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Impacts of ITS designed for special user groups

Deliverable 4 of Task Force B

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List of Abbreviations

ACC – Adaptive Cruise Control

ADAS – Advanced Driver Assistance Systems

HMI – Human Machine Interaction

IVIS – In-Vehicle Information and Communication Systems

ITS – Intelligent Transportation Systems

Executive Summary

The work performed so far under the umbrella of HUMANIST Task Force D was based on the implicit assumption that the risks and benefits of ITS solutions are the same for all user groups. No differentiation was made according to specific characteristics of the users (e.g. age) or conditions of use (e.g. type of vehicle).This Deliverable is a first step in order to close this gap. Four of the presentations given at the HUMANIST workshop *"User group specific impacts of IVIS and ADAS: Recent research on expectations, opinions, facts end developments"* from 14-16th of September 2005 in Madeira were dealing with issues related to special user groups thereby taking one of the approaches described before. Results from these contributions will be summarised and discussed in this report. It is concluded that a state-of-art on the impacts of ITS designed for special user groups has not been established so far. One reason might be that in-vehicle applications of ITS are usually not designed for exclusive use by one special user group. As an other obstacle it is figured out that research on ITS impacts on special users might sometimes require also special methods which do still not exist.

INTRODUCTION

As an overall goal Task Force D aims at describing and continuously updating the "state-of-the-art" on the impact of ITS on relevant criteria of driving behaviour. In order to reach this aim a safety-oriented perspective has been taken, i.e. special focus is put on potential risks due to perceptive and/or cognitive interference with the primary task of driving or phenomena like behavioural adaptation. However, the work performed so far (see HUMANIST Deliverables D.2/E.2 and D.3) was based on the implicit assumption that the risks and benefits of ITS solutions, or to be more precise IVIS and ADAS, are the same for all user groups. No differentiation was made according to specific characteristics of the users (e.g. age) or conditions of use (e.g. type of vehicle).This Deliverable is a first step in order to close this gap.

There are several ways to deal with this problem. First, one might ask if the impacts of certain IVIS or ADAS are different for different user groups, e.g. if the distracting effects of phoning while driving are different for different age groups (e.g. Strayer & Drews, 2004), or the research is focused on a specific driver group which is most likely to use a certain device, as e.g. young drivers sending and receiving SMS while driving (Hosking, Kristie & Regan, 2005). A second approach, which is suggested by the title of this document, might be to focus on a certain group of users of a certain system and to compare driving behaviour when driving with and without using the system (for ACC see e.g. Dragutinovic, Brookhuis, Hagenzieker & Marchau, 2005 for an overview and meta-analysis). However, this approach assumes that the ITS application under consideration is designed for exclusive use by only one specific user group which might not be the case for the majority of systems available on the market although they might be offered only for certain classes of cars (e.g. Night Vision or ACC systems). An exception might be systems that are under development only for certain types of vehicles (e.g. platooning systems for trucks) whose drivers constitute a special user group by definition (e.g. professional drivers in the case of trucks).

SUMMARY OF RELEVANT CONTRIBUTIONS AT THE MADEIRA WORKSHOP

The HUMANIST workshop *"User group specific impacts of IVIS and ADAS: Recent research on expectations, opinions, facts end developments"* from 14-16th of September 2005 in Madeira, Portugal, which was jointly organised by the Task Forces A, B and D aimed at compiling and integrating results of research on the effects of ITS on various traffic related criteria (see HUMANIST Deliverable B.3 for a complete documentation). Contributions were made by HUMANIST partners and participants from other relevant European projects (e.g. AIDE, SAFETYNET).

Four of the presentations given at the Madeira workshop were dealing with issues related to special user groups thereby taking one of the approaches described before. Results from these contributions will be summarised and discussed in this report. It is obvious that the picture drawn from this is heterogeneous and far from complete. This is true for the definition of the user groups (e.g. by demographic characteristics or vehicle type) as well as for the types of systems considered (Navigation systems, ACC, ITS in general). Nevertheless, it puts a spotlight on trends in ongoing and finalised research activities by HUMANIST partners in this area and might be of help for the identification of research needs to be tackled by future efforts.

Problems related to the increasing proportion of elderly people in the car driving population of industrialised countries are well known facts (e.g. Hakamies-Blomqvist, 2003). Meanwhile these trends also become obvious in parts of the former Eastern world. In the presentation given by Karel Schmeidler (CDV) at the Madeira workshop data were provided showing that in the Czech Republic the share of elderly people in the total population is expected to rise from 21% in 2000 to around 31% by the year 2020 and to around 34% by the year 2050. Disabled people represent around 13% of the Czech population. He figured out that various initiatives recognise the needs of elderly people. With changing attitudes and conditions the desire to travel for education, business and leisure creates a potential major new source of ideas for IVIS and ADAS designers and producers.

Karel Schmeidler (CDV) also figured out that with an increasing number of elderly drivers in the population one can also expect an increasing number of drivers with disabilities and ITS could contribute to increase safety and comfort of this special user group. Although ACC systems are not specifically designed to support disabled drivers they might offer a benefit in particular if they are properly designed according to the special needs of this user group. The exploration of these relationships was the objective of an experimental study presented by Birgitta Thorslund (VTI; see Annex 1). Twenty subjects with lower limb disabilities participated in a simulator experiment. All drivers were used to drive with hand controls for accelerating and braking. The purpose of the experiment was to investigate how an ACC system together with two different hand controls for accelerator and brake influenced workload, comfort and driving behaviour and to further develop a method to evaluate vehicle adaptations for drivers with disabilities. The ACC system could maintain a constant speed selected and set by the driver. Furthermore, the ACC adapted the speed in order to keep a safe distance to a leading vehicle. A stop-and-go function was also integrated in the ACC system. The stop-and-go function made the car stop at e.g. a traffic sign if a lead vehicle stopped. When the car in front started to drive the ACC would accelerate the car to reach the set speed without any driver action required. The hand controls used were different both with respect to design, combined or separate levers, and position, on the steering column or between the front seats. All subjects drove 100 km at two occasions, with and without the ACC system available but with the same hand controls at both occasions. The ACC system was well received, trusted, and wanted. It was concluded that the ACC system substantially decreased workload, increased comfort and did not affect safety. However, the user interface of the ACC did not seem to be optimal with respect to the needs of the participants even if this was only tentatively considered in the evaluation. The only difference found between the two types of hand controls was that drivers using the dual lever system had less variation in lateral position. It was concluded that the evaluation method used proved to be useful but further development was needed.

There are no ITS applications which are specifically designed for use by young novice drivers. Consequently there is no systematic research on the impacts of those systems on the driving behaviour of this special user group. This does not mean that there is no need to consider the use of ITS by young novice drivers as a problem because this group could be inclined to use certain devices while driving more than other driver groups and this might lead to undesirable effects. This is suggested by research performed by Hosking et al. (2005) that demonstrated the detrimental effects of sending and receiving SMS on young novice drivers' performance. Based on a review of the available literature Christine Turetschek (Factum) proposed in her presentation (see Annex 2) some hypotheses on the effects of IVIS and ADAS on young drivers behaviour which might be a good starting point for future research activities. In particular, possible effects of longitudinal support on communication behaviour and the use of ADAS to compensate for skill deficits or lack of experience were new aspects figured out and discussed in this presentation.

Drivers of two-wheelers are a user group which has been so far largely ignored by behavioural research on ITS impact. This was focused more or less exclusively on drivers of M1 vehicles although there is a growing market for IVIS specifically designed for use while driving a motorcycle. This problem was tackled by a field study recently performed at BASt. Christhard Gelau (BASt) presented preliminary results of this project which was designed to investigate the effects of navigating with two different types of a navigation system on motorcycle drivers' workload (see Annex 3). The results are not yet conclusive with respect to the effects of the navigation systems under consideration and the design of the HMI. However, they clearly pinpoint the specific methodological difficulties which arise when applying workload measurement techniques which were primarily developed for car drivers when driving a motorcycle. Obviously there is need for more research on methods applicable HMI evaluations at this special user group.

CONCLUSIONS

In the present report, a spotlight was put on ongoing and finalised activities in the area of impact analyses for special user groups. The picture is far from being complete and we cannot say that a state-of-the-art has already been established in this area. One reason for this might be that most ADAS and IVIS which are presently available on the market are not designed for the exclusive use by a certain user group defined e.g. by demographic (e.g. age) or other person-related characteristics (e.g. disabilities) although there might be specific risks and benefits for these people as was suggested by the presentations given by Karel Schmeidler (CDV) and Christine Turetschek (Factum). However, on the basis of presently available results from empirical behavioural research these considerations have the status of hypotheses which deserve further investigation as society is developing and special needs and preferences on ITS might arise in these groups.

The approach underlying the research presented by Christhard Gelau (BASt) was a slightly different one. Here the special user group was defined by the vehicle type (motorcycle) and thereby implicitly by the conditions of use. The study presented has still pilot-character and shows in a first time that research on ITS impacts on special users might sometimes require the development of special methods as a precondition.

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ANNEXES

1 – "Evaluation of an Adaptive Cruise Control (ACC) system used by drivers with lower limb impairments" by Björn Peters & Brigitta Thorslund (VTI) (Extended Abstract)

2 – "Impact of IVIS and ADAS on young drivers" by Christine Turetschek (Factum) (Extended Abstract)

3 – "Workload measurement when driving a motorbike" by Michael Haumann, Rainer Krautscheid & Christhard Gelau (BASt) (Extended Abstract)

4 - "ITS for ageing drivers' generation" Karel Schmeidler (CDV) (Short Summary)

ANNEX 1

Evaluation of an Adaptive Cruise Control (ACC) system used by drivers with lower limb impairments

BJÖRN PETERS & BIRGITTA THORSLUND, VTI

This work was done within the DRIVE II Project TELAID. The objective of the TELAID was to investigate the pros and cons of ATT applications from the perspective of drivers with various disabilities, or as we prefer to say, drivers with special needs.

As you might already know there are a considerable number of people who have functional impairments which restrict their independent mobility. Depending on the definition of impairments at least 10 - 15% of the population has special needs with respect to our transportation systems. This proportion seems to be rather constant at least within Europe but it is steadily increasing. A large number of these people are elderly or senior citizens.

Mobility impairments are the most frequent reason behind special needs. Mobility impairments can make a person both dependent and isolated. Driving a private car is a way to restore independent mobility for these people. Sometimes though the car has to adapted or converted so that it conforms to the driver's resources and needs.

A quite common adaptation is to install hand controls for accelerating and braking (longitudinal control). There are a number of ways to design such adaptations. Even if this adaptation enables the driver with lower limb impairments to drive, it will induce overload and discomfort in the upper limbs. These drivers avoid long distance travels. ATT applications like advanced cruise controllers could be used to improve comfort and decrease the physical load.

The questions we wanted to answer with this study were:

1. will an ACC decrease physical load and improve comfort?
2. will is influence the driving behaviour?
3. how will it influence car following situations?
4. will the drivers approve of the ACC support?
5. will ACC driving influence driving behaviour differently depending on the design of the hand control?

We used a mixed design in where 20 experienced drivers with lower limb impairments drove under two conditions (with and without ACC available). The subjects were divided in to two equal subgroups depending on the type of hand control system they used in their own car. The order of ACC condition was counter balanced.

The two types of adaptations we used in this study are the most frequently used systems for this group of drivers. The first system consists of a single lever combined mounted on the floor between the front seats. It is operated so that the driver pulls for accelerating and pushes for braking. The second system consists of two separate levers for accelerating and braking. The accelerator lever is operated by moving it downwards to speed. The brake lever is pushed forward towards the dashboard.

The twenty subjects were all experienced with the type of hand control they used in the simulator. Mean age and driving experience were approx. the same for both groups (40 years and 10 years). Mean yearly driven distance was also approx. equal.

The driving task consisted of a 100 km country-side road with some urban flavour (cross roads and traffic lights). The signed speed limit varied between 70 and 90 km/h. There was oncoming traffic with varying density in order to improve the reality. There were 14 car following situations with a well defined catch-up procedure. In order to simulate unexpected events we used a visual stimulus (red or yellow). The stimuli appeared at the left hand side of the road. The subjects got verbal and written instructions before the test. The subjects drove a 20 km long training route in order to familiarise with the simulator. The training route contained all the situations that would appear on the test route.

We used the moving base driving simulator at VTI for the experiment. The simulator has a wheel chair lift in order to make it accessible for wheelchair users. An ACC system provided by SAAB was installed in the driving simulator. The ACC system communicated with the driving simulator via a CAN bus system. The main computer was used record all driving data (speed, lateral position, reaction time etc.)

The ACC (Adaptive Cruise Control) system worked basically as an ordinary CC. The driver could select and adjust a constant speed. Buttons on the direction indicator stalk were used to control the ACC. Selected cruising speed could be increased or decreased in steps of 10 km/h. Selected speed was indicated by amber LED's on the speedometer. The ACC was equipped with a simulated sensor that detected leading vehicles. If the lead vehicle had a lower speed than the test vehicle speed was adjusted to maintain a safe headway. An amber car symbol on the dash board would inform the driver that a leading vehicle had been detected. Current speed was displayed on the ordinary speedometer. The driver could deactivate the ACC by braking or turning it off. Speeding would over ride the ACC system.

The measures we used were the following:

Speed
Lateral position
Time headway
Reaction time
Subjective workload by NASA - RTLX
and Questionnaires

Speed level and lateral position for the total route was unaffected by ACC usage. The two groups did though differ with respect to lateral position. The group driving with the dual lever system drove more to the right in the lane. This difference was constant independent of ACC usage.

Free flow driving was defined as those parts of the test route where there were no cars following, overtaking, traffic lights etc. The same pattern appeared for free flow driving as for the total route.

Variation in speed for free flow driving decreased when the ACC was available. This difference was significant (less than 5% (1,5%)) The subjects who used the single lever system had a greater variation in lateral position. (approx. 6 cm). This difference was significantly different (5%).

The decreased speed variation for the ACC condition was significant. Also the difference between the two groups with respect to lateral position and variation in lateral position.

Mean reaction time was calculated for each individual. The reaction time was shorter for the ACC condition was shorter but the difference was not significant (5%).

Headway is a measure of how close the vehicles drive. Headway was analysed for the car following situations. Mean headway was significantly shorter for the ACC condition. Variation in headway was also significantly reduced for the ACC condition. Also number of short headways was reduced when the ACC was used. There was no difference between the two groups. Mean TTC was significantly longer for the ACC condition.

Subjects estimated their workload on the NASA - Task Load Index after the test ride. This was done for the total task, car following, and traffic lights. Physical demand and time pressure was more than 50% lower for the ACC condition. Effort was approx. 40% lower and performance was 22% higher. The other differences were not significant.

The difference in speed variation between the ACC and No ACC condition increased with distance driven. This might indicate that the subjects got more tired the longer they drove. It is tiresome to keep a constant speed.

The decrease in workload for the ACC condition was even more pronounced when considering just the car following situation. The differences in all factors except time pressure were significant.

For the traffic light situations were all loading factors significantly lower for the ACC condition. Performance was higher.

The subjects rated on a 7 point scale how well they thought they could control speed and distance to leading vehicles and how much effort they had to allocate to the task. All difference were significant. There was no difference between the groups.

The subjects rated some aspects of the ACC on a 7 point scale. General opinion of the ACC, Did the ACC contribute to increase comfort?, Was it easy to learn how to use the ACC?, How well did they trust the system?, How much they would like to have such a system? and If the ACC was better than their own CC?
As you can see the ratings were all very high.
More than 90% of the subjects had a CC in their own car.

Result Summary

• Speed level	0	
• Speed variation	⇓	
• Lateral position	0	
• Var. of lat. pos.	0	
• Reaction time	0	
• Mean headway	⇓	
• Min headway		⇓
• Var. in headway	⇓	
• TTC	⇑	
• Workload	⇓	
• Speed & dist. contr.		⇑
• Drivers opinion	++	

Conclusions

∗ ACC reduced workload and increased comfort
* ACC support more important for long drives
∗ ACC improved speed + distance control
∗ ACC well accepted, wanted and trusted
∗ ACC reduced headway
∗ ACC did not influence speed level, lane keeping, and reaction time
∗ ACC driving did not influence workload, comfort, and driving behaviour differently with respect to type of hand control used

ANNEX 2

Impact if IVIS and ADAS on young drivers

CHRISTINE TURETSCHEK, FACTUM

Young Drivers

It is without controversy, that young drivers are the group with the highest accident risk. In Austria 2003 9.684 15 to 19 year old have been in an accident; 88 died. For this age group the risk to get involved in an accident is three times as high as for the whole population (KfV, 2004). In Germany the situation is quite similar. More than a fifth of the 18 to 25 year old have been in an accident in 2004 and again more than a fifth of these died. The main causes of accidents are unadapted speed (27%), followed by mistakes in giving right of way (12%), mistakes in distance keeping (12%) and problems with turning (11%; (Statistisches Bundesamt, 2005) What could be the reason for this?
According to literature one has to differentiate between the "risk because of being a novice driver" ("Anfängerrisiko") and the "risk because of youth" ("Jugendlichkeitsrisiko") (Mienert in ZVS Nr. 4, 2002). Mienert describes the difference as follows: the main discrepancy is the degree of becoming involved in risky situations or taking risk consciously.
Because of absence of experience, there are many reasons why young drivers get involved in accidents. They may end up in unexpected situations where they do not know what to do or they may be busy with handling the car, so that they cannot react adequately at the same time. There also exists evidence that not only age but primarily driving experience influence accident risk. Especially in the first three years of driving age seems to have only a minimal bearing on the accident liability as the table below shows.

Table 1: The effects of age and experience on accident liability for young and inexperienced drivers (Bast, 2001)

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%**

The results derive from a British study from Maycock et al.,1991

On the other hand some studies exist that document that the "risk because of youth" is the main reason of high accident rates (ZVS, Nr.3, 2002). The "risk because of youth" seems to be much more complex than the factor driving experience; it seems to be logical that people with less experience make many mistakes. To handle this topic one has to go far back. Adolescence is a period of life where many processes happen while a person becomes a grown-up. Mienert, 2003 notes that society's demands on the adolescents to become grown-up but do not show them, when they have achieved this status. And youth on the other hand is looking for a new identity, for autonomy and acceptation (ZVS, Nr.3, 2003). Lamszus (ZVS, Nr.3, 2002) specifies this behaviour with terms like showy behaviour, force or autonomy. This leads to a different view on the vehicle; it is no longer only a means of transport but an instrument for profiling, a possibility to experience strong feelings, or just a sign of freedom. The car is used to demonstrate power and advantage or to provide adventure and thrill through dangerous driving manoeuvre (Lamszus, Nr.3, 2002). Not every adolescent shows the same risky behaviour in traffic. For instance female adolescents still are less involved in traffic accidents than boys are.

We have to bear in mind, additionally, how important the driving license is for young people. Not only 18 years old but already 16 years old teenagers share this opinion. The driving license is the key to autonomy and mobility (Mienert in ZVS Nr. 4, 2002). In this study it is pointed out, that there exists a discrepancy between the group of the potential risky drivers and the normal drivers regarding social acceptability.

Mienert (2002) also mentioned that risky drivers are more strongly against restrictions concerning their driving license than “normal” adolescent are. They do not want to have an alkolock in their car, nor an ISA like application that does not allow them to drive faster than 80 km/h. This specific group is also against a label that shows that they are still novice drivers. However, there are hardly any differences between the groups regarding tachographs, longitudinal and lateral control systems.

Additionally to their age and there lack of experience, adolescents do also show a specific exposure, like driving by night frequently.

So what can be done? We know, that young people do have problems at the beginning of their driving career because of a lack of experience but also because of their age-specific behaviour which in many cases is risky. Sometimes it becomes risky because they do not know better and sometimes their youthfulness gets the upper hand.

In-Vehicle Information System / Advanced Driver Assistance Systems and adolescent road users

This part deals with possible solutions for some of the problems that have been mentioned above. IVIS and ADAS systems that may influence young drivers behaviour in the one or other direction are presented. First of all, we have to have a more thorough look on the systems that are chosen.

<u>In-Vehicle Information Systems</u>

IVIS in contrast to ADAS mostly have a recommendatory and warning character (Project Telematik, 2005).

The classification of the systems that will be used in this presentation derives from a report from the EU-project AIDE. It will be distinguished between navigation systems, travel- and traffic-information-services and infotainment-services. But only those systems that may have an influence will be mentioned.

- Navigation systems

This group is cut into three parts. *Integrated navigation* systems signal the driver for example if the speed limit is reached or if a lower speed limit is coming closer or if a collision risk exists. *Route-guidance-systems* help the driver to find the best route for any wanted locality. They provide information and issue instructions about the best route. *Route-navigation-systems* only show the current position and the wanted destination but the driver has to decide himself which route he wants to take.

- Travel- and traffic-information-services

This 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, the weather, 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 the information to different rescue services.

- Infotainment-services

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

Effects: Especially for route guidance systems it can be said that their use may lead to shorter distances to the car ahead, to more distraction from actual traffic participation, and to heterogeneous compliance that could did cause problematic interactions (QUARTET project STORM – HOPES).
On the internet we could find some studies that referred to hypothetical effects on the driving task and the driving behaviour of other systems, as well. These types of systems mentioned above will probably not help young drivers to improve their experience. On the contrary, such systems may take the drivers attention off the road. Sagberg (1998) “found mobile phone use in Norway only accounted for 0.3% of all accidents, whereas conversations with passengers accounted for 8% of all accidents.” But it is not studied, yet, what influence on young drivers with less experience and more mobile phone use (see Lamble et al. 2002) can be expected.
Certainly these systems can be used in quite a proper way, if the driver is aware of the kind of situation he is in. If, e.g., on a country road, there are not many other vehicles around, such systems can improve the orientation and the comfort. The problem that arises may be that especially young drivers mostly overestimate their abilities and use these systems in situations where all their attention would be needed. It could be a solution to use Advanced Driver Assistance Systems for compensation bearing, however, the risk of stimulus satiation.

So far one can say that IVIS systems that should act recommendatory on the driving task, pose a threat just for young drivers. In this respect it is necessary to make young drivers aware of this problem as early as possible during their driving education.

- Driver identification and automatic cockpit configuration

Any driver has his/her own physical characteristics that make specific configurations of the car necessary, such as position of the seat, adjustment of the side mirror, etc..

Effects: As novice drivers often use the car of their parents or share it with other people, these systems might be a good possibility to facilitate the use of the car, although they do not exert influence on their driving skills.

<u>Advanced Driver Assistance Systems</u>
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.

- Lateral control (e.g. blind spot warning)
These systems assist with keeping or changing the lane and overtaking, either by actively keeping the car in the middle of the lane or by only warning the driver. Some systems also check the vehicles behind. If one is overtaking the system warns the driver to take care.

- Longitudinal control

There already exist different possibilities to help the driver in this regard. One alternative is *ISA (Intelligent Speed Adaptation)* that warns if the car becomes too fast, or it automatically limits speed to the allowed limit, although the driver still can ignore the system by kicking-down function. *ACC* (Adaptive Cruise Control) helps to keep a save distance to the vehicle in front, it can also can be used for Stop & Go situations. The system cannot avoid an accident, therefore a *collision warning or avoiding system* is needed that can also be of use at crossings, at level crossings or to advise the driver that pedestrians are near by.

- Miscellaneous
Supplementary systems that help the driver to drive into a parking space, improve the sight in bad weather conditions, observe the bio-physical status of the driver, or pre-crash systems have to be mentioned.

Effects: ADAS systems can help novice drivers to fill the lack of experience. But we also have to keep in mind, that for example an ACC (Autonomous Cruise Control) can have an impact on the communication between the driver and vulnerable road users, which may become worse. On the other hand, an active accelerator pedal (AAP) can improve the communication of drivers with other road users. Studies (e.g. Hjälmdahl, 2004) showed that they for instance yielded more often (gave pedestrians the right of way at zebra crossings) but also that the headways to the vehicle in front increased slightly. These two results of studies show us a very heterogeneous influence of ITS systems on the drivers' behaviour. What we do not know out of this is how the behaviour especially of young drivers is affected.

Maybe for some of the young drivers this can reduce the accident risk. But still one group of them will stay hat a high level of risk. And maybe also those, who show a more or less well-adapted behaviour may “change their mind” and behave more risky while using an ITS system because of the enhanced feeling of being safe. Out of this many side effect may arise. The safety gains might be compensated by more **risky behaviour**.
Another aspect that has to be stressed is that there exists a dialectic relationship between risk as it actually exists ("**objective risk**"), and risk experienced by people, in different situations ("**subjective risk**"). According to the model of Klebelsberg, many safety problems result from a discrepancy between these two aspects. An increase in objective safety, for example on icy winter roads when using spikes, can lead to a disproportionate increase in a person's feeling of safety. This phenomenon may lead to overcompensation for the possible safety gains and a reduction of safety, thus.
As it is very difficult for people to understand and follow complex dynamical processes and asses their outcome, a part of the road users rely on technical systems to take difficult decisions. And a logical consequence is that trust in a "perfectly" functioning system is quite easily achieved. This can lead to nonchalance about one's own behaviour - "the system is taking care of that". For example, in connection with ACC, that could mean that "If keeping or changing the lane is solved by an ACC, I do not have to be so careful in that part of my driving". The problems which may arise have already been mentioned. This phenomenon is called “**delegation of responsibility**”.
The last aspect to be discussed is **interpersonal communication**. It has already been shown, that some ITS systems may lead to the reduction of communication. This seems particularly problematic, as 70 % of all accidents happen between two or more road users.

ANNEX 3

Workload measurement when driving a motorbike

MICHAEL HAUMANN, RAINER KRAUTSCHEID & CHRISTHARD GELAU, BAST

Navigation systems are becoming more and more a standard equipment in modern road vehicles. This development also concerns motorbikes where navigation systems can be expected to replace the conventional map on the tank backpack of the motorbike in the oncoming years. Although these systems are designed to support the driver by relieving him of the tasks of navigating there are concerns about possible negative effects due to additional visual load and distraction imposed on the driver when using these systems while driving. However, actually there was no empirical evidence about the impacts of the use of navigation systems on workload and behaviour of motorbike drivers nor could we identify any tools or methods for workload measurement when driving a motorbike which would make it possible to assess these effects. The research presented here was a pilot study as a first step towards closing this gap of knowledge.

Method

A driver behaviour with 36 participants was performed in real traffic where subjects had to drive with an instrumented motorbike on a previously defined test route which was composed of road sections of motorways, rural roads and urban roads. All subjects were experienced drivers of a motorbike, the test route was unknown for them at the beginning of the test drives. In order to get a reference standard for comparisons that reflect the demands of the task of navigation an additional test drive was made on a route which was known by the subjects in advance.

Subjects were randomly assigned to one of three experimental conditions which differed with respect to the navigational support provided: driving with a conventional map, navigation system *without* speech output, navigation system *with* speech output.

Driver workload was measured by means of the “Rating Scale Mental Effort” (RSME) from the available subjective methods and the “Peripheral Detection Task” (PDT) as a secondary task method. Both tools are well established in research on driver workload when driving a car.

The RSME was administered three times after each of the different types of sections of the test route (motorway, rural roads, urban roads).

For the PDT a special device for use while driving a motorbike was developed by adapting the head-mounted version frequently used in studies with car drivers. The LED was mounted at a fixed position at the inside the helmet and subjects’ manual responses to the LED stimuli were gathered by means of the button which otherwise used to operate the horn.

Figure 1: PDT device adapted for use when driving a motorbike

Summary of results

- Concerning the PDT the proportion of missed signals was considerably higher than those usually recorded in comparable studies with car drivers. For this reason the PDT parameter "response time" was considered as not interpretable and the analysis concentrated solely on the error rates.
- Both RSME and PDT were shown to be sensitive against the demands of the road characteristics.
- The additional load imposed on the driver by the demands of navigating through unfamiliar areas were reflected by the PDT.
- No differences – neither with the PDT nor with the RSME – were found between the three different types of navigational support tested.

Summary of conclusions

The present study had pilot character because a first attempt was made to adapt methods which are well established for workload measurements at car drivers to the task of driving a motorbike. It does not need to be stressed that this task is different from that of car driving in many aspects and appropriate methods for workload measurement should take these differences into account.

At a first glance the results seem to encouraging because findings from studies with car drivers were replicated insofar as the demands of the traffic situation were reflected by the workload measures. However, none of the measures could discriminate between the different types of navigational support. Thereby one has to keep in mind that from the PDT data only the missed signals could be used which throws some doubt on the sensitivity of this tool for use at motorbike drivers (see Haumann et al., 2006, for further details).

Because information and communication technologies can be expected to become a common equipment also for motorbikes in the future our results point to a need for intensified research for Human Factors assessment tools and methods specifically suited for use while driving a motorbike

Reference note

Haumann, M., Krautscheid, R., Sander, K. & Gelau (2006). *Untersuchung der Belastung und Beanspruchung von Motorradfahrern bei Navigationsaufgaben.* Unveröffentlichter Abschlussbericht um Forschungsbericht AP 02 542/F4 der Bundesanstalt für Straßenwesen (BASt). Bergisch Gladbach: BASt.

ANNEX 4

"ITS Support of ageing drivers' generation"

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- Ageing of population, is the life expectancy 120 years in 2070? The percentage of elderly people (65+) is growing rapidly
- negative scenario (mobility handicapped people) – positive scenario (active people, who are travelling a lot, traffic safety being the main point that needs to be taken care of)
- The risk for elderly people: physical changes (physical and mental), medication etc.
- Fatalities in Czech republic have not changed in a similar way as in other European countries
- 4 dimension related to mobility: fears, quality of life, barriers in mobility, solutions for mobility
- more concentrating on advantages of ITS to elderly people, but also remembering the possible drawbacks of ITS to elderly (information overload, distraction etc.)
- ITS – preventing accidents, not a privilege, possibility to install systems also to old cars