”SAFE YOUNG DRIVERS”

– Experiments with Intelligent Speed Adaptation

Bente Schmidt Nielsen, Project Manager, Aalborg University, Department of Development and Planning, 11 Fibigerstraede, DK-9220 Aalborg. Phone +45 9635 8364, E-mail: bsn@plan.aau.dk

Harry Lahrmann, Associate Professor, Aalborg University, Department of Development and Planning, 11 Fibigerstraede, DK-9220 Aalborg. Phone +45 9635 8381, E-mail: lahrmann@plan.aau.dk

Background

Most European countries have experienced an almost constant decline in the number of fatalities and injuries in road accidents during the last 25 years. However, in recent years the decline has become smaller, and in some countries it has even changed to an increase. There are strong reasons to believe that if the reduction in the number of accidents is to continue, it will be necessary to use new measures. Intelligent Speed Adaptation (ISA) and other ITS-systems will certainly be a key factor in road safety research in the future.

ISA is a general term for systems that establish the geospatial position of a car, compare its current position and speed with a digital road map which includes the local speed limits, and it responds if the speed limit is exceeded. The response can take various forms; it can be as a light and sound response; can register the speed limit violation in an on-board car computer; there can be a built in resistance in the accelerator when the speed limit is exceeded; and eventually it can be made impossible to exceed the speed limit. The different ISA-systems can be classified as informative, controlling, or intervening systems.

The INFATI project was the first ISA project in Denmark and it was a project on informative ISA carried out at Aalborg University from 1 July 1998 to 31 June 2001. The project was small with only 24 drivers tested for 6 weeks, but the results from INFATI were promising. The INFATI pilot project resulted in general speed reductions of about 5 to 6 km per hour corresponding to approximately a 25 % reduction in the risk of road accidents. Taking into consideration that most accidents and fatalities take place in rural areas, where speeds generally are highest, the results of the INFATI project are very promising as it also showed that the decrease of speed was largest in particularly rural areas. In general the conclusions from the INFATI-project fit very well to solving the problem of young drivers having a disproportionate high risk of injuries and fatal accidents.

The new project is a collaborative project carried out by Aalborg University, the County of North Jutland, the large Danish insurance company “Topdanmark” and the Danish Road Safety and Transport Agency. Each partner is responsible for a part of the project; Aalborg University for project development, -management and research; The County of North Jutland for developing the digital speed map in cooperation with researchers in geo-informatics at Aalborg University; Topdanmark for administrating the test drivers among their customers and aiding the discounts on the insurance fees and finally the Road Safety and Transport Agency for giving generous financial support and attention towards the project.

“Traffic safe young car drivers” – design of an experiment

The promising results from the former INFATI-project are about to be re-examined in this project regarding young drivers at 18 to 24 years of age. This group is known to be overrepresented in road accidents. The reason for this seems to be that they do not respect speed limits and that they are rather inexperienced drivers.

The following table will tell its own story about the number of 18-24 year old car drivers in the county of North Jutland (about 500,000 inhabitants) from 2001 to 2003:

Year	Number of killed	Number of injured
2001	7	241
2002	15	294
2003	12	282
Total 2001-2003	**34**	**817**

It also implies the perspectives in reducing the risk of accidents by 25% as was the result of the INFATI-project:

Average	11,3	272
25%	2,8	68

The overall purpose of the project is to examine whether equipment for Intelligent Speed Adaptation installed in young drivers' cars informing about speed limits, in combination with discounts on insurance fees, can motivate young road users to reduce speed and thus possibly save lives.
Getting insurance cover for a new, young car driver is very expensive in Denmark - about 2400 €/year. The level of insurance fees added to the price of a midrange second hand car, makes it very expensive for youngsters to buy and own a new car.
Based on the insurance companies' experiences with the total amount of indemnifications for this group of young people, insurance fees appear to be much more expensive than more experienced drivers' insurance fees. This fact gives the reason for the design of the project; you can meet the young car drivers need for cheaper insurance fees by rewarding them for respecting the speed limits.

As in the previous INFATI study the "On Board Unit", OBU, gets the cars position from the GPS receiver. This position is matched onto a digital speed map stored in the OBU. By matching the position and speed map you get the current speed limit which will be compared to the actual speed of the car. If the car exceeds the speed limit by more than 5 km/h; the OBU gives the driver a verbal warning e. g. "50 – you are driving too fast". If the driver does not react to the warning within 6 seconds, (s)he will loose a number of "merit-points". On the contrary if the driver does not exceed the speed limit or reacts properly after the warning (s)he will obtain a reduction of 30 % of the insurance fee.

In this way the main questions for the project are:

- Can Intelligent Speed Adaptation support young drivers in keeping the speed limit and thereby contribute to saving young lives in traffic?
- Can financial factors contribute to young people's development of safer behaviour in the traffic?
- And will the results of the project have a permanent effect on traffic behaviour?

In a larger perspective the questions also are:

- What role can the insurance companies play in securing traffic safety?
- Will it pay the insurance companies to offer discounts for driving with ISA-equipment?

To conduct the experiment lots of preparation is needed and some of it has already been finished as will be described in the following tasks of the project.
1. The development of a second generation of equipment and software to be installed in the young drivers' cars.
2. The development of digital speed maps and a web application for local authorities to update the position of speed signs.
3. A three year test period involving 300 young car drivers as participants in our project.
In the following the four themes will be presented separately.

<u>1. The development of a second generation of equipment and software to be installed in the young drivers' cars</u>

The first generation of equipment was an "On Board Unit", OBU, which matched GPS-positions with a digital speed map stored on a computer in the car. The actual positions and speeds were written in a log, which at the end of the short test period was extracted and analysed by the researchers. The equipment also con-

sisted of a display showing the actual speed limits and a device using a female voice for warning the drivers when the actual speed limit was being exceeded.
The second generation of OBU will be very advanced compared to the former generation. We have recently finished developing the requirement specification for the equipment and the web server related to it. It resulted in 145 requirements that the small local development company must meet.
In short the demands consist of different subjects such as

- securing daily transmission of logs from the OBU via a GSM-module to the server
- containing and securing proper map matching to a digital speed map using only the GSM-module's processing capacity
- updating the digital speed maps in the OBU when needed
- revealing attempts of cheating with the GPS antenna
- real time calculating of the amount used when ending a trip
- updating the drivers account of discounts in case of just objection against an incorrect warning
- securing that the web server is always updated so the young drivers can login to their own logs and see maps of driven routes
- handling logging of all attempts to access to data on the server due to demands of the Danish Data Protection Agency because we store data on personal breaches of law
- showing the proper information in the display and also showing when the map matching is uncertain
- letting the display show different data depending on what group of test drivers the young car driver belong to and at what time in the project
- installing the equipment physically in the car without causing any damage or draining the entire car's electricity etc.
- using GSM and GPRS communication devices for daily export of logs as well as for the import of updates to the speed map on a regular basis.

Developing the requirement specification and negotiations about the whole delivery of equipment has recently been completed and we are at present (march 2005) testing the very first attempt of further development of the equipment from the INFATI-project. We are especially focussing on the functioning of the display and the absolutely necessary improvements of the map matching. After this period of initial testing the development of a new prototype will be initiated. Development of the prototype is estimated to about 35 weeks so in the end of this year we expect it to be tested and approved. Afterwards the production of the final equipment will be initiated and delivery of 300 units is scheduled to the first quarter of 2006.

2. The development of digital speed maps and a web application for local authorities to update the position of signs

The digital speed map is based on the registration of road signs regarding speed restrictions on the roads for the whole county of North Jutland, about 10,000 km of roads. The local road authorities are supposed to update the speed maps via a new web application when they put up new speed signs, delete existing ones, make changes of speed limits or change the positions of the signs. In this way we aim at always having a correctly updated digital speed map.

The detailed digital speed map, including every minor road, only covers the county of Northern Jutland, and this county also is the arena of the experiment. But as we are aware that car drivers do not always stay in their own county, we have incorporated a speed map over the rest of Denmark including all roads with a speed limit on 90 km/h or more. Only on these roads are the young drivers allowed to drive faster than 80 km/h. On all other roads in the rest of Denmark the OBU will react if they exceed 80 km/h. In this way we can prevent the young drivers from driving wildly when they are outside the boarders of their own county. We cannot prevent them from driving too fast in cities for example, where the speed limit is always max. 50 km/h – this will as always be a matter for the police – but we can prevent them from driving at more than 80 km/h on normal rural roads, and speeding on these roads is also regarded as the most dangerous type of speeding.
Around the whole of Denmark a polygon indicates that you are now outside the Danish territory and of course outside the experiment. If the car should accidentally be stolen, we have the possibility to send a SMS to the OBU, and it will return the car's specific position from the GPS. In this way we can also talk about the benefits of participating in our project as gaining free anti-theft protection for your car.

Map matching between the GPS-signal and the digital speed map is a matter that has required a great deal of efforts already and it is a very important part of the interaction between the functioning of the OBU, the digital map and the reaction towards the driver. Not only should the equipment warn you when you really are driving too fast, but it has also economic consequences for the driver because it cost "points" – and thus money.

Regarding the detailed description of the development of the digital speed map we refer to the paper also submitted for this congress by Ian Berg Sonne, County of Northern Jutland[1].

3. A three-year test period involving 300 young car drivers as participants in our project

The aim is to run this project over a three-year testing period to ensure that a large amount of empirical data is collected. The aim is also to generate new knowledge of possible changes in traffic behaviour related to the technical effect of the speed map, the displays and the use of artificial speech.
Another very important aim is to focus on motivation; what behavioural changes will result from the possibility of achieving considerable discount in insurance fees? We expect about 300 young people to participate in our project over a period of three years. The criteria for participating is that they are between 18 and 24 years of age and that they are car owners and also that they are insured with the participating insurance company, Topdanmark.

Great efforts have been made to decide how to investigate the effect of the motivational factors and we have now ended up with defining 4 different groups of drivers and 3 different periods of driving.

The 300 participants will for the first period of 2 months be driving with an inactive display, being logged only for their usual way of driving and managing speed. In the next period of 4 months the participants will be divided into 3 groups of 40 persons;

1. Control group: The speed is logged, but the driver gets no information about exceeding the speed limits.
   The driver receives a fixed sum of money for participating independent of breaking the speed limits.
2. Information group: The driver receives visual and auditory information about exceeding the speed limits.
   The driver receives a fixed sum of money for participating independent of breaking the speed limits.
3. Incentives group: The speed is logged, but the driver gets no information about exceeding the speed limits.
   The driver receives a fixed sum of money plus a reward for respecting the speed limits. For each breach of the speed limit of more than 5 seconds duration we subtract a small, fixed sum of money.
4. Combination group: The driver receives full visual and auditory information about exceeding the speed limits.
   The driver receives a fixed sum of money plus a reward for respecting the speed limits. For each breach of speed the limit of more than 5 seconds duration we subtract a small, fixed sum of money.

After the 4 months of driving in different groups all drivers are transferred into the combination group, and they stay in that group for the rest of the 3 years.
As it appears the groups are differentiated on being informed or incited and in the end of the period all should be informed and incited.
By setting up this design for the different groups we expect to be able to document different methods of influencing young driver's behaviour in traffic

In the evaluation of the experiment we will use both qualitative and quantitative methods. We will examine the young driver's attitudes towards respecting the speed limits and we will analyse the log data from the cars to decide whether they have changed their behaviour in traffic after driving with the OBU

In particular the presentation will stress the importance of the insurance company's financial involvement in the project. Large amounts of money are spent on insurance settlements for damages, death and disablements related to the young target group driving their cars. For every 100 DKR paid as insurance fee 130 DKR are paid back to the young drivers as indemnification.

Therefore it is a great challenge for the project to develop a method of calculating the discounts related to the proportions of exceeding the speed limits. We have decided to calculate it in the same way as the Danish police have developed their structure of punishment for speeding violations. The method has a progressive structure so that a small violation is not punished as severely as a serious and dangerous violation.

The general perspectives on improving traffic safety and the insurance company's interest in saving on settlement payments seem to go hand in hand and therefore we consider the insurance companies as new fellow players in the arena of traffic safety.

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[1] (22516: Establishing speed map in northern part of Denmark. Ian Sonne, County of North Jutland, presented in session 47.)