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Behavioural effects of fixed speed cameras on motorways: Overall improved speed compliance or kangaroo jumps?

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ABSTRACT

The present study evaluates the speed effects of fixed speed cameras on motorways. Two locations with speed cameras were extensively examined in a quasi-experiment: (1) a two-lane motorway and (2) a three-lane motorway, each with a posted speed limit of 120 km/h and sited in Flanders, Belgium. The effect is analysed through a before-and-after comparison of travel speeds. General time trends and fluctuations were controlled through the analysis of the speeds at comparison locations. At each of the two roads, data were gathered at five measurement points from 3 km upstream to 3.8 km downstream of the camera. Three outcomes were analysed: (1) average speed, (2) the odds of drivers exceeding the speed limit and (3) the odds of drivers exceeding the speed limit by more than 10%. Speeds decreased on average by 6.4 km/h at the camera locations. Both the odds of drivers exceeding the speed limit (−80%) and the odds of drivers exceeding the speed limit by more than 10% (−86%) decreased considerably. However, before and beyond the cameras the speeds hardly, if at all, reduced. Moreover, the analyses of the speed profiles before and beyond the cameras show that drivers do slow down quite abruptly before the camera and speed up again after passing the camera. It is concluded that a V-profile is found in the spatial speed distribution for both locations.

1. Introduction

Excessive speed is an important contributory factor in many crashes. It increases both the chance of the occurrence and the severity of the crash (Elvik et al., 2004; Mountain et al., 2004). It is a major traffic safety problem at all road types, also at roads with a higher speed limit, such as motorways. According to the SARTRE 3 survey, which provides information on self-reported speeding behaviour of drivers in Europe, the highest number of speed violations occur on motorways. Twenty- eight percent of the car drivers reported to violate the speed limit often, very often or always on motorways (SARTRE consortium, 2004). In Flanders, Belgium the crash risk on motorways is lower compared to other roads, but the severity of the crashes is the highest on these road types: 25.2 deaths per 1000 injury crashes (Carpentier and Nuyttens, 2013). Belgian drivers are more tolerant of speeding on motorways compared to other roads (Boulanger et al., 2011). The average speed of passenger cars is 117.1 km/h, and the 85th percentile speed is 130 km/h (Riguelle, 2012). This average speed is the highest compared to other European countries that have a speed limit of 120 km/h (Finland, the Netherlands, Ireland, Switzerland) and is even higher compared to France, which has a speed limit of 130 km/h on motorways (Riguelle, 2012). In response to this problem of excessive speed, the Flemish government installed fixed speed cameras at motorway locations with a high number of crashes. The present study analyses the effect of speed cameras on the driving speed. Whereas previous studies mainly analysed the effects at the camera location, the present study also analysed the effects at the locations at a greater distance upstream and downstream of the camera. The objective hereof was to point out whether effects, if present, are merely local (at the spot of the camera) or do extend to a wider area.

2. Literature review

An extensive research in Great Britain (Gains et al., 2005) analysed the effect of 502 fixed speed cameras on both speed and crashes. At roads with a speed limit of 50–70 mph (≈80–104 km/h), the installation of speed cameras resulted in an average speed decrease of 5.3 mph (≈8.5 km/h). The

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proportion of drivers breaking the speed limit decreased by 51%. The proportion of drivers speeding excessively (more than 15 mph) fell by 62%. These authors however applied a simple before-and-after study, without controlling for other factors that could have influenced the driving speed. Makinen (2001) applied a before-and-after study with a comparison group, and analysed the effect of 12 speed cameras at a motorway in the direction of Helsinki, with a speed limit of 80–100 km/h. At the road sections with a speed limit of 80 km/h, the number of drivers exceeding the speed limit decreased by 8% during the first year and by a further decrease of 2% during the second year. At the roads with a speed limit of 100 km/h, the speeding rate decreased by 5% during the first year, with a further decrease of 2% during the second year. Also, Retting et al. (2008) applied a before-and-after study with a comparison group and examined the effect of six speed cameras at a motorway in a 9-month pilot programme. Those speed cameras were sited on an 8-mile stretch of a freeway in Arizona with a speed limit of 65 mph (≈105 km/h). The average speed decreased from 70 mph (≈113 km/h) before the installation of the cameras to 63 mph (≈101 km/h) six weeks after the installation and 65 mph (≈105 km/h) five months after the installation. The odds of drivers that exceeded the speed limit by more than 10 mph decreased by 88%. Liu et al. (2011) examined the effect of speed cameras at different distances from these cameras. They included seven locations in Nanjing, China. The results showed no effect at 1 km upstream and downstream of the camera. They found that drivers suddenly braked at about 400–300 m before the camera and accelerated again from about 300 m to 400 m after the camera.

3. Method

3.1. Design

In order to analyse the speed effect of speed cameras, a quasi- experiment was set up. Two locations on motorways were selected at which the government planned to install a speed camera. Speed data were recorded during the research period of the present study. The recorded speed data during the before period were compared with the speed data during the after period, i.e. the period after the installation of the camera. 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 to the treated locations on traffic volume and types of passing vehicles but differed in that there were no speed cameras.

3.2. Study and comparison locations

Two locations on motorways were selected. Motorways are defined here as roads for motorised vehicles only with a median barrier and no at-grade junctions (Elvik et al., 2009). The minimum speed limit on Flemish motorways is 70 km/h and entrance is forbidden for pedestrians, cyclists, moped riders and all vehicles that cannot drive faster than 70 km/h. Eligible locations were: (1) E19 at Brasschaat in the direction of Antwerp, which is a two-lane motorway, and (2) E40 at Boutersem in the direction of Liège, a three-lane motorway. The posted speed limit at both locations is 120 km/h. The cameras were installed in November 2011. Speed data were collected 13 months before (October 2010) and 10 months after the installation (September 2012) at the Brasschaat site, and 11 months before (December 2010) and 18 months after the installation (May 2013) at the Boutersem site. Speed data were collected for one week during the before period and one week during the after period.

At each of the motorways, speed data were collected at five locations. These measurement points were for both roads located at similar distances from the camera (Fig. 1):

- 3 km upstream (Brasschaat site) – 2.5 km upstream (Boutersem site)
- at the information sign (0.25 km upstream [Brasschaat site] and 0.70 km upstream [Boutersem site])
- at the speed camera
- 1 km downstream
- 3.3 km downstream (Brasschaat site) – 3.8 km downstream (Boutersem site)

For the first and last measurement point, it was not possible to select the same distance from the camera for both motorways, as there were certain restrictions on the locations where the TIRTL devices could be installed (for more information on the TIRTL devices, see Section 3.3). It was for example impossible to install these devices close to entry or exit lanes.

Next to the treated locations, comparison locations were selected in order to control for other factors that could have had an effect on the driving speed, such as weather and seasonal factors and other more general implemented traffic safety measures. For

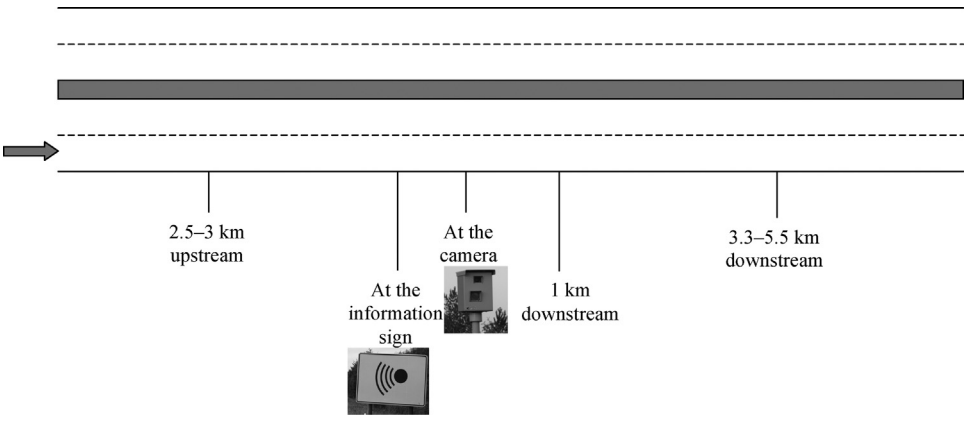

Fig. 1. Measurement points at different distances from the camera.