TESTING THE IMPACT AND FEASIBILITY OF 30 km/h SPEED LIMIT ZONES AT SCHOOLS

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ABSTRACT

Local authorities such as the City of Tshwane (CoT) Municipality are confronted on a daily basis with road traffic safety challenges around schools. School principals, councillors, parents, scholars and neighbourhood residents approach local authorities for assistance to address unlawful driver behaviour and implement remedial measures to enhance the safety of scholars at schools. One potential countermeasure is the implementation of 30 km/h speed limit zones at schools. However, such speed limit zones to improve pedestrian safety on lower order roads around schools are not common in South Africa. Very little before-and-after data are available to understand and evaluate the effectiveness of such zones.

The objective of this study was to measure the effectiveness of introducing a 30 km/h speed limit zone strategy at schools, where high pedestrian activity and non-motorised transport are present and can be endangered by vehicular traffic. Thirty kilometre per hour speed limit school zone signs were designed and installed to enforce a 30 km/h speed limit for specific periods of time during school arrival and departure times. Three school sites in different areas in the City of Tshwane Municipality were selected as case study sites.

Before-and-after speed data were used to test the hypothesis that the 30 km/h speed limit zone has no effect on the mean and variance of speed. The results showed that the speeds recorded after the implementation of the 30 km/h speed limit school zone signs varied between 30 km/h and 35 km/h at all the sites. The mean speed at all the sites was lower than before, for both passenger and public transport vehicles. A control site was also used to ensure that the results were not caused by spurious fluctuations. Qualitative feedback from the schools showed widespread acceptance of the measure.

The results of this study show that international best practice initiatives can be applied with great success and that 30 km/h speed limit school zones can contribute to safer roads and support the National Road Safety Strategy to reduce the increasing trend in road traffic fatalities.

1. INTRODUCTION

1.1. Problem Statement

Local Authorities are confronted on a daily basis with road traffic safety challenges. Authorities (I speak here on behalf of the CoT) do their best to assist, within their capacity, to address unlawful driver's behaviour by implementing remedial measures to enhance the safety of scholars and other road users. Despite these measures, affected parties around the school continue to approach the authorities to implement further measures to curb the dangerous driving behaviour.

The Swedish and other European countries apply best practice measure principles to address road safety challenges. One of these best practice measure used by authorities was the introduction of 30 km/h speed limit zones at schools and other highly pedestrianized areas. The "National Road Safety Strategy, 2006 onwards" document also referred to 30 km/h speed limit zones as a best practice measure which can be applied to enhance safety in areas where road users are highly vulnerable. Yet the practice of 30 km/h speed limit zones is not commonly applied in South Africa to improve pedestrian safety on lower order roads around schools. Very little before-and after data are available to understand and evaluate the effectiveness of 30 km/h speed limit zones, where installed.

1.2. Aim of Paper

The aim of this paper is to discuss the implementation and findings of the study which measured the effectiveness of introducing a 30 km/h speed limit zone strategy at schools, where high pedestrian activity and non-motorised transport are present and which are endangered by vehicular traffic.

Figure 1 depicts the school zone sign which was designed and manufactured for the project.

Figure 1- School Zone Sign

2. SCOPE

2.1 Motivating Literature

Studies by Tharp (1974) and Walz et al. (1983) concurs with each other and concluded that at 30 km/h impact a pedestrian has a 10% probability to be fatally injured. Figure 2 depicts the Impact Speed versus the Injury Severity Score.

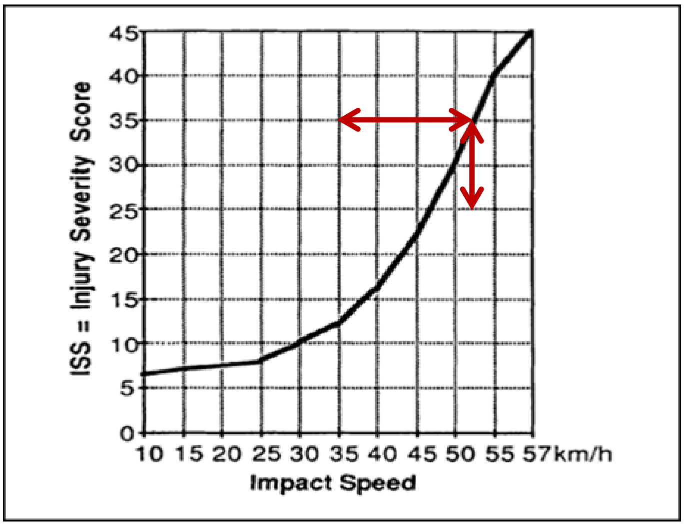

Figure 2- Impact speed versus the Injury Severity Score

Source: Waltz *et al* (1983)

Research done by Casanova, et al (2009) shows that by reducing the speed limit from 50 km/h to 30 km/h, using a normal driving style, the time taken for a given trip does not increase, but fuel consumption and carbon dioxide (CO2), carbon monoxide (CO), nitrogen oxides (NOx) and hydrocarbons (HC) emissions are clearly reduced.

The above international research shows that reducing operational speeds on streets in residential and commercial areas and in city centres, not only increases pedestrian safety, but also contributes to reduction of the environmental impact from motor vehicles and reduced fuel consumption.

2.2 Objective of Experiment

The objective of the study was to quantitatively measure the impact of a 30 km/h speed limit zone at schools on:

- Average speed
- Speed variances
- The odds of change in speed, and to
- Assess the acceptability to the community

2.3 Variables Related to the Research Hypothesis

The variables which were measured are:

- Before-and-After Mean Speeds
- Before-and-After Population Speed Variances around the Mean

2.4 Formulating the Hypothesis Statement

The objective of the study was measured in terms of the following hypothesis statements:

2.4.1 Hypothesis for mean speed

The hypothesis is formulated as follows for the mean speed (Two-Tailed Hypothesis Test) – Equal Population Means**:**

- H0: μ = the 30 km/h speed limit zone has no effect on the mean speed
- H1: μ ≤ the 30 km/h speed limit zone will result in a change in the mean speed

2.4.2 Hypothesis for population speed variances

The hypothesis is formulated as follows for the distribution of the speed around the average speed variances (Standard Deviation Test):

- H0: μ = There has not been a change in the variances of two populations' speeds as a result of the 30 km/h speed limit zone.
- H1: μ ≤ There has been a change in the variances of two populations' speeds as a result of the 30 km/h speed limit zone.

2.5 School Sites Identification and Description

The schools were selected through a judgment and convenience sampling method. The three school sites are located in Atteridgeville, Lukasrand and Soshanguve, namely:

- Phelindaba Secondary School, Atteridgeville – Maboea Street Section between Sehloho Street and Moroe Street
- Crawford College, Lukasrand – Sibelius Street section between Lente Street and Dr Lategan Road
- A Re Thabeng Primary School, Block L, Soshanguve – Road A19528

Due to the size constrain of this paper only one school is include as an example.

Figure 3 illustrates the site map for Phelindaba Secondary School along Maboea Street.

The following criteria were used to select the three school pilot sites:

- High pedestrian volumes and activity
- Complaints by pedestrian / community to address safety
- Vehicle/ pedestrian conflict
- School location related to road classification

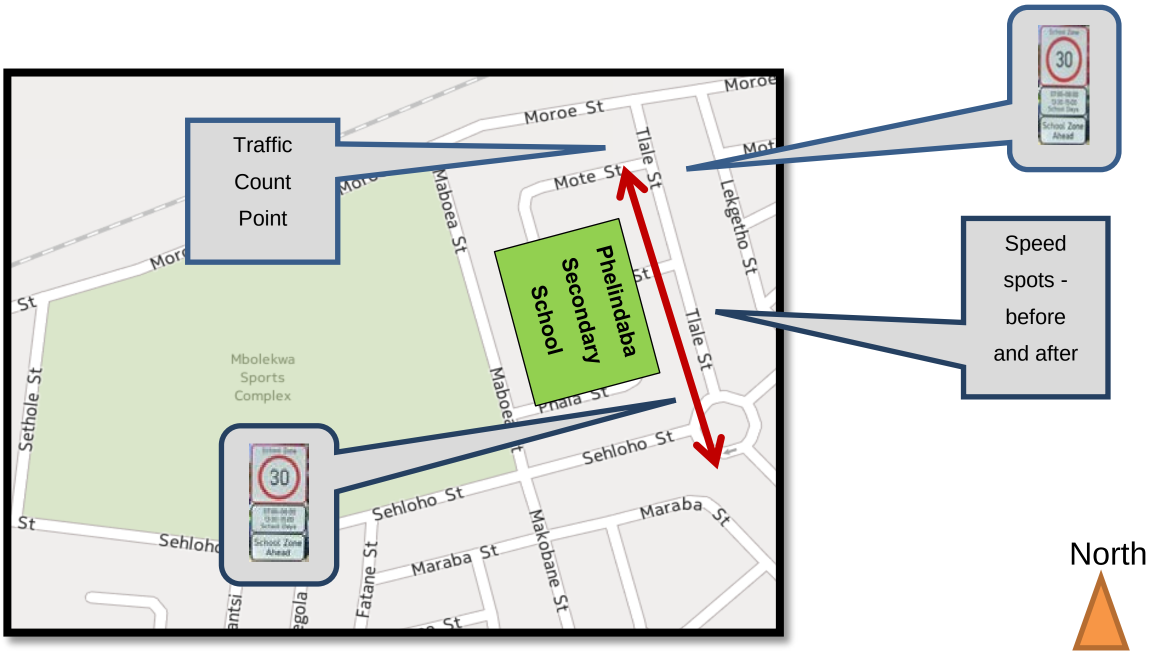

Figure 3- Maboea Street - Atteridgeville

Photos 1 and 2 respectively illustrate the “before” and “after” images of Maboea Street. The Phelindaba Secondary and High School is situated behind the greenish palisade fence on the left-hand side.

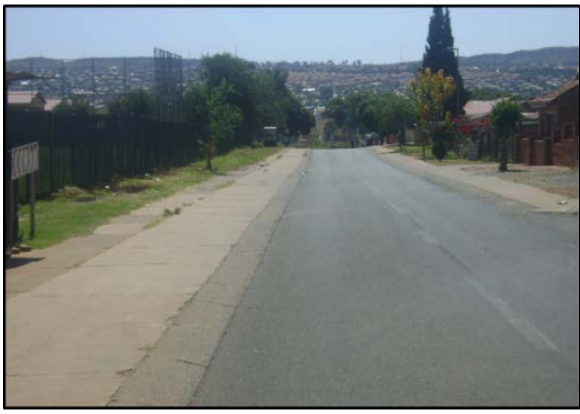

Photo 1: Before - Maboea Street Direction North

Photo 2: After - Maboea Street Direction North

2.6 Control (comparison) Site Identification

A control site was used as a comparative tool to check if there were not external activities which could have an influence on the experiment related to the three sitesThe site is located in Groenkloof, near Lukasrand. The street that was used as the control site is Totius Street.

The following criteria were used to select the control site:

- Close proximity to one of the school sites
- Similar road classification
- Similar traffic use and traffic volume

2.7 Data Collection

A stratified random sample method was applied to collect data from the four sites.

The population of interest was defined and divided into two groups as follow:

- Through traffic: Private passenger vehicles and
  Public transport vehicles
- Scholar-related traffic was excluded.

A distinction was made between through traffic and scholar-related traffic. It was argued that the attitude of a driver to whom the destination was the school would differ from that of a driver who used the road past the school as a short cut or the route towards his destination. It was also expected that scholar-related traffic would decelerate its speed to access the school or park in the close vicinity.

The public transport vehicles were identified as mini-bus taxis, buses and metered taxis by the laser gun operator who conducted the speed measurements and the person who conducted the traffic volume counts.

Before-and-after data were collected for both the public transport and private transport population groups.

2.8 Sample Size Requirement

The question that was addressed was whether the sample represented the population it was intended to represent. The following calculation was used to determine the sample required for a difference of 5 km/h from the 30 km/h in the mean speed to be statistically significant at the 5% level of significance.

The required sample sizes (n) were calculated as follows:

$n = \frac{(S)^2 * Z^2}{E^2}$ **Example:** $\longrightarrow$ $n = \frac{(9)^2 * 1.96^2}{(0.05 * 56)^2}$ = 39.7 (40)

The author ensured that the sample sizes obtained exceeded this minimum number. In each case, the mean speed and standard deviation observed at a site were used to determine "n" and the sample expanded until the minimum was reached. For a number of travel directions the required sample sizes were not achieved due to lower vehicles volumes. In these cases the sample sizes were equal to the population.

2.9 Survey Methodology

The quantitative data were obtained using the following approach and method:

- Knowledge was gained from the sites
- The population for each site was measures for a 12 hour period
- The speed of vehicles was measured randomly
- Only “free vehicles” un interrupted flow of vehicles were measured
- Only the first vehicle in a queue was measured
- A hand-held laser gun was used to measure the vehicle speeds
- The data was collected during the following dates:

- “before” – March 2011
- “after” – August 2011
- “after” – April 2013

2.10 Quantitative Data Analyses

The quantitative elements with reference to this study are referred to as follows:

- Reduction in the mean speeds
- Reduction in the 85th percentile speeds
- Reduction of the highest speed

The Two-Sample *t*-Test was used to determine if the two “before” and “after” population means were equal.

A common application of this test is to test if a new process or treatment is superior to a current process or treatment.

In the case of this dissertation it was tested to ascertain if the standard deviation of the mean speed from the second population was less.

2.10.1 ODDS Ratio Test – Quantitative Data

An additional method, namely the “Quasi-Experimental Method” (Odds Ratio Test) was applied to test the treatment sites against the comparison site.

The odds ratio (OR) is one of several statistics that have become increasingly important in research and decision-making. It is particularly useful because as an effect-size statistic, it gives clear and direct information about the research results.

The question that was addressed by the Odds Ratio Test was:

How many more times the average “before” speed is likely to be exceeded before the erection of the 30 km/h speed limit signs, and then after the erection of the signs?

2.11 Qualitative Data Approach

The qualitative data were obtained to gain some formal public feedback from the school headmasters and the scholars.

The following questions were put to the school representatives:

- What is your experience since the implementation of the 30 km/h speed limit zone signs?
- Will you say that the safety of the scholars has improved?
- Was there a change in attitude or behaviour in the motorists since the signs were installed?
- Have you had any feedback from scholars and parents?
- Will you say these 30 km/h speed limit zones can be considered at other schools in Tshwane?

The interviews did not form part of the statistical evaluation, but the feedback from the interviews was included in the conclusion of the study.

2.12 Data Analysis and Findings

The findings presented are the analysis of the before-and-after data for each site at the 30 km/h speed limit zone sites. The "before" data represents each site in its then-existing state without the 30 km/h speed limit signs. The "after" data represent each site with no additional traffic calming measures apart from the newly erected 30 km/h speed limit signs.

Due to the size constraint of this paper the graphs will be displayed and discussed during the presentation.

2.13 Discussion of Results

The Hypothesis F-value result delivered a corresponding p-value which falls well within the confidence interval of 5% used for this study. At all three sites the reduction in speed was of significance.

At all three school zone sites the mean speed decreased. In Tables 1 to 4 the percentage change per direction for the three sites is displayed. Tables 1 and 2, deal with passenger vehicles and Tables 3 and 4 with public transport vehicles.

Table 1: Percentage change – direction 1 for passenger vehicles

Site	**Average (Mean) Speed**	**85th Percentile Speed**
Road A 19528	19.3 % lower	11.9 % lower
Maboea Street	12.9 % lower	10.4 % lower
Sibelius Street	19.3 % lower	11.9 % lower

Table 2: Percentage change – direction 2 for passenger vehicles

Site	**Average (Mean) Speed**	**85th Percentile Speed**
Road A 19528	19.5 % lower	16.8% lower
Maboea Street	35.3 % lower	27.2 % lower
Sibelius Street	30.3 % lower	24.4 % lower

Table 3: Percentage change – direction 1 for public transport vehicles

Site	**Average (Mean) Speed**	**85th Percentile Speed**
Road A 19528	28.3 % lower	25.1 % lower
Maboea Street	34.3 % lower	30.7 % lower
Sibelius Street	No data	No data

Table 4: Percentage change – direction 2 for public transport vehicles

Site	**Average (Mean) Speed**	**85th Percentile Speed**
Road A 19528	22.2 % lower	14.6 % lower
Maboea Street	36.8 % lower	36.9 % lower
Sibelius Street	No data	No data

The differences in the reduction in mean speed fall into two groups. It is only the percentage change in respect of passenger vehicles in one direction in Maboea Street which is much lower than the others. This smaller change was possibly because of the lower “before” speeds which were measured.

As shown, for passenger vehicles the average percentage reduction in mean speed is between about 20% and 30%.

For public transport vehicles, the average percentage reduction in mean speed is between about 25% and 35%.

The calculated average speeds at all the sites which were recorded after the implementation of the 30 km/h speed limit school zone signs varied between 30 km/h and 35 km/h.

The null hypothesis for all the sites was rejected, meaning that the mean speed at all the sites for both passenger and public transport vehicles was lower.

2.14 Odds Ratio Test Data Discussion

The Odds Ratio test provided significant results which clearly support the Independent Sample t-test. Results of the tests showed that the odds of exceeding the average “before” speed before the erection of the 30 km/h speed limit sign *is 1.5 times to 51 times* the odds of exceeding the average “before” speed after the erection of the 30 km/h speed limit sign.

These extremely significant results suggest that the 30 km/h speed limit signs were heeded by a large proportion of the road users for the specific period of time. The measured before-and-after speed data clearly show that the motorists took note of the information displayed on the high-visibility road signs.

A reason for this noteworthy result is that the road signs are warranted during the periods during which scholars arrive at and leave the designated school zone perimeter.

2.14 Feedback from School Representatives

Feedback was received from all three school representatives. The overall responses were very positive towards the implementation of 30 km/h speed limit school zones. The feedback ranged from:

- Traffic is much calmer
- Change in speed is quite adequate

The recommendation made by the representative of A Ra Thabeng School in Soshanguve is *"that signs like these be put at most schools since this would save lives of our children".*

2 CONCLUSION AND RECOMMENDATION

Although a substantial reduction in the mean speeds was obtained by the 30 km/h speed limit school zone signs, the measured data showed that several drivers still exceed the 30 km/h speed limit by some margin.

One method of achieving the desired vehicle speeds within the designated school zone perimeter is to introduce a level of law enforcement. Law enforcement may assist to change driver behaviour and the attitude of drivers regarding adherence to 30 km/h school zones.

Another method is to introduce traffic calming measures. Such measures can be introduced in addition to the 30 km/h speed limit signs. The negative aspect of physical traffic calming measures is that they affect all road users for 24 hours, seven days a week.

Many questions are asked concerning the significance of road signs directed towards motorists on a day-to-day basis and the effectiveness of road signs when road safety is concerned.

Although the objective of this study was not to evaluate the effectiveness of a road sign, the results clearly show that if road signs are placed in a correct manner and where the message is relevant to the location, a large proportion of motorists are willing to adhere to the instruction given by the sign.

The results arising from this study further show that international best practice initiatives can be applied with great success and that 30 km/h speed limit school zones can contribute to safer roads, which again add to the National Road Safety Strategies to reduce the increasing trend in road traffic fatalities.

It is therefore recommended that authorities introduce 30 km/h speed limit zones at schools and other high-volume pedestrianized areas, to improve road safety, if warranted.

It is recommended that further research be done into the effectiveness of 30 km/h speed limit zones on higher order roads where pedestrian activity is high, which aspect was not addressed by this research.

REFERENCES

City of Tshwane Municipality, 2006. City of Tshwane Integrated Plan, 2006 – 2011. Pretoria., South Africa.

Casanova, J., Fonseca, N. & Espinosa, F. 2009. Proposal of a dynamic performance index to analyse driving pattern effect on car emissions. In: Presented at 17th Transport and Air Pollution Symposium and 3rd Environment and Transport Symposium. Proceedings INRETS No. 122, Toulouse.

Page, C. & Meyer, D. 2000. Applied Research Design for Business and Management, Irwin/Mcgraw Hill Companies, New York.

Tharp, K.J. 1974. Multidisciplinary accident investigation - pedestrian involvement. Washington (DC): US Department of Transportation, National Highway Traffic Safety Administration; 1974 Jun. Report No.: DOT HS-801 165.

The World Health Organisation, 2010. The Decade of Action 2011 – 2020, WHO/VIP. March 2010. Geneva, Switzerland.

Walz, F.H., Hoefliger, M. & Fehlmann, W. 1983. Speed limit reduction from 60 to 50 km/h and pedestrian injuries. In: Proceedings of the 27th Stapp Car Crash Conference with International Research Committee on the Biokinetics of Impact (IRCOBI), pp. 277–285.