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MANAGEMENT OF SPEEDING COMPARING TWO APPLIED ENGINEERING MEASURES

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Abstract
The importance of safety comes from the responsibility towards protecting the vulnerable road users, who seem to be the victims in most road crashes. Thus, authorities tend to focus on reducing the travelling speed of the vehicles, whereas some road users may consider the move to interfere with mobility. In this study, a case study in Perth's two roads was conducted to compare two engineering treatments of speed reductions on these two busy shopping strips. The study aim is to illustrate the effect of using the electronic flashing signs rather than the standard signs in terms of speeding reduction and harm minimisation. Crash data were analysed and supported the safety benefits of the electronic flashing signs. Authorities have measured the reduction of the travelling speeds of vehicles and found it to be encouraging. There are clear, positive safety benefits from the study in terms of engineering and enforcement measures.

Keywords
speeding, electronic signs, traffic signs, road crashes, Chi-Square.

Introduction

It has been shown worldwide that speed limit reduction, can contribute to reduce frequencies and severities of crashes. Many researchers around the world have emphasised on one common aim and that is to reduce the speed of the vehicle [1–4].

Researchers also agree that for drivers to comply with a new reduced speed limit, enforcement measures are an essential complementary component. Enforcement is a vital intervention process in restoring road rules that leads to a balance between safety and mobility.

The study aim is to compare between two busy roads and measure the effect of two engineering measures including the effect of speeding enforcement. It also discussed the road width effect on speeding.

The detection type used in this paper is on the spot detections which involves all pullovers, including marked/unmarked cars and hand-held detectors. This is referred to as 'on the spot' detection. Traffic Infringement Notices issued at the time of detection will be referred to as (TINs).

Method

This study compared two engineering treatments on two popular roads. Both roads have access to the many businesses, cafes, shops, restaurants and cater for shoppers and diners with high volume of traffic and pedestrians at different time of the day and of the night.

An electronic signs that are displaying 40 km/h was installed in Beaufort St which is the treated road and is called (Road B). This road has a consistent width of nearly 3.1 m lane width and the strip is in length is 0.70 km in length. For Road B, authorities introduced a variable speed zone effective from August 2009.

The other road is the compared road and it has a standard signs with road markings installed, all displaying 40km/h instead of the previous 50 km/h.

The road is Albany Hwy which is called (Road A). This is effective from June 2010.

Data

The study collected data other than road crashes. This involved speeding data, including other parameters for both roads. Authorities have conducted speed count, Western Australian authorities, WA (2011). As shown in Table 1 below.

Table 1
Data collected for both roads.

Item	Road A (compared)	Road B (treated)
Existing Design	Two single Lanes separated with median or painted median at different locations with parallel parking along each side of the footpath	Two single Lanes separated with median or painted median at different locations with parallel parking along each side of the footpath
Road length (km)	3.2	0.70
Lane width (m)	3–4.2	3.1
Speed Reduction (85^{th} Percentile)	3.7 (average of two locations)	7.65 (average of both bounds)

In terms of the 85^{th} percentile speed of the travelling vehicles on the two roads under study, Table 1 shows that a better reduction rate of speed on Road B compared to that on Road A [5]. The tangible reduction showed the initial benefits of the electronic variable speed signs over the use of the standard signs and the road markings.

The scope of this study is to highlight the benefits of the electronic signs from the road safety perspective in terms of crash reductions and speeding reduction and less excessive speeding.

Analysis

Crashes before – after

The two crash trends are shown in Fig. 1 below. They are for the period 1990–2011. It can be noticed that Road A has a clear declining crash trend compared to Road B.

For Road B, the crash trend in the last five years has been the lowest ever in the last 21 years compared to that of Road A. In the meantime Road A showed lowest recorded crashes in 2003, and 2006 and not recently as noticed in Road B has the lowest crash values in the last few years.

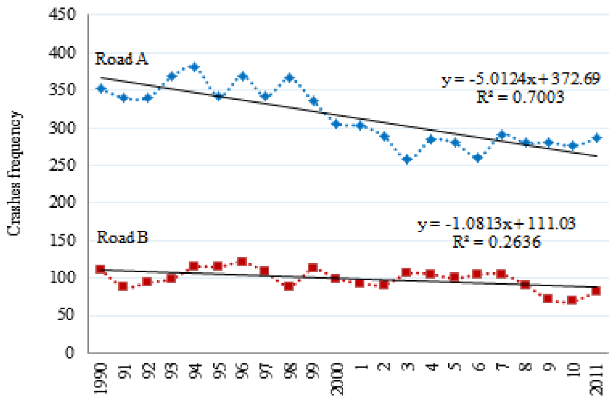

Fig. 1. Crashes frequency during 1990–2011.

Importantly, data was analysed to compare before-after crash frequency as shown in Fig. 2 below. Road A does not show much reduction after the use of the standard 40 km/h signs and road marking. Road B showed on average lower crash frequency of the 40 km/h electronic signs. This reduction would even be higher had the main intersection crash data were separated [6].

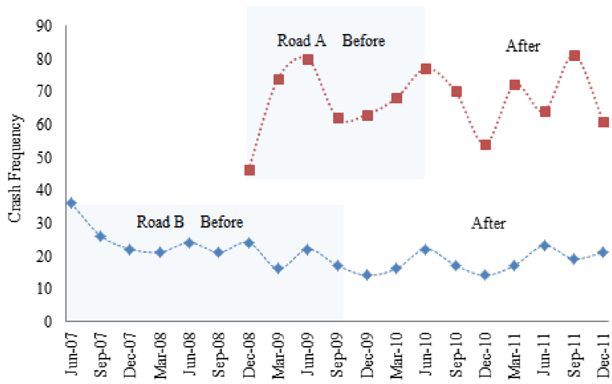

Fig. 2. Before – after crash frequency.

If it was not for the crash influence of the intersection, Road B crash reduction would have improved by further 7% as shown in Table 2. In fact analysis showed that Road B has zero severity crashes without the influence of the intersection. This is considered vital in terms of KSI (killed or severely injured). Pedestrian crashes were also reduced by 20% since the installation of the electronic signs in Road B. Careful interpretations need to be taken into consideration of the pedestrian results for two reasons. Firstly the low number of pedestrian injuries would make it difficult to come to firm conclusions and secondly there need to be more data. The study found that long term crash trend seems to be contributing to the reduction of crashes for both roads. The long term crash trend would still leave Road B with reasonable reduction that may override regression – to – the – mean. This is a phenomenon that occurs particularly when high number of crashes may regress towards the mean of that particular road at a later stage [7]. The 18% reduction of total crashes achieved in Road B may be considered high enough to cater for such phenomena. According to [8], three years or more are required for before and after to alleviate the regression to the mean effect. In the case of Road B, data used are less than three years but the crash reduction is still considered high. Crash reduction may be due to chance if not large and if it is large then it could be attributed to the treatment [7, 9].

Table 2
Crash reductions and trends.

Location	Total crashes reduction %	Pedestrian crashes reduction %	Injury reduction %	Crash trend %
Road A	−7	−86	−10	−18
Road B	−18	−20	−10	−9

Treatment effect on speeding

Statistical analyses were employed using Chi-Square to establish if there is an association between three speeding levels (less than 9 km/h) above the speed limit, between (10 km/h–19 km/h) above the speed limit & (20 km/h and more) above the speed limit) and the type of treatment on the two roads. After controlling for the hourly rate per month using on the spot detection type of enforcement, a Chi-square test of independence was conducted. See Table 3.

Table 3
Chi Square based on speeding levels.

Association between	Number of cases	Degrees of freedom	Chi Square X^2	p
Three speeding levels and two Types of engineering treatments on Roads A & B	1342	2	29.38	.001
Road B Before and after	1175	3	81.02	.001

It was found that there is a significant association between the type of treatment on Roads A & B and the three levels of speeding. This may confirm that the electronic signs use and benefits differ from the standard signs in terms of speeding levels. It can also be noticed that speed violation level get higher, Road A showed less affect by the treatment of the standard signs compared to the electronic flashing speed signs of Road B. This is clear except for the lowest speed violation level. See Fig. 3.

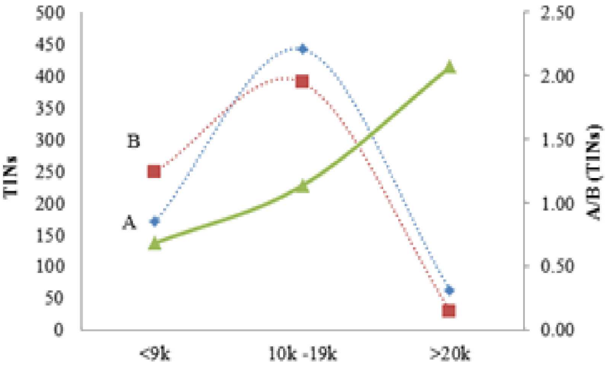

Fig. 3. The effect of the electronic signs treatment on reducing excessive speeding levels.

It was thought appropriate to compare the before-after of drivers speeding behaviour of the treated Road B. A Chi-Square analysis revealed that there was an association between the after speeding levels and the TINs detected. See Table 3 above. It showed that with p value is 0.001 $<$ 0.005 and null hypotheses is rejected that states speeding levels and treatment periods (before/after) are independent. Therefore there is an association between the treatment and its effect on speeding behaviour. Hence lower number of TINs were detected at higher speeding levels on the after period compared to the before period. Thus, the electronic sings are contributing to safer speeding levels, particularly low TINs at the high and extreme speeding levels as shown in F.

Speeding on Road A

Other engineering aspect in this study is investigated the two width segments of the Road A. It has wide segments ranges from (3.8–4.2) m and narrow segments ranges from (3.0–3.5) m. Figure 4 shows that frequency of speeding levels is higher in wider segments. It may be that drivers are travelling with higher speed after passing the narrow segments and taking more risk.

It may need to be mention that more speeding data is required to be able to unifying the hourly rate on both width's segments in order to achieve a more reliable results.

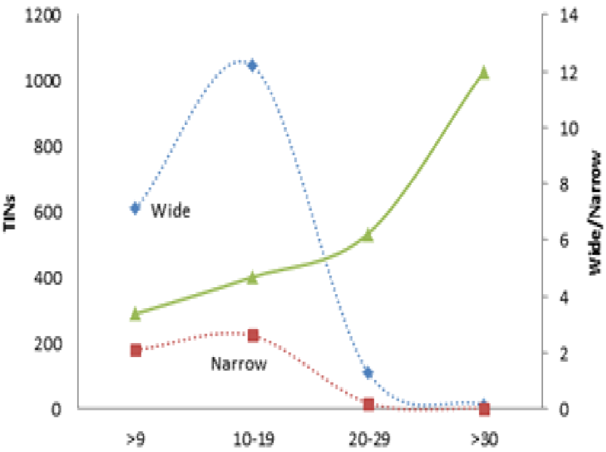

Fig. 4. Drivers at road A, slowing down at the narrow segments & not at the wide segments.

Discussions

The study found encouraging evidence in this study to suggest that the installation of the electronic 40 km/h signs were positive. In fact even with the use of the same electronic signs some were else covering 50 km/h zone (in trial). Authorities believe that these initial findings have shown that electronic speed signs, which are used on Road B, seem to be effective devices in reducing speeds of the travelling vehicles [10].

The study is not assuming that the speeding reduction and road crash reduction are solely from the electronic signs. In the same, it is trying to relate different positive safety aspects that are contributing to the reduction which may be coming from the electronic 40 km signs. it could be the combination of the low speed limit which is the 40 km/h limit and the electronic signs including the coercive enforcement Where all have contributed to such safe speeding behaviours.

The study found that the electronic signs were used in 18 of Melbourne's busiest strips shopping centres. Following the successful trial of these 40 km/h signs, more shopping strip zones are gradually being introduced to these signs [11] and the same was confirmed recently in [12]. Similarly, the Toronto authorities are adopting 40 km/h for areas with busy pedestrian movements and 30km/h for most residential streets [13].

In addition to that, the European Parliament is currently calling for speed limits on residential roads and single-lane roads to be reduced to 30km/h without cycle tracks throughout the European community in the interests of road safety. That would equate to 20 m/h in the UK and the move has been welcomed by the campaign group "20's plenty for us", which lobbies for that limit to be put in place [14]. In fact 20 m/h (32 km/h) speed limits have already been introduced in a number of cities in Britain including Bristol and Liverpool.

In Australia, there are recent calls by Curtin-Monash Accident Research Centre, for the 30 km/h limit to be tested near shopping centres, hospitals and schools as pedestrian fatalities have risen in roads with 60 km/h limits [15]. In Toronto, there is evidence to suggest that both cyclists and pedestrians are far less likely to be killed for every 10 km/h reduction below 60 km/h [13].

In terms of enforcement, a recent communication between the European commission and the European Parliament, the second key objective recommended for the next decade is to increase enforcement of road rules. It added that enforcement remains a key factor increasing the conditions for a considerable reduction in the number of deaths and injuries, especially when it is intensively applied and widely publicised [16].

To conclude, it is essential to sustain safe roads by including proper engineered and enforced speed limit. Enforcement is crucial and tangible element to monitor, regulate and sustain safe speed.

Limitations

Limited data availability was of concern into the before and after period in terms of crashes and speeding data. The longer the period may confirm stronger reliability results. Road A has come into effect later than Road B that's why data was limited in terms of crashes and speeding. Also Road A is longer than Road B which was difficult to divide to segments due to limitation in speeding data.

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