curriculum and training tools. The project is therefore supporting traffic safety, by promoting the “Road Safety in the EU” policy and the “Common driver training and licensing procedures in the EU” policy.
The focus was put on driving and handling the vehicle itself, but also on the improvement of risk awareness of drivers. For this purpose simulation tools were developed and a number of scenarios for application in the simulators were implemented. These scenarios were based on accident statistics and an extensive literature review. They have been structured in accordance with the four hierarchical levels of the GDE-matrix (Hatakka, Keskinen, Gregersen and Glad, 2002).
The GADGET matrix is based on the assumption that the driving task may be described as a hierarchy. The idea of the hierarchical approach is that abilities and preconditions in a higher level influence the demand and preconditions on a lower level. The hierarchy is developed by Keskinen (1996) and shows many similarities with the Michon hierarchy. The most important difference is the addition of a fourth level relating to personal preconditions and ambitions in

life in general, which have shown to be of great importance for driving and road safety. The following four levels are described by Keskinen and were later also applied in the EU project GADGET.
The purpose of this matrix is to provide a theoretical framework for defining the competences of a safe driver and the goals of driver education and training. The matrix includes three hierarchical levels – the strategic, tactical and operational level, but a fourth level is also added concerning "goals for life and skills for living. " The levels have been also divided into three dimensions concerning knowledge/skill, risk increasing factors and self-assessment. The highest level refers to personal motives and tendencies in a broader perspective. This level is based on knowledge that lifestyle, social background, gender, age and other individual preconditions have an influence on attitudes, driving behaviour and accident involvement.
The TRAINER project has developed a low cost and enhanced reliability stationary driving simulator to support driver training and assessment in manoeuvring and control tasks for practical driver training in driving schools, based to the maximum extent on existing elements from the market, and a mean cost and high performance semi-dynamic driving simulator to support specific needs of selected driver cohorts (novice drivers with enhanced knowledge problems, re-training of drivers in high-risk groups), extending the previous one.

Control task
Training the basic vehicle handling skills is a natural feature of driver training. But in order to enable trainees to cope with new technical devices, like ACC or ABS, it is necessary to implement lessons that take these new developments into account. The simulator is a useful device for training the very first steps of vehicle handling. The advantages are not only safety related – trainees could learn these skills without endangering themselves or other road users (like learning with a real car in a fenced off driving-instruction range), but also **ecological related: fuel is not consumed; the use of a simulator is absolutely exhaust-free.**
Trainees should learn to know or better experience the risk increasing aspects of the tasks, especially underestimation of speed. To enable trainees to evaluate their skills in a realistic way they should have the possibility to compare their estimates with the real outcome. Especially the connection between reaction, braking and total stopping distance should be understood.

Manoeuvring tasks
Insufficient skills and incomplete automation of manoeuvring skills lead to a greater involvement of novice drivers in accidents. Furthermore, research shows that novice drivers (and for some tasks drivers in general) **lack essential perceptual skills**. On the one hand they do not use peripheral vision and on the other hand they underestimate the time needed for many manoeuvring tasks, like overtaking, merging, lane changing, reaching an intersection, stopping, turning off. They have problems to **estimate the behaviour of other road users as well**, i.e. how much time these drivers need to perform the tasks mentioned above. When an unexpected and unusual situation does occur, they do not know how to react adequately. To train these cognitive skills it is suggested to use filmed clips, videos or digital media, where the trainee has to detect certain cues, to predict, what could happen and what he/she would do. Trainees should also be given comprehensive feedback whether the task is an estimate or a performance prediction. It is also possible to train this with simulators. The main **advantages of simulators** compared with real cars are that trainees can experience **scenarios, which are too dangerous to create on the road**, and that trainees can train cognitive skills without fully automated manoeuvring skills. Recent developments in software make it possible that drivers in a simulator could **behave in very realistic way**. Automatic Traffic Generation and Autonomous Driver models reproduce the circumstances in real traffic, and enable the users

to repeat and therefore train certain tasks in changing environments, with varying risk, and different road users, with variable behaviour. With these devices it is possible to train anticipating skills, like risk or hazard perception, which are highlighted by recent research as very important for safe driving. Through the combination of opportunity to practice and obtaining feedback on those skills trainees can come to their own understandings of how cues in traffic and outcome are related. Moreover, trainees can experience the results of their own risky choices. However a risky driving behaviour results not only from poor perception, but also from overestimation of own skills. In order to increase driving skills without increasing the confidence in these skills the manoeuvring component should not be overemphasised. It is better to use more demonstrations and exercises in which novice drivers fail in order to develop a realistic self-evaluation of their capabilities.

Strategic tasks

Demonstrations should also be used to convince trainees on following safety instructions (e.g. use of seat belt). Trainees should know or better experience (in a simulator) which harmful influences on driving behaviour factors like stress and mood could have and how drivers can cope with these risk increasing aspects. Techniques like mental practice and group decision could influence the behaviour of novice drivers due to the fact that trainees are forced to make known their own attitudes and reflect them. So trainees are aware of their own conditions and can discuss the influence of their and other road-users´ conditions on the interactive task of driving. They should know that certain motives for driving, like competing or showing off have serious effects on driving performance.

Behavioural aspects

Knowing the relations between driving style on the one hand and personal tendencies, social pressure and lifestyle on the other hand, could enhance the trainees´ awareness of their higher risk in accident involvement. Feedback during training, self-assessment tools like questionnaires and scales, discussions with other youngsters about personal experiences and evaluations made by instructors or examiners seem to be appropriate educational methods.

It should be beared in mind that every training of manoeuvring skills (and probably this is as well relevant for cognitive skills like e.g. hazard perception) may result in overconfidence of young drivers. Therefore, training safe driving strategies can only be successful, if driver training covers the whole range of contents, and consequently it should also include motivational and self-evaluative aspects.

In conclusion, TRAINER project highlights the need for a further research on training issues regarding several other categories of drivers, such as professional drivers (truck drivers, bus drivers, dangerous goods vehicles´ drivers, emergency vehicles´ drivers, etc.). The Improvement of their training is a very important issue, since, very often, the integrity of many human lives depends on them or is directly influenced by them. Thus, the improvement of training courses may clearly offer some potential solutions to one of the most intense und unwelcome social phenomena, which is the unjustified loss of human life due to accidents caused by improper driving behaviour.

The final results of TRAINER, besides the exploitable products, are the guidelines and recommendations generated. These contribute to the realization of the fact that a constructive review of the driver training system should take place in order to improve novice drivers´ driving behaviour, risk awareness and generally the normal introduction of them in the real traffic.

The guidelines and recommendations generated by TRAINER focus on the way trainers should carry out the training procedure and the main training issues that they should give attention to, during the training, on the way that trainers should take advantage of the TRAINER tools and integrate them with traditional training, the way a training curriculum should be structured and of which content should be consist, to be sufficient for training, and also on he advantages and disadvantages of **using new technology driver training procedures, like simulators.**
In general, TRAINER has recommended a series of actions towards research, regarding training and general driver support objectives in order to implement TRAINER project's main purpose, which is to develop a globally accepted system for driver training and assessment using interactive valuation tools and reliable methodologies.

Conclusions

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Driver state, for example fatigue, alcohol related scenarios are not adequate for training in the simulator, as young drivers are not convinced by demos, unless they experience them. There was an experiment in USA, where novice drivers were allowed to drink one glass of alcohol, under medical supervision. Then they drove a simulator and were exposed to traffic risks. It seems that this experience influenced them, as during a year of driving after it, they did not combine driving and drinking (reported through self evaluation and absence of accident data).

The implication for TRAINER would be to present theoretical data on driver´s state effect using the multimedia tool and to consider in the simulators training curricula drink and drive session.

All driving simulators, even the most advanced research ones, **are good for training on how to avoid dangerous situations but not on how to handle them**. Simulator technical limitations in low speed manoeuvring would not allow such tools to be used for teaching for example obstacle avoidance manoeuvres.
The implication for TRAINER is to avoid implementing emergency negotiation scenarios and hypothesise that an accident has occurred in any case that the driver is involved in a high-risk situation.
In USA driving simulators are used also to recognise the driver´s driving style and even to influence/change it. Algorithms on driving style extraction from combined simulator and real car data exist but are not commercially available.

The simulator should not be used for a complete driver training but only for specific tasks, in order to avoid learning and automising skills in an artificial environment.
The implication for TRAINER is to devise specific simulator scenarios and integrate them into the training curricula, combining them with actual car driving in between.

Car control would be interesting to be exercised also using the simulator, especially in high traffic density (where actual driving, without good control skills, could pause accident danger or influence the traffic flow).
During actual training, some trainees go too slowly and avoid overtaking. That is even more evident during their on-road evaluation. **The simulator should allow them to expose themselves in higher speeds.**
The current price for using a simulator in a driving school is around the standard training hour. The ratio of one instructor per 8-12 trainees had been recommended both for the multimedia tool and the simulator and an organised training centre approach is suggested. Emphasis should be put on the developed database for automatic storage of trainee data, to allow trainers to evaluate trainees behaviour after the training session automatically and thus support one trainer in instructing more than one trainees simultaneously.