Potentials and Risks of New Technologies in the Training of young drivers

Christine Turetschek
FACTUM
Danhausergasse 6/4
1040 Vienna
christine.turetschek@factum.at

ABSTRACT

In most countries young drivers are the group of road users with the most accidents. Reasons for this are their lack of experience on the one hand but also the typical characteristics because of their youth; they tend to drive more risky for instance. Mostly, accidents happen because of badly adapted speed, mistakes in yielding and distance keeping, in connection with turning, etc.
It seems comprehensible that different ITS systems can help young drivers to show a better driving performance and to reduce their accident risk. In this context definitely ADAS (Advanced Driver Assistance Systems) like collision warning, ISA or lateral control systems have to be mentioned. Maybe also IVIS like navigation systems or travel- and traffic-information-services can support novice drivers, since they can provide them with information to avoid difficult situations. Especially for this kind of systems but also for ADAS we must not forget about problems which may arise in the driving performance of novice drivers because of distraction or overload. Additionally we have to bear in mind that all drivers are human beings who “function” under similar psychological rules; e.g., drivers tend to delegate their responsibility to the system, to misjudge the objective risk in different situations, and so on.
Therefore we have to take a look on both sides of the coin; the positive effects of new technologies but also the negative ones.

INTRODUCTION

Novice drivers are the group with the highest accident risk. The risk to get involved in an accident is for instance in Austria three times higher than for the whole population (KfV, 2004). Alan E. Drummond (1989) could show in his literature review, that in most Western industrial countries novice drivers between 18 and 20 years are over represented in accidents. Peden et al. (2002) established road accidents as the main fatality reasons of adolescents and young adults (15 to 29 years old) in high income countries. Males have a higher fatality rate than females.

According to the Federal Statistical Office in Germany (2005) the main causes of accidents are badly adapted speed (27%), followed by mistakes in giving right of way (12%), mistakes in distance keeping (12%) and problems with turning (11%). Engström et al. (2003) mentioned single, loss-of-control and left turn accidents where young drivers are over-represented; but also overtaking and negotiating bends can be found in literature as typical accident reasons for this group of drivers (ROSPA, 2002). Novice drivers are more often involved in accidents during evening and night hours (Gregersen and Nyberg, 2002) but also during weekends (Department for Transport of United Kingdom, 2000 and 2005) and often drive with passengers, which can distract them (Kelly & Nielson, 2005). Other reasons for the high accident involvement are alcohol, sleepiness, non-usage of seat belts, badly adapted speed (as already mentioned above) but also the usage of older and smaller cars (Engström et al., 2003 and Kelly & Nielson, 2005).

In literature, evidence could be found that young drivers are at greater risk to get involved in a traffic accident, since they tend to understand signals (f.i. blinkers, headlights, hazard lamps or hand gestures) used in traffic situations erroneously (Renge, 2000), they show an inefficient ("inexperienced") visual search (Underwood et al, 2002) and are hardly able to adjust their speed and driving distance to the driving conditions (Clarke et al., 2005). It takes them longer to develop risk assessment skills and they detect and assess hazards more slowly (Deery, 1999). "They also under-estimate the risk of a hazard resulting in an accident and over-estimate their ability to deal with hazards" (Deery, 1999). Whelan et al. (2004) showed that novice drivers concentrate more on cars in other lanes lanes and focus too little on cars in their own lane, which could be a reason for the involvement in rear-end collisions. Crundall et al. (1998) found out that young drivers have difficulties in gathering relevant visual information while driving, especially when driving conditions become more complex, which is supported by the findings of Whelan et al.; there, novice drivers show to be more disrupted by distraction in their situation awareness (2004).

It can be summarised that reasons for the high accident involvement of adolescents can be found in "the risk of being a novice driver" since they have a lack in experience, but nevertheless one should not forget about "the risk of being young" in terms of personality influences (Mienert, 2002).

According to Engström et al. (2003) several studies could show, that the accident risk decreases rapidly during the first years of driving experience (Sagberg, 2000; Gregersen et al., 2000a and 2000b; Mayhew et al. 2000 and Drummond, 1989).

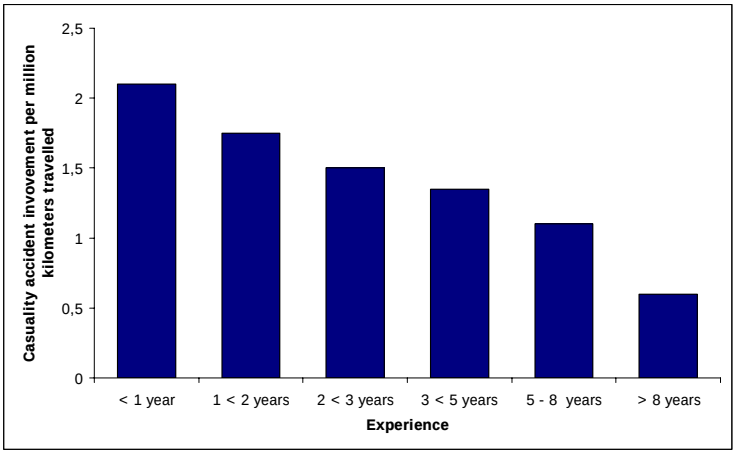

Figure 1: Risk of Casualty Accident involvement by Time Held Licence (Drummond, 1989)

Similar results arise from a British study by Maycock et al. in 1991, which stated that primarily driving experience influences accident risk. Especially in the first three years of driving "the risk because of youth" seems to have only a relatively low bearing on the accident liability as the table below shows.

Percentage reduction in accident liability				
Experience Alone		Age Alone		Age and Experience
During year 1	30%	Between 17 and 18	6%	34%
2	17%	18 and 19	6%	22%
3	11%	19 and 20	5%	15%
4	7%	20 and 21	4%	12%
5	5%	21 and 22	4%	9%
6	4%	22 and 23	4%	8%
7	3%	23 and 24	4%	7%
8	3%	24 and 25	3%	6%

Table 1: The effects of age and experience on accident liability for young and inexperienced drivers (Willmes-Lenz, 2002)

IN-VEHICLE INFORMATION SYSTEM (IVIS) & ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS)

This part deals with IVIS and ADAS systems and how they can support young drivers in performing the driving task. But also problems which may arise while using such systems especially for young drivers will be exemplified. The classification of systems derives from the EU project AIDE (Floudas et al., 2004).

a) In-Vehicle Information Systems (IVIS)

In the last few years several in-vehicle information systems have been developed, with the aim to support the driver. But so far, "*no in-vehicle ITS technologies have been designed specifically to enhance young drivers' safety*" (Young, 2004).

- *Navigation systems*

It can be distinguished between *Integrated navigation systems* that tell the driver for example if the speed limit is reached, if a lower speed limit is coming closer, or if a collision risk exists; *route-guidance-systems* that help the driver to find the best route for any wanted locality by providing information and instructions about the best route; and *route-navigation-systems* that only show the current position and the desired destination but the driver has to decide himself which route he wants to take. (Turetschek, 2005)

Possible Effects: Pauzié (2002) mentions in a study about safety aspects of in-vehicle communication systems the usefulness and efficiency of different guidance and navigation systems for drivers of any age. This estimation can also be found in Young et al. (2003), where the authors notice positive effects of navigation systems, since they help to reduce the amount of mental load while navigating in unfamiliar areas. It was found out that younger drivers base their action mainly on auditory information, instead of combination of visual and auditory one as older drivers do. Younger drivers also showed a better technical driving performance the more difficult the situation was.

- *Travel- and traffic-information-services*

These systems are primarily available through broadcasting services or through mobile services. Users can get information about traffic jams or road blocks because of different events, about the weather, the availability of parking lots but also about alternative routes that may be more attractive, e.g., because of the landscape. But there also exist emergency call services that automatically send information to different rescue services. (Turetschek, 2005)

- *Hands-free-Infotainment-services*

The hands-free handling of equipment like mobile phone, radio, CD-player or navigation system ought to reduce the distraction of the driver during the driving task. (Turetschek, 2005)

Possible Effects: Several studies have shown, that drivers tend to reduce their mean speed while dialling or talking on a mobile phone (Alm & Nilsson, 1990; Burns, Parkes, Burton, Smith & Burch, 2002; Haigney, Taylor & Westerman, 2000; Horberry, Anderson, Regan & Triggs, in press Rakauskas, Gugerty & Ward, 2004).

In contrast to that, Hosking et al. (in press) found out in a simulator study about the effects of SMS-retrieving/sending on novice driver performance that young drivers tend not to increase the distance to the car in front, also they not reduce their speed. But this study also states a reduced ability of novice drivers to maintain their lateral position on the road and to detect and to respond appropriately to traffic signs while text messaging. In a study of Ford, which was carried out in the VIRTTEX simulator, in order to measure the effect of age on cell phone distraction, the teen distraction level rose from the basis level up to more than 50 percent, whereas the increase was only 13 percent for the adults (Figure 2).

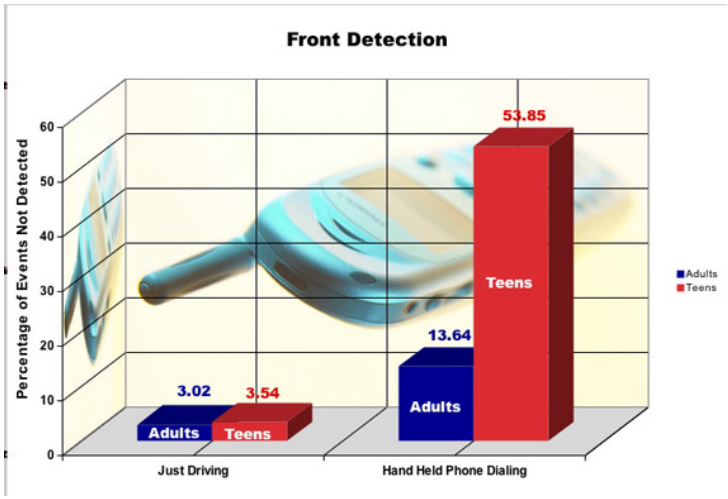

Figure 2: Difference within the detection rate of adults and teens http://www-nrd.nhtsa.dot.gov/departments/nrd-13/driver-distraction/PDF/4.PDF

b) Advanced Driver Assistance Systems (ADAS)

ADAS ought to relieve the driver in the driving task. They reach from systems that only recommend or warn to systems that actively intervene in the driving task (Turetschek, 2005). Concerning young novice drivers, this group was named as the most endangered user group of ADAS in the EU Project RESPONSE (RESPONSE, 2001).

These systems can be divided into lateral and longitudinal systems that assist the driver in keeping the lane by actively supporting the driving task or by only warning. There exist different systems like blind-spot warning, ISA (Intelligent Speed Adaptation) or ACC (Adaptive Cruise Control), but also systems that help the driver to drive into a parking space or improve the sight in bad weather conditions.

Possible Effects:

No literature concentrating on effects ADAS systems could have on novice drivers was found. But generally it can be assumed that these kinds of systems may help young inexperienced drivers to compensate for the lack of experience, as shown in the introduction. However disadvantages of such systems have been found, not directly related to novice drivers but to all driver groups. An ACC, for instance can have a negative impact on the communication between the car driver and other, vulnerable, road users (Chaloupka et al. 1998).

PSCHOLOGICAL ASPECTS

Next to heterogeneous effects of ITS in general, it is not always clear if people use the systems in the wanted way. Human beings are influenced by their own understanding, performance, motives, attitudes, experiences, etc. and therefore will also act according to them, and not only according to the instructions provided to them for the use of a certain equipment. I.e., they will not react like a robot. This is visualised in the figure below:

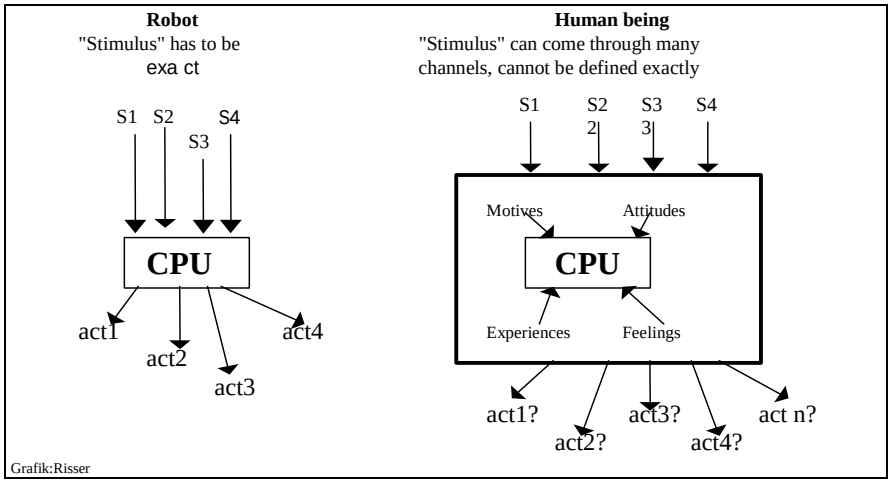

Figure 3: Robot compared to human being (Source: Risser and Petica 1998)

Since humans make decisions and behave according to their own conclusions that they draw from the world which surround them and from experiences they already have made it happens that people under certain circumstances experience a situation as less risky (*subjective risk*) than it actually is (*objective risk*). According to Klebelsberg (1982) this fact leads to safety problems in traffic. As example one can imagine that people who use an ABS drive faster than they would without as they feel save and thus reduce the benefit of the system. Humans also tend to *delegate the responsibility* for their behaviour to the system they use. It is quite easy to drive fast, if a system takes care of the distance to the car in front and the vehicle is equipped with specific brakes, which shorten the braking distance. But our reaction time cannot be reduced under a certain limit and this is sometimes lost of sight. Associated with this problem is also the tendency of humans to *generalise* their behaviour. E.g., in connection with speeding, it has to be kept in mind, that people who drive fast on motorways tend to drive faster also on urban roads. Reasons for this is habituation that among other things can happen due to the fact that their behaviour hardly ever causes negative consequences. Schlag (1994) additionally pointed *conflicts between motives* out. As an illustration a conflict between the understanding of the necessity to drive slowly of safety reasons and the wish to reach a target destination as fast as possible can be assumed. Especially young, novice drivers may be very susceptible to this phenomenon. An example of a conflict specific for this user group could be the indecision if they want to impress their peers or rather take care of the car they borrow from their parents. Next to intra-individual conflicts also conflicts between the individual and the society (the driver may not agree on the speed limits) and the individual and other groups, for instance between the young driver and pedestrians at a crossing, has to be mentioned (Lehner & Risser, 1998).

Last but not least also reactance, viz. acceptance have to be kept in mind. A system, regardless how well developed it is, will not work or be used in a proper way, if people do not want to use it (in such a way). In order to achieve a positive impact of these systems on traffic safety it is a quite important issue to find out what drivers, in our case young novice drivers, think about different types of systems. Young et al. (2004) carried out a comprehensive study about the acceptance of ITS, mostly ADAS, among novice drivers from 17 to 25 years. Results showed that the best accepted technologies are the Seat belt reminder and the Alcohol interlock, whereas the Fatigue Warning, ISA and the Lane departure warning are the least appreciated systems. These results stand partly in contrast to the findings of Regan et al. (2002) where in a study the acceptance among 18 to 39 year old drivers of an alerting ISA system was very high. Differences between young persons from rural and metropolitan areas where found in the research of Young et al. (2004). Metropolitan adolescents for example liked the Lane Departure Warning and the Fatigue Warning systems more than the rural participants did. In general it can be summarised that young drivers are more willing to use a system that has a warning character, can be overridden and has a good reliability (Young et al. 2004).

CONCLUSIONS

As we have seen so far, there does not exist that much research concerning ITS and the specific user group of young, novice drivers. Nevertheless, the results already available show some positive effects concerning traffic safety but only if the systems are used in a responsible way, which among other things depends on several things: subjective versus objective risk difference, delegation of responsibility, behavior generalization, conflicts between motives but also the acceptance of a system.

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