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Acceptance of automatic violation-registration systems

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SUMMARY

In *Chapter 1*, it was argued that many traffic accidents are preceded by a traffic violation. In order to diminish the amount of deaths and casualties caused by traffic accidents, the amount of violations should be reduced. An effective way to reduce the amount of violations is to discourage, by means of intensive police surveillance, driving behaviour that transgresses the law. However, it requires a large police force to conduct all these surveillance duties. This disadvantage might disappear with the introduction of automatic surveillance. Up until now, drivers have been familiar with violation registration by police officers and by on-site equipment. These forms are quite well accepted by the drivers. Technologically, another way of law enforcement is also possible - an in-car violation registration system. With this system, the driver is under continuous control. The system operates automatically and every violation can be registered. This form might be a very intensive form of police control and effective in diminishing the amount of accidents. Whether or not such a system will be accepted by drivers is yet unknown, but it is important to investigate this. Acceptance is thought to be crucial for the success of a system, which also involves other factors such as costs and benefits, technological and juridical elements. If drivers do not accept a new system, they will probably not act according to the demands of the system, or they might resist it. In that case the system will not be successful. In this thesis, the acceptance of registration systems by drivers will be investigated.

The acceptance will be assessed according to the aspects of a system one can distinguish (e.g., its way of meting out punishment, or its accuracy). These aspects might contain some underlying components, some aspects might relate to an 'enforcement' component (e.g., the aspect: the severity of punishment after a violation), other aspects might be linked to the technological functioning of the system (e.g., the aspect of when exactly does one exceed the limit). The investigation of these components might facilitate and direct further studies on the acceptance of systems.

Acceptance will be determined for two groups of drivers, offenders and non-offenders. Especially in the case of offenders, it is important to know the aspects upon which their acceptance is based, because they are the ones who will be most affected by the system. Another subject of study is the 'human operator'. It is often said that, with the introduction of automatic registration, the human operator will disappear. What this means is not fully known. The acceptance of policing by police officers will therefore be compared to policing with automatic systems. Policing by police officers is already accepted, so this comparison might reveal which aspects are important for the 'human operator'. Distinguishing those aspects which are relevant for the acceptance of a system might provide the means to design a new system in such a way that its acceptance can be guaranteed in advance or this knowledge can be applied to make a prediction of the system's acceptance.

Another issue of interest is whether or not the effectiveness of a system (i.e., does it lead to fewer violations and accidents?) will enhance its acceptance. It is assumed that the more a system reduces the amount of violations and accidents, the more it will be accepted. Finally, in the present study, we shall investigate whether or not experience with a registration system influences the acceptance of such system.

Several previous studies about traffic systems are reviewed in *Chapter 2*. Registration systems are reviewed, in addition to feedback and information systems. Firstly, it appears that systems can be distinguished on three dimensions: 1) the *location* from which the system provides the driver with varying kinds of information (e.g., traffic jams, feedback about one's own traffic behaviour, or about receiving a citation because of a violation), from the roadside or from equipment in the car; 2) the function of the system related to the degree of *intervention* with the driver's behaviour, and 3) the level of *intrusiveness* of the content of the messages provided by the systems. The main difference found between information, feedback and support systems, on the one hand, and police registration systems on the other, is that the first category of systems has benefits for the user whereas police registration systems mainly have a benefit for society and for drivers who already drive in accordance with the traffic rules. It was thought that a system providing information on-site alone would be accepted more than a system that continuously polices a driver's traffic behaviour in-car, constantly providing him/her with feedback, because this latter system is meant to compel the driver, in one way or another, to adjust or maintain her behaviour to conform to the traffic regulations.

Secondly, many relevant aspects are found: e.g., the possibility of warning a driver if she is violating, enhancing safety on the road in general and for the driver in particular, the societal benefits (e.g., less pollution, fewer traffic jams), and personal benefits (e.g., less travelling time, lower costs). These aspects are dealt with in Chapters 4 and 5, with respect to different registration systems.

Thirdly, the sort of violation that is under control of the system also appears to be of importance (e.g., a speed-violation registration system was more acceptable than an illegal-parking registration system).

The methods used to assess the acceptance of a system are also reviewed. It is found that various different concepts are used, but that attitudes are very often used and appear to be very important to the researchers. We conclude that attitudes mainly assess the cognitive and affective evaluation of a system, while we think that acceptance seems to be more a judgment on the behavioural level and therefore must also be assessed in behavioural terms.

In *Chapter 3*, an acceptance model is presented to assess the acceptance of a registration system. It is based on the Theory of Planned Behaviour (Ajzen & Fishbein, 1980; Ajzen, 1989). To include the behavioural level of acceptance, acceptance was defined as *the degree to which a person will not resist the implementation of a registration system*. Attitudes were thought to be one of the variables that influence acceptance. Attitudes can be directed towards the **acceptance** of a system and are then defined as evaluations of the acceptance in terms of favour or disfavour. Attitudes can also be directed towards the **registration system**. These attitudes are based on the evaluation of adjectives which are relevant with respect to the system. These attitudes were thought to be influenced by the beliefs about the aspects of a system.

Other variables in the acceptance model that were thought to influence acceptance are social norm, personal norm, perceived behavioural control and driving behaviour. This last determinant makes it possible to distinguish between violators and non-violators. Violators are expected to accept a registration system to a lesser degree than non-violators, because

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their behaviour will be more affected by the system, if implemented. In this chapter, the research questions of this thesis are formulated.

In *Chapter 4*, two pilot studies were carried out in order to test the list of aspects on their importance; these aspects were derived from the reviewed studies discussed in *Chapter 2*. After two pilot studies, 20 aspects were identified which are relevant for the evaluation of a registration system. The beliefs about these aspects were assumed to represent the current salient beliefs with respect to registration systems.

The beliefs were used in a study (*Chapter 5*) about police registration and on-site automatic registration. To measure the effect of registration on the beliefs and on driving behaviour, two surveys were carried out, one before and one after a period of police activities; both surveys were also conducted on a control road where no police activities were carried out. Ultimately, 17 beliefs about a registration system were evaluated. All the beliefs were found to be (very) important. The most important beliefs concerned: the possibilities for misuse of data on the drivers; the accuracy of the system, so that only drivers who committed an offence could receive a citation; fairness, so that every driver who commits the same offence has the same chance of detection; and, if caught, they will receive the same punishment; that registration is active on those spots where a lot of accidents happen; and that road safety will be enhanced. The relatively least important beliefs concerned: the possibility to reward a driver for driving according the rules; personal economic benefits; and being warned while violating. The beliefs could be clustered into four factors: *societal effects*, referring to the effects of registration on society, (e.g., fewer accidents and less pollution); *enforcement effects*, referring to the possibilities of registration to warn and/or punish drivers after violating; *fairness*, referring to accurate registration, in which no misuse of the data on registered drivers can be made, and in which all driver have an equal probability of being detected after violating; and *positive personal effects*, referring to the effect that registration may have on individual drivers when they comply with the traffic rules (e.g., fewer accidents, lower costs or even a reward when no fine has been received during a certain period of time).

The beliefs concerning the societal effects of registration systems were the most positive ones and those concerning the positive personal effects were least positive. The enforcement effects of a registration system were evaluated positively to a moderate degree. The fairness of a registration system was also evaluated moderately positively and would be evaluated more positively if 'no misuse of registered data' on violating drivers could be guaranteed.

If different systems are under evaluation, these four factors can be useful to determine which groups of beliefs are important for a certain system. In that way, they might be useful in predicting acceptance. Drivers in this study had more positive beliefs about police registration than about on-site registration. The human factor in policing and registration is mainly associated with the beliefs concerning the societal effects of registration and with the following separate beliefs: that it will lead to more road safety, has more societal benefits, ensures a shorter time between violation and registration, and puts more constraint on violators.

Beliefs about registration in this survey were not influenced by on-site registration activities.

As a result of experience with the registration system, the drivers' reported speed did change; it decreased somewhat and the registered speed was decreased to a larger extent, about 2.5 km/h.

In general, drivers who normally obey traffic rules (non-violators) are more positive about both forms of registration, by police officers and by on-site equipment, than drivers who regularly violate traffic rules (violators). Beliefs which need special attention to influence the opinion of violators positively are the same as those associated with the human factor of police registration, as was mentioned above. Furthermore, in this study, a positive relation was found between a driver's attitude and speed; the faster one normally drives, the less positive one's attitudes towards registration systems.

In *Chapter 6*, a survey is described in which registration by police officers was compared with a system that was thought to be more intrusive than on-site registration, namely an in-car system. The feature of this type of in-car system is that it can continuously control a driver's behaviour; theoretically it can register every kind of violation. In this study, the system monitored the drivers' law-abiding behaviour and provided the drivers with warning messages in cases of speeding and red-light running. Young and older drivers were compared, in a pre- and post-measurement, with respect to two dimensions, usefulness and satisfaction. These two dimensions formed the attitude towards the system, which was also called 'user acceptance'.

Both groups found the system, before and after driving, useful (the young drivers) or even very useful (the older drivers). However, satisfaction with the system changed for the young drivers from slightly satisfying prior to driving to slightly unsatisfying afterwards. The older drivers expected the system to be slightly unsatisfying before driving but, after driving, they were very satisfied with it.

Beliefs about the system were also measured. Most beliefs were found to be important, only three beliefs were of minor importance: personal reward, personal benefit and warning. The beliefs about and the attitudes towards the in-car system were more positive than those towards registration by police officers. The effectiveness of the in-car registration system (i.e., in diminishing the amount of violations and accidents) was thought to be high. The effect of the in-car system on speeding behaviour was positive for both the young and the older drivers; it leads to a decrease in driving speed and in the quantity and amount of speed violations.

Age and offending behaviour were found to be highly related, especially on an 80 km/h road. It was found that, within the group of young drivers, about 80% were offenders, and, within the group of older drivers, about 80% were non-offenders. Age was also found to be related to the effectiveness of the system and attitudes towards the system. For young drivers, it was found that the more effect the system had on their behaviour, the more negative their attitudes were. For the older drivers, the opposite was found; the more effective the system was to them, the more positive their attitudes were.

To assess the attitudes (or user acceptance) of different in-car systems, a third survey was

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conducted and described in *Chapter 7*. The user acceptance of six systems was assessed, varying from a feedback system that was thought not to have a high degree of intervention, to a collision-avoidance system that takes over certain driving behaviour (e.g., braking), which was thought to have a high degree of intervention. In six studies, six systems were tested in a simulator car or in a car with instruments on the road. User acceptance was again split into the two dimensions of usefulness and satisfaction with the system. The usefulness and satisfaction scales had a very high rate of consistency in all studies and are very well able to assess the user acceptance of any in-car system.

In general, prior to driving, the drivers in the studies expected that all six systems would be useful and would also be either not or only slightly satisfying. After test drives with the systems in the simulator car, the systems were still thought to be useful, although some to a greater and some to a lesser extent. Satisfaction with the systems, however, changed in a more negative direction for some systems and in a more positive one for others. This seemed to depend upon the degree to which a person is forced to act in a specific way (e.g., in one study drivers received tactile feedback by means of a counterforce on the accelerator if they drove too fast). The more a system restrains free choice of behaviour, the more unsatisfying the system was evaluated as being. The most satisfying were the warning signals, which only provide information.

Chapter 8 discusses the last survey, which embodied all variables of the acceptance model as depicted in Chapter 3. Three systems were evaluated: police officer registration, on-site registration and in-car registration, with respect to two violations, speeding and red-light running.

The acceptance of a violation registration system was best predicted by the attitude towards and social norms about accepting a system. This means that acceptance is best predicted by following the approach of the Theory of Reasoned Action, which is a precursor of the Theory of Planned Behaviour. Perceived behavioural control, personal norm and driving behaviour did not add any substantial value to the prediction of acceptance. Beliefs about the system and the user-acceptance of a system can be used very well to reveal important information about the systems, but, to predict the acceptance of a system, the attitude towards acceptance is a better predictor.

The beliefs were grouped according to three underlying factors and these factors referred to the societal/personal effects, the fairness, and the controllability of the driver over the system. All three systems were thought to have positive societal and personal effects and are thought to be fair, but are also thought to have a low degree of controllability.

Drivers who normally speed are, in comparison to drivers who normally obey the speed limits, more negative in their attitudes; this will, according to the acceptance model and the theory of reasoned action, negatively influence the acceptance of a system.

Chapter 9 summarises the most important findings of the surveys. The acceptance of registration systems is best predicted by attitudes towards and social norms about the acceptance of such system. For the judgement of the systems, two instruments are thought to be helpful, 1) the beliefs about the system and the underlying three factors within these beliefs (societal/personal effects, fairness and controllability) and 2) the attitude towards the system, assessed by means of the adjectives of the system and the two dimensions into

which the adjectives could be divided (usefulness and satisfaction).

It is concluded that registration by police officers is most readily accepted, followed by the on-site registration. In-car registration is not accepted by drivers, especially not by speeders. To reduce the amount of violations and accidents the best method will be to implement more on-site registration, because this form is accepted and also perceived as being effective in enhancing road safety. The implementation of in-car registration is not accepted by the drivers involved in this thesis, but, if policy makers wish to implement it, they should be aware of the following implications, according to our findings.

Firstly, the systems must be designed in such a way that the driver will be supported while driving. Secondly, an implementation must be conducted in steps. Initially, the system must support, at a later stage it must control, and in a final step (if necessary) it should register violations and hand out punishment. Thirdly, if a system is to be implemented, it will meet the least resistance if it is required by law for specific driver groups, e.g., those drivers who violate the most, or young drivers who have just received their driving license.

SAMENV

In hoofdstuk 1 wordt de verkeerstoestand in Nederland te reduceren. Een effectieve wetgeving wordt door intensieve hetgeen op wel haalbaar verkeersovervloed van de door automatische auto. Bij registraties geldende straffen toezicht is deze vorm vanwege het succes financiële (minder ongelukken minder ziektedagen van een niet te zijn voor zouden ze verzetten. Daarom acceptatie aspecten d... bekeuren, c... Een ander c... gezegd dat... werd daaro... door agente... duidelijk w... zullen waa... Door aspec... team, zou... geaccepteer... worden. Het is mo