NEW IDEAS IN INTELLIGENT SPEED ADAPTATION - MEASURING AND RECORDING DRIVING STYLE

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ABSTRACT

Intelligent Speed Adaptation (ISA) is one of the most promising Intelligent Transport Systems in terms of its potential impact of safety. In Finnish ISA trials the focus is on speed recording and acceleration and deceleration measurements. In the study presented in this paper, driving speed was measured among taxi drivers and drivers were given 1) information about speed behaviour and speed recording system and 2) group feedback in a case of unwanted driving behaviour. In this paper the results of the effects of the information and group feedback are presented and discussed.

KEYWORDS

Recording ISA; driving style; driving behaviour; speed; acceleration; deceleration; driver feedback.

INTRODUCTION

Intelligent Speed Adaptation (ISA) is one of the most promising Intelligent Transport Systems in terms of its potential impact of safety. Activities related to Intelligent Speed Adaptation (ISA) started in the mid of 90's with initiatives from Sweden, UK and the Netherlands. Since 2000 several other countries have launched national trials such as Finland, Norway, Denmark, Belgium, France, and Austria. These national activities have been highly valuable conclusions about potential benefits of such in-vehicle speed management system to road safety and with very encouraging results regarding user acceptance and transport policy. [1]

In terms of intervention level, the ISA has often been mentioned to have three levels of intervention. In advisory version of the ISA the driver is informed of the limit and of violations, in voluntary version the system is linked to the vehicle controls but the driver can choose when to have the system enabled and in mandatory version the system is enabled all the time (usually an override of brief duration is possible). In addition to these three levels, a fourth level - recording ISA - has been introduced and piloted in Finland.

In recording ISA the drivers' location and speed is measured and logged and this information is sent to central unit to be analysed afterwards. The feedback is given to the driver from longer period of time, in separately arranged training or feedback sessions and not as immediately feedback simultaneously when driving. The feedback can be given by employer, customer, insurance company or even parents. [2] The advantage of this afterwards feedback is that the system gives the driver a general overview of his/her speed behaviour, but also points out the specified situations, where unwanted speed behaviour was recorded. This is done by showing the detailed information (time, location, speed limit and driver's actual speed) about driver's speed violations. Compared to mandatory ISA, the recording ISA is not as vulnerable to errors. Since the feedback is given afterwards, it does not stress the driver

while driving and it motivates the concentration of the speed behaviour more on strategic level. [3]

OBJECTIVES

Earlier studies have shown that recording ISA with direct personal feedback has been quite effective [3]. However, in larger companies, installation of the system in each company vehicle, the individual data logging and personal feedback sessions might sometimes require too much extra work. Therefore the question is could there be some positive effects on speed behaviour even with random data collections (only some company vehicle equipped with speed recording system) and group information and feedback sessions where no personal feedback would needed. The main aims of this study was to study 1) the possibility to measure driver-specific driving style in normal traffic and 2) the possible effects of random speed recording and information and group (non-personal) feedback.

METHOD

In this study the recording ISA system called SPEEDAUDIT (developed and piloted in Finland in year 2003-2004) [3] was used. The system has the GPS for location information and an (non-visible) on-board unit, which includes speed measuring and modem for sending the collected data to server. In addition to speed and location measurements, also the possibility to measure and record information about acceleration and deceleration was piloted in the study. This was done by installing a sensor for acceleration measurements and memory for data logging to the SPEEDAUDIT system. In this paper the results of recording ISA and possible effects of information and feedback sessions are presented.

In the data collection phase the acceleration was measured and logged ten times per second and the speeds were logged once every 50 or 100 meter depending on the speed of the vehicle (more often when the speed is under 40 km/h). After collecting the speed and location information from vehicles to server, the location based speed limit was attached to the speed data from a digital speed limit map using Map Info programme (Figure 1).

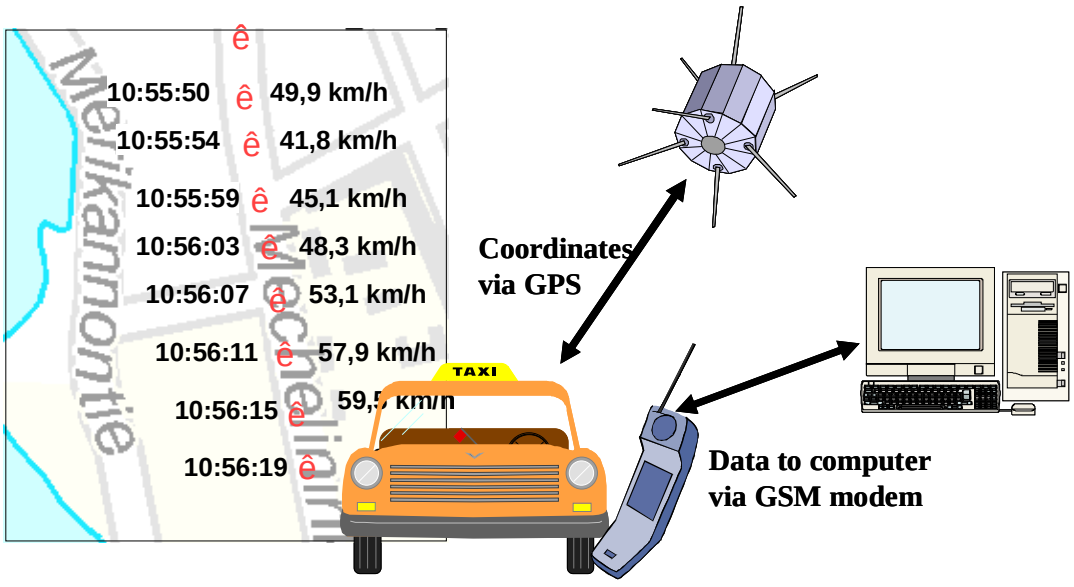

Figure 1. The basic idea of measurements, data logging and possibilities to illustrate the collected and analysed information in the Finnish recording driving style pilot.

The data was collected in Finland, in Helsinki area between January and July 2006 in three taxi minibuses in three phases. In first phase, there was no specific information about the study given to the driver. However, the taxi drivers in the company involved to this study are generally informed that their driving style might be measured and the company's policy (safe and comfortable driving) has been emphasized. In the second phase all the company's drivers participated an information session, where drivers were reminded of the possibility of driving style measurements and explained in detail the possibilities to illustrate the results (see Figure 1). In third phase the drivers that have serious speed violations were called for special group feedback session. In this session actual, but anonymous, examples of location- and time-based results of bad driving behaviour were shown and discussed together with their employer. There was also feedback about the safety effects of speeding (increased risk of death accident, increased break distance etc.) in each situation. The effects of information and feedback session is analysed by comparing the data before and after the sessions (phase1-phase2 and phase2-phase3).

RESULTS

Data

During the data collection (three phases) 94 taxi drivers participated in the speed recording study and speed was measured during 55 450 km of driving. However, when studying the possible changes in speed behaviour (phase1-phase2, phase2-phase3) only thirteen drivers had data in both phases (total kilometrage of 36 200 km). These drivers were included in the following analyses.

Approximately 40% of the kilometrage was driven during night time (between 22-07). Fifty five percent of the kilometrage was driven in areas where speed limit was lower that 80 km/h and 45% in areas with speed limit of 80 km/h or higher. More detailed information about the collected data is presented in Table 1.

Table 1. Percentage of collected in different phases of the study by phase, time of the day and speed limit.

Time of day	***Phase1***	***Phase2***	***Phase3***	***All (mean)***
Weekdays, rush hour (07-09;15-17.30)	13 %	13 %	12 %	13 %
Weekdays, other times (09-15)	20 %	14 %	17 %	17 %
Weekend, day (07-17.30)	14 %	13 %	12 %	13 %
Evening (17.30-22)	16 %	17 %	12 %	15 %
Night (22-07)	37 %	44 %	47 %	43 %
Speedlimit				
30/40 km/h	22 %	24 %	22 %	23 %
50/60/70 km/h	32 %	32 %	32 %	32 %
80/100/120 km/h	46 %	44 %	46 %	45 %
				All (sum)
Total (km)	13633	17475	5097	36204

Speed behaviour

The speed behaviour of drivers was somewhat different in different speed limit areas. Speeding was done more often in high speed limit areas (speeding 63% of all kilometres driven in this area) than in lower speed limit areas (approximately 45%). As expected, in high speed limit areas (80-120 km/h) also the speeding violation were bigger. In those areas 20% of the all kilometres, drivers were exceeding the speed limit more that 10 km/h where the same percentage was approximately ten in lower speed limit areas. More detailed results are presented in Figure2.

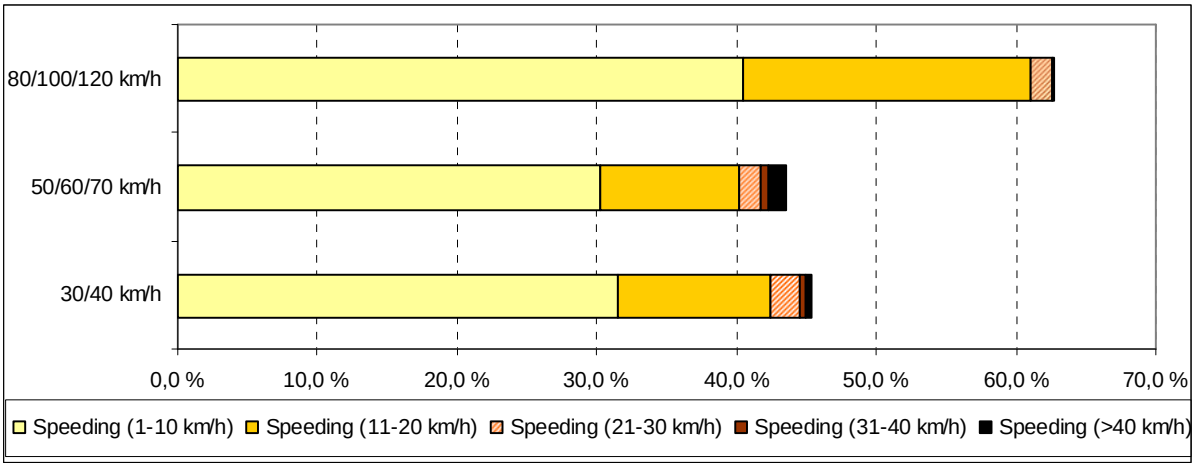

Figure 2. Distribution of speeding magnitude by speed limit area.

The results also showed that speeding was done more often during nights and weekend days (speeding 58% of all kilometres driven in this area) than during evenings and weekdays rush hour (approximately 45%) (Figure3).

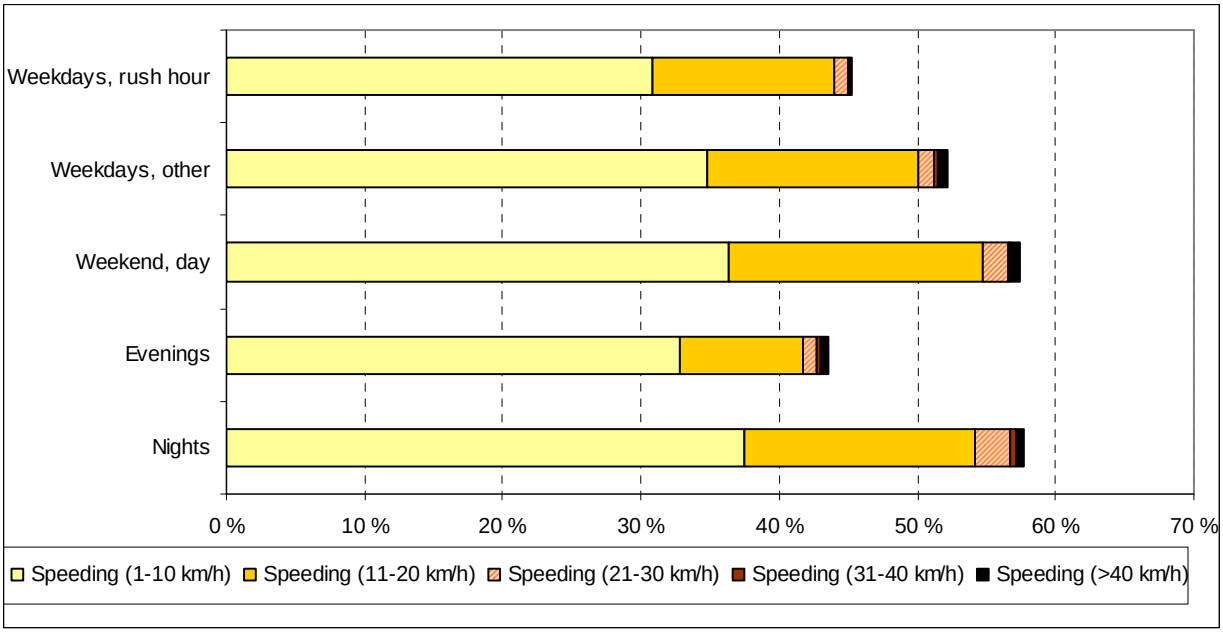

Figure 3. Distribution of speeding magnitude by time of driving.

The possible effects of information and feedback

When studying the possible effect of information and group feedback sessions, the differences on speeding percentage (percentage of speeding compared to the total kilometrage in that speed area) were compared. The results show that neither the information sessions nor the group feedback session had strong effects on drivers' speed behaviour. On the contrary, especially after the information sessions (phase1/2) drivers were speeding more often than in before situations. This happened especially in lower speed limit areas. After the group feedback (phase2/3) the only reductions in speeding happened in high speed limit areas (80-120 km/h). More detailed percentages are presented in Table 2.

Table 2. The differences on speeding percentage (percentage of speeding compared to the total kilometrage) between different phases by speed limit and the magnitude of speeding.

Speed limit	***30/40***		***50/60/70***		***80/100/120***	
	Phase1/2	***Phase2/3***	***Phase1/2***	***Phase2/3***	***Phase1/2***	***Phase2/3***
Speeding (1-10 km/h)	0,6 %	1,5 %	**3,2 %**	1,4 %	-1,2 %	**-2,7 %**
Speeding (11-20 km/h)	**4,4 %**	1,3 %	**5,8 %**	0,4 %	1,9 %	**-3,8 %**
Speeding (21-30 km/h)	1,4 %	0,2 %	1,9 %	-0,3 %	2,4 %	-1,3 %
Speeding (31-40 km/h)	0,3 %	0,0 %	0,4 %	-0,2 %	0,7 %	-0,5 %
Speeding (>40 km/h)	0,4 %	-0,3 %	-0,4 %	0,0 %	0,1 %	-0,1 %

When studying the possible effects of information and group feedback on speeding by time of day (categories), the results show that speeding increased in phase2 especially during evening and night time. In phase3 there was a reduction in speeding during weekend daytime and evening (Table 3). However, the results show that the group information or group feedback did not have expected effects on drivers' speed behaviour.

Table 3. The differences on speeding percentage (percentage of speeding compared to the total kilometrage) between different phases by time of driving and the magnitude of speeding.

	Weekdays, rush hour		***Weekdays, other***		***Weekend, day***	
	Phase1/2	***Phase2/3***	***Phase1/2***	***Phase2/3***	***Phase1/2***	***Phase2/3***
Speeding (1-10 km/h)	1,1 %	1,3 %	-0,2 %	1,7 %	1,7 %	**-5,2 %**
Speeding (11-20 km/h)	2,2 %	1,4 %	1,0 %	**-3,3 %**	**-2,8 %**	**-5,6 %**
Speeding (21-30 km/h)	0,4 %	0,7 %	0,3 %	0,1 %	-0,2 %	-0,7 %
Speeding (31-40 km/h)	0,2 %	-0,1 %	0,0 %	-0,2 %	0,0 %	0,1 %
Speeding (>40 km/h)	0,3 %	-0,4 %	-0,4 %	-0,3 %	-0,2 %	0,8 %
	Evenings		***Night***			
	Phase1/2	***Phase2/3***	***Phase1/2***	***Phase2/3***		
Speeding (1-10 km/h)	**3,7 %**	-0,4 %	-0,6 %	-0,9 %		
Speeding (11-20 km/h)	**7,6 %**	**-4,0 %**	**5,9 %**	-0,3 %		
Speeding (21-30 km/h)	1,3 %	-0,9 %	**3,9 %**	**-1,5 %**		
Speeding (31-40 km/h)	0,1 %	-0,2 %	1,0 %	-0,6 %		
Speeding (>40 km/h)	0,0 %	0,0 %	0,1 %	-0,1 %		

CONCLUSIONS

Driving behaviour is a main issue when safety is concerned, but it is also a key factor in economical driving and vehicle running- and maintenance cost. In addition to more economic

driving and reduced costs, the improvement in driving behaviour will most likely have also a positive effect on vehicles re-selling value and company's image. [4]

In earlier studies [2] it has been shown that recording ISA with personal feedback to drivers reduces the speeding for example among taxi drivers. As an example of the effects of personal feedback, the drivers' average speed in 100 km/h speed limit area reduced from 108 km/h (before personal feedback) to 100 km/h hour. However, in this study where only information and group feedback sessions were used, there were no wanted effects on drivers' speed behaviour achieved.

The results suggest that recording ISA, in order to be efficient, needs personal feedback about unwanted driving behaviour periodically. The active monitoring and feedback of drivers' driving behaviour stresses the importance of safety as company's policy and therefore encourages the drivers to actually change their behaviour in daily work.

EXPLOITATION

The recording ISA has many possible application areas. In future the recording ISA could also be a part of the quality control system for companies. The quality system could be used especially in cases of transport of hazardous goods or with public transport contracts (school transport etc.). The system could also be used when monitoring special group of drivers for example speed limit offenders or young drivers (as a procedure in driver training). In larger scale, the collected data could be used as background information in traffic planning and research or when gathering information about exposure.

In further development of this research project, also 3D-acceleration sensor data (accelerations and decelerations) will analysed. The main focus is on modelling the individual driving behaviour, but also the possibilities to use gathered data for general purposes such as near-accident statistics, will be studied.

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