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Intelligent speed assistance for serious speeders: The results of the Dutch Speedlock trial

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ABSTRACT

One of the most important policy questions regarding Intelligent Speed Assistance (ISA) is whether or not it should be implemented, and if so how. In 2010 the Dutch Ministry of Infrastructure and the Environment decided to perform a field operational test to investigate the possibility of using ISA as a penalty system for serious speed offenders. This paper presents the results of this research, focusing on the effects on road safety. The results show that the two types of ISA systems that were tested have a huge effect on driver behavior and have the potential to improve road safety by reducing the level of speeding, mean speed, as well as the standard deviation of speed. However, the users show little sign of learning after the systems are turned off. Moreover, the serious offenders frequently use the emergency button to override the system which might seriously affect the efficacy of the system.

1. Introduction

Every day people in Europe and other parts of the world are confronted with the grim reality of losing loved ones due to traffic accidents. In 2004 the World Health Organization estimated that 1.2 million people die annually in traffic accidents, and another 50 million suffer non-fatal injuries (World Health Organization, 2009). This means that over 3000 people die every day, or more than 2 every minute. In the EU-15 alone a total of over 734,000 European citizens were killed in traffic accidents between 1991 and 2008. Road safety in Europe has however improved significantly over the past decade (43% less fatalities in 2010 compared to 2001).

Research shows that: “Excessive and inappropriate speed is the number one road safety problem in many countries, often contributing as much as one third to the total number of fatal accidents” (Organisation For Economic Co-Operation and Development (OECD, 2006)). Speeding not only influences the risk of getting involved in a traffic accident, it also affects the outcome of an accident. For the Netherlands, Oei and Polak (2002) estimated that, if all drivers complied with the legal speed limit, the number of accidents resulting in casualties would be reduced by between 25% and 30%.

In the past a wide range of policy options have been considered to address speeding behavior. These measures (speed management measures) are often categorized using the three E's: Engineering (related to both vehicle and infrastructure), Education, and Enforcement (for examples of these measures and effects see Elvik and Vaa, 2009). When it comes to speed management, there are many successful examples for each of the three E's. However, history shows that vehicle engineering measures are structurally underused. Vehicle design is usually focused on making the vehicle faster instead of making speeding more difficult. For example, research shows that in Sweden the average top speed of all newly sold passenger vehicles has increased significantly over recent decades, from 153 Km/h in 1975, to 172 Km/h in 1985, 194 Km/h in 1995, and to over 200 Km/h in 2002 (Sprei et al., 2008). In-vehicle systems that assist the driver in driving the vehicle are called Advanced Driver Assistance Systems (ADAS). Intelligent Speed Adaptation (ISA) is an example of an ADAS designed to assist the driver in choosing the appropriate speed.

ISA is an in-vehicle system that helps the driver to comply with the legal speed limit at a certain location. ISA technology is relatively straightforward and uses the functionality of systems that are already available in most vehicles (e.g. a GPS device, digital maps, engine management systems, etc.). Most ISA devices can be

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assigned to one of three categories depending on the level to which they are able to intervene, or how permissive, they are (Carsten and Tate, 2005). An informative or advisory ISA system provides the driver with feedback using a visual or audio signal. A supportive or assisting ISA system intervenes when the speed limit is exceeded by, for example, providing increasing counter pressure on the accelerator pedal when the driver attempts to drive faster than the speed limit. A restricting or intervening system prevents the driver from exceeding the limit: the driver cannot overrule the system. Since the early 1980s, the effects of ISA have increasingly been studied using different methodologies and data collection techniques, including traffic simulation, driving simulators, and field operational tests. ISA has also been demonstrated in different trials around the world including Sweden (Almqvist and Nygard, 1997, Biding et al., 2002), the Netherlands (Duynstee, 2001), UK (Carsten and Tate, 2000; Carsten et al., 2008), Australia (Regan et al., 2006), Belgium (Vlassenroot et al., 2007), etc. The conclusions from these trials and research are unambiguous regarding the positive effect of ISA on driving speed, and the calculated effects on road safety (AVV, 2001; Lahrmann et al., 2001; Biding and Lind, 2002; Saad et al., 2007; Vlassenroot et al., 2007). The most advanced ISA is expected to reduce the number of fatalities by 59% (Carsten and Tate, 2005). Recent Australian research shows that, depending on the assumptions underlying the research, the benefit-cost ratio could vary from 0.29 to 4.03 (Doecke and Woolley, 2011).

Over time the research into ISA has gradually moved from focusing on the technical realization to research regarding the effects in general, to more implementation-related research. Current research focuses for instance on the cost and benefits of ISA implementation (e.g. Doecke and Woolley, 2011; Lai et al., 2012), the selection of target groups for implementation (Lahrman et al., 2012b) and on ways to get ISA implemented (e.g. Agusdinata et al., 2009; Van der Pas et al., 2010; Van der pas et al., 2012; Vlassenroot, 2011; Jimenez et al., 2012). Some researchers argue that ISA implementation will not take place on a voluntary basis and that implementation should start with specific groups, for instance for young drivers (Van der Pas, 2011; Lahrman et al., 2012b), or as a sanction for speed offenders (Lahrman et al., 2012b). Indeed, in 2010 the Dutch Minister of Infrastructure and Environment promised the House of Representatives that the possibility of implementing ISA as a penalty for serious speed offenders would be investigated (source M. H. Schultz van Haegen-Maas Geesteranus, 2011). This is the first time a field operational test has combined this specific target group with this type of system. For this research two types of ISA systems were defined by the Ministry: a Speedlock and a Speedmonitor. The main goal of the research presented in this paper was to gain insight into the road safety effects and the preconditions necessary for the implementation of a Speedlock and a Speedmonitor for serious speed offenders in the Netherlands. In this paper we will address the following research questions:

1. What are the effects of a Speedlock and Speedmonitor on the speed behavior of a serious speed offender?
2. What is the effect of the design of the Speedlock and Speedmonitor on serious speed offenders (e.g. does the target group use the emergency button more often than regular users)?
3. What are the road safety effects of a Speedlock and a Speedmonitor?

The field operational test lasted 7 months and took place in 2011, following 51 drivers who drove over 650,000 km in the Dutch provinces of Noord- and Zuid-Holland with a Speedlock or a Speedmonitor. In addition a group of experts (in the field of road safety and serious speed offenders) were invited to drive with the systems for four weeks and to assess the system in a focus group. This paper focuses on the results regarding driving behavior based on in-vehicle data and the expert focus group. An assessment of the state of the art of the technology and other topics such as acceptance and workload are beyond the scope of this paper and will be addressed in a separate paper.

Section 2 presents the research methodology and the characteristics of the field operational test. In Section 3 presents the main results based on the vehicle-data collected. Section 4 presents a discussion of the results and Section 5 the conclusions.

2. The research methodology

2.1. The design of the trial

The Netherlands is a frontrunner when it comes to road safety (ETSC, 2012) and has carried out different ISA trials in the past, one of the first being the field operational test with a restricting system in the region of Tilburg in 1999 (Duynstee et al., 2001a,b). Since then a number of smaller ISA or ISA related trials have been performed: a trial with garbage trucks in The Hague (2004), a study with ISA around school environments (2007)), a trial with a Speedalert system (2008), and a trial with minivans in Enschede (2009).

In 2009 a study by the Dutch Ministry of Infrastructure and the Environment revealed two promising systems to address the speeding behavior of serious speed offenders (Source DHV 2009): a monitoring device (Speedmonitor), and a more restrictive speed limiting system (Speedlock). This research tested both systems.

The field operational test adopted a "within subject design" for each of the systems (a similar A-B-A design to the one used by, for example, Lai et al. (2012)). Fig. 1 shows the design of the field trial.

2.1.1. The Speedlock and the Speedmonitor

The Speedlock is a system that prevents a vehicle exceeding the local speed limit. The system continuously limits the car to the locally prevailing speed limit (plus a margin). This margin depends on the speed limit – where the speed limit is below 60 km/h the margin is 3 km/h, where the speed limit is 60 km/h or above the margin is 5 km/h). The Speedmonitor is a system that provides feedback when the legal speed limit is exceeded. In addition the system analyzes the times when the speed limit is exceeded. Based on the time spent speeding, the location (prevailing speed limit), the number of km/h above the speed limit, and previous behavior the Speedmonitor is able to, with a warning, autonomously implement a temporary Speedlock (Appendix 1 explains the underlying credit system used). Both systems were equipped with an emergency button that allowed the participants to override the speed limit, initially for 15 s. If, after these 15 s, the speed is below the speed limit, the Speedlock comes back into operation. If after 15 s the speed is still above the speed limit, the system gives a loud high beep every 2 s. Once the vehicle speed drops below the speed limit, or after a maximum of 1.5 min, the Speedlock becomes active again. If necessary (if the speed limit is still being exceeded) the Speedlock can immediately be deployed again. Fig. 2 shows a picture of the Speedlock, and a number of screenshots in specific situations.

The systems were not available off-the-shelf, but had to be designed, developed, tested, and implemented. A great deal of insight was gained through this process into the challenges of implementing both a Speedlock and a Speedmonitor. It also revealed the fact that the systems could be overridden by use of the cruise control. In the field operational test an agreement was included in the contract with the participants that they were not allowed to use the cruise control during the period of the trial. The use of the cruise control was monitored during the field operational test and if its use was observed participants were reminded of the contract.