EFFECTS OF DRIVER ACCIDENT INVOLVEMENT ON ITS ACCEPTANCE

G. YANNIS, J. GOLIAS, I. SPYROPOULOU,
Department of Transportation Planning and Engineering
National Technical University of Athens, Greece

Abstract: Driver attitudes towards intelligent transport systems comprise a crucial parameter of their effective implementation. This study investigates Greek driver attitudes towards specific systems that have the potential to improve road safety, and traffic and environmental conditions. Results indicate that drivers are more positive towards technologies that are anticipated to reduce travel times and hence improve traffic conditions and less keen on systems that monitor their driving. Using as a hypothesis that driver attitudes towards the examined technologies and driver accident involvement are related, statistical analysis is performed to identify this relationship. The results of the discriminant analysis that was conducted indicate that these two parameters are indeed related. The results of this study reinforce the need of the design of appropriate implementation strategies to support the use of intelligent transport systems.

INTRODUCTION

Intelligent transport systems (ITS) comprise a potential answer to the problems that have been triggered by mobility growth, and in particular the increase in accident rates, congestion, and environmental pollution [1]. Conventional measures to deal with these problems are still valid, however their effectiveness is rather limited. Hence, this new set of tools is being employed to treat them [2]. Intelligent transport systems are sophisticated systems that range from information systems providing advice on quickest routes to intervening systems that do not allow drivers to drive over the speed limit. As a consequence driver attitudes towards them ranges from quite positive to rather negative as a consequence of what the drivers perceive that the systems have to offer but also what the drivers perceive that they will be deprived of. Hence, the success of the systems depends greatly on system acceptance from the drivers which has to be considered when designing implementation plans to support system use [3]. Under this scope, research was conducted to identify the attitudes of Greek drivers towards specific intelligent transport systems. The data for this study was extracted from a questionnaire survey, which was conducted within the framework of SARTRE 3 [4]. The recorded data were processed and drivers' attitudes were identified also in relation to their involvement in road accidents, to check whether this comprises an important parameter of the user attitudes towards the investigated systems.

This paper is organised as follows: In the next section, the data and methodology of this research is presented. A discussion of the specific characteristics of Greek drivers follows as the observed driver attitudes should be discussed under the light of these characteristics. In the fourth and fifth section of the paper, the results in terms of needs and acceptability of intelligent transport systems as perceived from Greek drivers are presented. In the sixth section, some initial modelling results that describe the relationship between accident involvement and ITS attitudes are presented being followed by the discussion of the main findings of the paper.

DATA AND METHODOLOGY

The data used in this study was extracted from a questionnaire study that was conducted within the framework of the European Project SARTRE 3. SARTRE stands for 'Social Attitudes to Road Traffic Risk in Europe' and followed the European Projects SARTRE 1 and SARTRE 2. The SARTRE research commenced in 1991, and SARTRE 3 started in 2002 and finished in 2004, with the participation of 23 European Union countries. The questionnaire study was conducted in all 23 countries, with a sample of around 1.000 responses from drivers (in each country). The results were analysed within each nationality, but cross-national comparisons also took place to identify the similarities and differences between drivers of different nationalities as well as the main reasons behind these differences.

The main tool of this research was the questionnaire which included a wide range of questions the aim behind which was to monitor driver behaviours towards different elements of the road environment. Hence, questions driver general characteristics, driving behaviour (speeding, wearing seat-belt, driving headways, alcohol consumption etc), assessment of driving behaviour of other drivers (in relation to the respondents'), driver accident involvement, as well as other questions on rather general issues such as environmental pollution, legislation, etc. Part of the questionnaire comprised questions on specific intelligent transport systems presented in two different ways: needs and acceptability.

The analysis that followed can be divided into two main parts: descriptive and modelling. In the first part the participant answers on ITS needs and acceptability were presented in relation to driver accident involvement. This allows for a first identification of what the attitudes of Greek drivers towards ITS are but also for the indication of possible correlations between driver attitudes and accident involvement. In the second part, discriminant statistical analysis was conducted to identify the possible factors that correlated accident involvement and driver attitudes towards ITS.

ABOUT GREEK DRIVERS

Attitudes of drivers towards the examined systems comprise part of the general attitudes of drivers towards driving related elements. In additions, these attitudes are also formed by the society in which the drivers belong. Hence, the attitudes of Greek drivers as these were recorded from the questionnaire survey should be investigated taking into account significant particularities of this specific driver group and should not be examined as isolated parameters. The mentality of driver groups as this is established within the geographical and societal borders is of great importance. Greek drivers may have different mentality and hence driver behaviour from other drivers and under the light of these differences results may be interpreted in different ways.

A first important difference between Greece and most European countries is that Greece demonstrates rather high accident rates [5] mainly due to insufficient maintenance of the road network, inappropriate behaviour of the road users and lack of efficient and systematic enforcement [6]. Although accident rates have been decreasing during the recent years, they are still quite high. Hence, road safety constitutes a significant problem of the Greek society, and Greek drivers in general are conscious of its existence, and this could be an attribute that may influence driver attitudes towards safety improving technologies.

Another direct parameter that is anticipated to influence driver attitudes towards new technologies is driver familiarisation with intelligent transport systems as these are quite recent in Greece. Common systems that are in use include navigation systems, but only as nomadic devices and not built-in the vehicle. These systems provide only route information and no elements of real-time information are included in their operation, yet. Further to that, variable message signs (VMS) are also operating in the greater Athens area [7], in a motorway (Attiki odos) [8] in the vicinity of Athens and further south, and in a national road (Egnatia odos) [9] in the Northern part of Greece. The operation of the VMS commenced in 2004. Advanced traveller information systems (ATIS) are also operating in the metro stations indicating the waiting times. However, the above systems were implemented subsequent to the conduction of the questionnaire survey. What is important is to identify the familiarisation of Greek drivers on intelligent transport systems at the time of the survey. Greek drivers are driving vehicles equipped with ABS (anti-lock braking system) and some with ESP (electronic stability positioning), but these are not considered to be intelligent tranposrt systems. A first attempt of the introduction of ITS and more specifically ATIS was made in 1997 in Athens within the framework of the QUARTET PLUS project [10]. VMS were positioned at dedicated locations, and information on the traffic conditions of downstream routes was provided supported also by the development of an internet-based traffic map of Athens providing information on traffic conditions and travel times on specific routes using major arteries also took place. However, at the time of the conduction of the questionnaire survey, Greek drivers were not familiar with the operation and use of intelligent transport

systems. The non-familiarity of Greek drivers of new technologies is expected to affect their attitudes towards the examined ITS. This influence could lead in them being rather sceptical, as it would comprise the reaction of a first encounter with such new technology or being rather enthusiastical as they are not aware of the intervention of the system in the driving task.

Another indirect parameter that could influence driver attitudes towards ITS is the fact that a number Greek drivers is not law-abiding [11]. Existing rules of the highway-code may often adjusted and tailored to their needs under the notion that 'they know better' or 'they are careful' when they violate them. An example is exceeding the overtaking a slow driver on the inside [12]. In the cases that this is a conscious violation the driver argument is that either the posted speed limit is lower than it should be or that they drive carefully even at higher speeds so there is no risk involved. Still, a proportion of drivers acknowledges that this behaviour is risky [13].

NEEDS FOR ITS

In this section, the Greek drivers needs on the suggested ITS as these were recorded from their answers to the question 'How useful would you find a …?' are presented. The different systems that were investigated within the framework of this study are:

1. Navigation system (en-route)
2. Congestion warning system (en-route)
3. Speed limiting system - mandatory intelligent speed adaptation system that prevents exceeding the speed limit
4. Alco-lock system - monitors driver BAC (blood alcohol concentration) and prevents the driver from driving in case it is higher than the legal limit
5. Fatigue intervening system – monitors driver conditions, and if fatigue is detected it forces the driver to take a break

The possible answers to the posed question were: 'very', 'fairly', 'not very' and 'not at all'. Driver needs are presented in relation to the drivers' accident involvement and hence the possible answers are presented in relation to two accident involvement categories. The two categories consist of drivers that have been involved in injury accidents and drivers that have been involved in damage only accidents during the past three years. The results presented in this study comprise only the positive driver attitudes towards the systems. The results of the analysis are presented in Table 1.

Table 1. Driver needs on ITS

	Injuries		**Damage only**	
	very useful (%)	fairly useful (%)	very useful (%)	fairly useful (%)
navigation system	52,3	21,5	42,2	34,5
congestion warning system	65,2	16,7	53,4	30,9
speed limiting system	50	27,3	33,9	35,6
alco-lock system	53	18,2	34,6	30,4
fatigue intervening system	34,3	34,3	33,6	32,8

Greek drivers have a positive attitude towards the investigated new technologies, as their recorded usefulness ranges from 66,4% to 84,3%. Information systems are considered to be more useful regardless of their accident involvement. The congestion warning system scores most on drivers' preferences, whereas the alco-lock and fatigue monitoring systems score the least. It must be noted, that even intervening systems such as the speed limiting system score unexpectedly high, which might be explained by the specific characteristics of this sample group (i.e. Greek drivers).

Results indicate that drivers' accident involvement influences the perceived driver needs on the investigated systems. In particular, driver needs are increased as the accident severity rates increase, for all investigated systems. Hence, drivers that have been involved in injury accidents tend to have higher needs on the investigated systems than drivers that have been involved in damage only accidents. This increase is higher for the systems that are anticipated to improve road safety (speed limiting, alco-lock and fatigue monitoring). The results indicate that campaigns to support intelligent transport systems can be successful and should target at the relationship between the systems and road accidents.

ITS ACCEPTABILITY

Next the acceptability of intelligent transport systems by Greek drivers was investigated. The acceptability of ITS was determined with the use of the following question: 'How positive would you be for a …?'. Acceptability was investigated for the following systems:

1. Speed limiting system - mandatory intelligent speed adaptation system that prevents exceeding the speed limit
2. Black box that will provide information to identify accident causes
3. Black box that will record driver behaviour and could be used from the police as evidence of dangerous driving.
4. Electronic identification system that will provide access to specific services (GPS, e-tolls etc)
5. Electronic identification system that could be used for enforcement by the police

The possible answers to the posed question were: 'very', 'fairly', 'not very' and 'not at all'. The drivers' answers were also analysed in relation to their accident involvement, as demonstrated in the previous section. As in the previous section, only answers that indicate positive attitudes of drivers are presented. Table 2 illustrates driver acceptability on the investigated systems in relation to their accident involvement.

Table 2. Driver acceptability on ITS

	Injuries		**Damage only**	
	very (%)	fairly (%)	very (%)	fairly (%)
speed limiting system	48,5	27,3	32,6	39,8
accident data black box	53	27,3	50,6	32,1
driver behaviour black box	48,5	22,7	36,6	28,1
E-identification for services	43,1	24,6	25,2	32,9
E-identification for the Police	38,5	23,1	22,4	22,8

Results indicate that driver acceptability varies greatly between the systems, in contrast to driver needs. More specifically, 45,2% to 82,7% of drivers are positive towards the investigated systems. The black box that will help on the identification of the causes of an accident is the most popular system being followed by the speed limiting system. On the other hand, the e-identification system that will monitor driver behaviour and will provide information to the police scores very low in driver preferences, as expected. For four of the systems (the accident black box system is excluded) accident involvement affects driver acceptability as, acceptability of the systems increases with the increase in accident severity. However the ranking of the systems as defined by driver preferences is the same regardless of the accident involvement.

ITS CLASSIFICATION BASED ON DRIVER PREFERENCES

Last, the investigated systems can be classified based on drivers' preferences, and an illustration of such a classification that divides systems into popular and unpopular is presented in Table 3.

Table 3. Driver preferences on ITS

Popular Systems	Unpopular Systems
navigation	speed limiting
traffic congestion warning	alco-lock
black box (accident data)	fatigue intervening system
e-identification (data for driver services)	
	black box (driver behaviour)
	e-identification (data to police)

CRITICAL PARAMETERS FOR ITS ACCEPTANCE

Currently analysis is conducted to test the relevant parameters that may affect driver preferences on ITS. First, identification of the anticipated influencing parameters shall take place and following that all possible correlations will be tested. Last, effort is made into designing a model that may predict driver preferences based on their characteristics and accident involvement. Initial analysis has been conducted to test the relevant parameters that might affect driver safety.

More specifically, one may assume that the relationship between accident involvement and driver preferences on ITS is twofold. Accident involvement - i.e. how many and what types of accidents drivers have had will affect their needs and hence preferences on intelligent transport systems. On the other hand, assuming that accident involvement is strongly correlated with driver behaviour and as driver attitudes towards ITS are also part of driver behaviour, driver preferences on ITS may also affect - indirectly - driver safety.

Within this framework, discriminant analysis was conducted to correlate accident involvement with driver characteristics and behaviour. Analysis resulted in a model for predicting whether there is involvement in injury accidents in which the determinant factors

were driver gender, driver age, annual mileage driven, and behaviour attitudes the following systems: navigation, congestion warning, speed limiting, fatigue intervening and the e-identification system used by the police. Similarly, a prediction model for involvement in material damage-only accidents (accuracy 59,2%) has the following variables: driver gender, annual mileage driven, and attitudes towards the following systems: congestion warning, alco-lock, speed limiting, accident data black box and the e-identification system used by the police.

DISCUSSION

This research investigates Greek driver attitudes towards new technologies that may improve road safety, and traffic and environmental conditions. Attitudes are examined in relation to perceived needs of drivers on ITS and ITS acceptability. The results indicate that Greek drivers are quite positive towards the investigated systems. However, the calculated positive percentages are considered to be rather high especially when compared to similar attitudes that have been recorded in other countries [14]. This difference can be caused by respondents responding "properly" to the questions by stating what should be a "safety-targeted" answer and not necessarily what their actual opinions are. This factor however may also be an influencing factor for the responses provided in the other examined countries. The road safety conditions in Greece, (i.e. high accident rates in relation to other countries) may also make Greek drivers needier and hence more positive towards systems that will improve this part of their life. Last, since Greek drivers are not familiar with such new technologies they cannot evaluate the impact of their implementation and in particular the resulting reduction of their 'driving freedom'. This might lead them to be more positive towards these technologies in relation to other drivers.

Next, driver attitudes were examined in relation to driver involvement in road accidents. The descriptive analysis of the data demonstrated that these two parameters are related. Drivers hat involved in more severe accidents tend to be more positive on the use of intelligent transport systems. In addition the results of discriminant analysis indicated the systems, the attitudes towards which are related to driver accident involvement. Results of the analysis also indicated that driver age and driver mileage also comprise an influencing parameter.

Results on drivers' attitudes demonstrate driver belief that the systems can improve road safety. This should be exploited appropriately when designing implementation strategies to support the use of intelligent transport systems, and allow for optimal effectiveness of the systems on road safety. Further research should look into including additional contributing factors such as age, gender, driving experience, etc. providing thus a more complete picture of the ITS driver acceptance and the design of a prediction model that estimated driver attitudes on ITS in relation to their accident involvement.

REFERENCES

[1] Golias, J., Yannis, G. and Antoniou, C. (2002). Classification of driver-assistance systems according to their impact on road safety and traffic efficiency. *Transport Reviews*, vol. 22(2), pp. 179 – 196.

[2] Spyropoulou, I., Karlaftis, M., Penttinen, M., Golias, J. and Yannis, G. (2005). Intelligent Transport Systems Today: A European Perspective, In Proceedings *European Transport Conference 2005*, Strasbourg, AET.

[3] Penttinen, M., Spyropoulou, I., Bauer, A., and Vaa, T., (2006). Opportunities and threats of ITS - expert opinions. In Proceedings *13th World Congress on Intelligent Transport Systems and Services*, London.

[4] SARTRE 3, 2004, Making our drivers and road safer. Selected results of a European survey, European Commission.

[5] SAFETYNET, (2005), Annual Statistical Report (based on data from CARE), European Commission.

[6] Yannis, G., Papadimitriou, E. and Antoniou, C. (2007) Multilevel modelling for the regional effect of enforcement on road accidents. *Accident Analysis & Prevention*, (In Press, Corrected Proof).

[7] Sermpis, D., Babis, C. and Theofilis, I. (2006) The effects of the VMS use in Athens, In Proceedings of the *13th World Congress on Intelligent Transport Systems and Services*, London.

[8] Papandreou, K., Kopelias P. and Prokos, T. (2006) Incident Management in Road Concession Projects: The Case of the Attica Tollway. In Proceedings *1st Symposium of on Freeway and Tollway Operations*, Athens, TRB.

[9] Koutsoukos, K. P. (2006) Incident Management Framework for Egnatia Odos. In Proceedings *1st Symposium of on Freeway and Tollway Operations*, Athens, TRB.

[10] QUARTET PLUS, (1999), Validation of a European urban and regional IRTE based on open system architectures, Final Report, European Commission.

[11] Kontogiannis, T., Kossiavelou, Z. and Marmaras, N. (2002). Self-reports of aberrant behaviour on the roads: errors and violations in a sample of Greek drivers. *Accident Analysis & Prevention*, vol. 34(3), pp 381-399

[12] Ozkan, T., Lajunen, T., Chliaoutakis, J. E., Parker, D. and Summala, H. (2006). Cross-cultural differences in driving behaviours: A comparison of six countries. *Transportation Research Part F*, vol 9, pp. 227-242.

[13] Kanellaidis, G., Golias, J. and Zafiropoulos, K., (1995). A survey of drivers' attitudes toward speed limit violations. *Journal of Safety Research*, vol. 26(1), pp. 31 – 40.

[14] SARTRE 3, (2004), European drivers and road risk. Report on principle analyses, European Commission.