Accident Analysis and Prevention 73 (2014) 313–322

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Automated section speed control on motorways: An evaluation of the effect on driving speed

Ellen De Pauw *, Stijn Daniels, Tom Brijs, Elke Hermans, Geert Wets

Transportation Research Institute Hasselt University, Wetenschapspark 5, BE-3590 Diepenbeek, Belgium

ARTICLE INFO

Article history:
Received 15 January 2014
Received in revised form 4 September 2014
Accepted 6 September 2014
Available online xxx

Keywords:
Automated section speed control
Before–after study
Enforcement
Motorway
Speed
Traffic safety

ABSTRACT

Automated section speed control is a fairly new traffic safety measure that is increasingly applied to enforce speed limits. The advantage of this enforcement system is the registration of the average speed at an entire section, which would lead to high speed limit compliances and subsequently to a reduction in the vehicle speed variability, increased headway, more homogenised traffic flow and increased traffic capacity. However, the number of studies that analysed these effects are limited. The present study evaluates the speed effect of two section speed control systems in Flanders, Belgium. Both sections are located in the opposite direction of a three-lane motorway with a posted speed limit of 120 km/h. Speed data were collected at different points: from 6 km before the entrance of the section to 6 km downstream from the section. The effect was analysed through a before- and after comparison of travel speeds. General time trends and fluctuations were controlled through the analysis of speeds at comparison locations. On the enforced sections considerable decreases were found of about 5.84 km/h in the average speed, 74% in the odds of drivers exceeding the speed limit and 86% in the odds of drivers exceeding the speed limit by more than 10%. At the locations up- and downstream from the section also favourable effects were found for the three outcomes. Furthermore a decrease in the speed variability could be observed at all these data points.

1. Introduction

Excessive speed is a major traffic safety problem at all road types. Driving at a higher speed than the posted speed limits increases the chance to be involved in a crash and increases the severity of the crash (Elvik et al., 2004; Mountain et al., 2004). The SARTRE 3 survey, which provides information on self-reported speeding behaviour of drivers in Europe, showed that most self-reported speed limit violations occur on motorways. Twenty-four percent of the car drivers reported to violate the speed limit often, very often or always on motorways (SARTRE consortium, 2004). A more recent SARTRE study, which analysed drivers' perceptions of other drivers, indicated that on average 52% of the drivers believe that other car drivers speed on motorways (SARTRE consortium, 2012). Many countermeasures have been developed in order to tackle this problem at motorways from which average speed control is one of the most innovative measures that is gaining popularity. Automated section speed control (ASSC), also called average speed enforcement, time over distance cameras, trajectory control, and point-to-point speed enforcement, measures the average speed over a road section. The vehicle is identified when entering the enforcement section through the registration of the license plate, and again when leaving it. The system calculates the speed of the vehicle based on the time the vehicle needs to cover the distance of the section. Drivers that violate the speed limit are ticketed. The threshold for ticketing drivers may vary between countries. At Flemish motorways the fine includes €50 up to a speeding level of 10 km/h and €5 is added for every km/h above the initial level of 10 km/h. At a speeding level from 40 km/h or more drivers are brought to court, they get a fine between €55 and €2750 and a driving ban for 8 days to 5 years. A technical margin of 6 km/h is applied for speeds lower than 100 km/h; for higher speeds this margin is 6% of the measured speed (www.wegcode.be).

The main reason for the installation of ASSC is the compliance of speed limits. Section control is however also intended to homogenise traffic flows, reduce traffic congestion and environmental and noise pollution (Soole et al., 2013). In addition, the police uses this system for the identification of unlicensed or uninsured drivers and tracking of stolen vehicles.

The focus in the present study is on the use of ASSC to improve speed limit compliance. It describes the results of a study that

* Corresponding author. Tel.: +32 11 26 91 11.
E-mail addresses: ellen.depauw@uhasselt.be (E.D. Pauw), stijn.daniels@uhasselt.be (S. Daniels), tom.brijs@uhasselt.be (T. Brijs), elke.hermans@uhasselt.be (E. Hermans), geert.wets@uhasselt.be (G. Wets).

http://dx.doi.org/10.1016/j.aap.2014.09.005
0001-4575/

analysed the effects of ASSC on the driving speed. The remainder of this paper is organised as follows. The next section gives an overview of previous research that studied the speed effects of ASSC. This is followed by a description of the method. In a fourth section the results are described, and in a last section these results are discussed.

2. Background

Several European countries already have ASSC systems for a longer period, such as the Netherlands, the United Kingdom, Italy and Austria (Soole et al., 2013). However, others installed ASSC more recently, from which Belgium is one example. Since this is still a relatively new measure, there is only a limited number of studies present that analysed the impacts of this approach. Recently, Soole et al. (2013) applied a review of both published and grey literature that examined the effect of ASSC on crash rates, speeding offence rates, vehicle speed profiles, traffic flow and congestion. In general they found several studies which showed that section control is associated with very high rates of compliance with posted speed limits, with offence rates that were less than 1%. Studies reported reductions up to 90% in the proportion of vehicles exceeding the speed limit. Furthermore speed variability reduced, which resulted in more homogenised traffic flows, improved traffic density and reduced journey travel times. The authors concluded that ASSC is a greater network-wide approach to managing speeds that can reduce the impact of time and distance halo effects associated with other speed enforcement measures. Nevertheless these results should be taken into account with caution, since the authors reported that there were methodological flaws in many of the studies they found.

Ragnøy (2011) studied three road stretches with ASSC in Norway. The sections had a length of 5 km to 9.5 km, all with a speed limit of 80 km/h. A before- and after study of the speeds showed a decrease for all three treated locations, with higher effects for roads with a higher driving speed during the before period. From an initial average speed of 76.7 km/h, 88.5 km/h and 89.4 km/h the speed decreased by 2.7 km/h, 10.2 km/h and 8.8 km/h respectively. Furthermore higher speed decreases were found at the entrance and the exit of the section, compared to the middle of the section. An analysis of the speeds downstream after the exit of the section, showed that the speed was influenced for at least 1000 m after the exit.

It should be noted that despite the favourable results that were found by Soole et al. (2013) effects can strongly differ. An evaluation of the driving speed after the installation of ASSC at the A3 motorway in Italy showed a high noncompliance of the speed limits. This noncompliance was 50.5% directly after the installation of ASSC and 57.4% one year after the installation (Montella et al., 2012b). Another study that analysed the effect of ASSC on motorway A56, which is located in the same geographic area, showed more favourable results. The noncompliance of the speed limits in the after period was on average 17% (Cascetta et al., 2010). The authors stated that differences in traffic conditions and the function in the territory could partly justify these differences. Nevertheless they indicated that also the enforcement strategy is an important difference and that higher compliance to the speed limits could be achieved by a better strategy of communication and information to the road users and an increased level of enforcement in the follow-up of offences.

These studies already give an indication of the effects of ASSC. Nevertheless Soole et al. (2013) stated that future research is necessary to improve the scientific rigour of conducted evaluations. At this moment there is only a limited number of peer reviewed journal articles that examined the traffic safety effects of ASSC. The present study analyses the effect of ASSC on speed on a methodologically sound basis, in order to examine whether or not similar results can be found with the limited number of previous studies. Furthermore the present study not only analyses the effects on the section, but also takes the effects at the locations upstream and downstream from the enforced section into account.

3. Method

3.1. Design

In order to analyse the speed effect of ASSC, a before- and after study was implemented. The recorded speeds during the before period were compared with the speeds during the after period. Other elements that could have had an effect on the driving speed during both periods were controlled through the inclusion of comparison locations. These locations were similar with the treated locations on traffic volume and types of vehicles but differed in that there was no ASSC.

3.2. Study and comparison locations

At the Flemish motorways, four locations are currently equipped with ASSC. Two locations at the E17 nearby Ghent, which were however not eligible for a before- and after study since there were problems with the homologation of the system for several years and thus it was not possible to apply an accurate before- and after research. Motorways are defined here as roads for motorized vehicles only with a median barrier and no at-grade junctions (Elvik et al., 2009). The minimum speed limit at Flemish motorways is 70 km/h and the entrance is forbidden for pedestrians, cyclists, moped riders and all vehicles that cannot drive faster than 70 km/h. The two systems which were included in the present study are located at the E40, which runs from the north–west of the country to the south–east and connects different main cities. The enforced sections are located between Ghent and Brussels, more specifically between the exits/entries of Wetteren and Erpe-Mere which covers a length of 7.4 km. The maximum speed limit at this road is 120 km/h, which means that it should take at least 222 s to travel this distance. The section has three lanes in each direction and an emergency lane. Each traffic lane has a width of 3.75 m, the emergency lane is 2.90 m wide. It is a straight road, with no curves below $R = 4000$ m. No formal information on the vertical curvature is available, but in general this environment is flat-surfaced. In 2011 the average daily traffic volume was 52,361 vehicles in the direction of Brussels and 52,662 vehicles in the direction of Ghent. At both directions 11.4% of the traffic were heavy vehicles (vehicles longer than 6.8 m).

Data on speeds were gathered through double inductive loops embedded in the pavement. These loops are present at several locations on the Flemish motorways, however are mainly present at exits/entries and at interchanges. The loops are managed by a government agency, and the data gathered by these loops are frequently controlled. The installations collect speed information on the vehicle level, together with information on date and time, lane number and length of the vehicle.

The selection of the locations to measure speed was based on the presence of inductive loops in the pavement. In total nine locations were selected: five locations in the direction of Brussels and four in the direction of Ghent.

1) E40 in the direction of Brussels:

- Location 1: 2.4 km upstream from the entrance of the section.
- Location 2: 1.7 km upstream from the entrance of the section.