

AN ASSESSMENT OF THE READINESS OF SOUTH AFRICAN ROADS AUTHORITIES TO REDUCE URBAN LIMITS IN LINE WITH INTERNATIONAL TRENDS

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ABSTRACT

International research indicates that decreasing speed limits in urban areas is a reliable means of reducing traffic injuries/deaths. This research project synthesizes the literature around urban speed limits, and questions why SA urban limits remain at 60km/h when international good practice suggest that lower levels offer improved protection for all road users. The project has two distinct components: the first is the development of a comprehensive discourse about the role of speed in crashes, and the proven effects of reducing speeds on injury levels. The second involves a qualitative evaluation of the positions and attitudes of road authorities in South Africa (engineers and policy makers) to determine levels of knowledge, attitudes and practical obstacles that may influence the adoption of lower speed limits. The research shows that there is only partial appreciation for the safety benefits achievable through reduced urban limits. Further, among those professionals who reflected an awareness of such benefits internationally there appears to be a degree of skepticism that reduced speed limits in South Arica would bring similar benefits. This suggests that the knowledge of how speed limit reductions can work – and indeed have worked - to reduce crashes, is possibly limited.

1. INTRODUCTION

This research paper looks at the role of speed as a factor in crash potential, and particularly at the effectiveness of speed reductions internationally in reducing crash rates. It examines the level of awareness of this international experience amongst South African transport professionals, and the attitude that such professionals have towards the value of reduced urban speed limits locally.

2. THE RELATIONSHIP BETWEEN SPEED AND CRASHES

2.1 General

Increasing speed not only enhances the severity of the crash (Aarts, 2006), but it also increases the chances of being involved in a crash (Moore, Dolinis and Woodward 1995). To avoid serious injuries the crash speed must therefore either be low or crash angles small (Nilsson, 2004).

As Aarts and van Schaagen describe in their extensive literature review, “*Driving speed and the risk of road crashes: A review*” (2006); once a crash occurs the release of kinetic energy is directly related to the initial velocity. As such, the faster a vehicle enters a crash the more likely it is that the passengers will be injured or killed (Nilsson, 2004; Aarts, 2006). High speeds also require a greater stopping distance, resulting in increased stopping times (Wilmot, 1999). Reduced speed thus means that the braking distance decreases according to the second power of the speed (Nilsson, 2004). Furthermore, the likelihood for skidding while taking evasive action increases.

The UK’s Transport Research Laboratory (TRL) published an extensive non-UK based study in 1994. This study found a positive relationship between speed and injury crashes – a 1mph ($\approx 1.61\text{km/h}$) average speed increase was associated with a 5% change in crash rates (Taylor et al. 2000).

Nilsson’s (1981) Power Model describes the relationship between accident severity, accident frequency and speed change. The model was based on Swedish crash statistics between 1967 and 1972, when speed limits in Sweden were changed. The model proposes an exponential relationship between crash frequency and severity with increased speeds: for each type of injury crash the crash risk is believed to increase by a factor of 2 with increases in mean speed; by a factor of 3 for serious injury crashes, and by a factor of 4 for fatal injury crashes.

One of the studies that echoed the results of the Power Model was an urban road speed compliance study in the Adelaide metropolitan area carried out by Kloeden and colleagues in 1997. They found that for every 5km/h increase in travelling speed the risk of involvement in a crash that involved injury doubled (Archer, 2008).

The Nilsson model has been subjected to meta-analysis by a number of different researchers. Elvik, for example, confirmed the model in his 2004 TOI report, though Cameron and Elvik (2010) qualified the applicability of the results to roads that were non-urban. For urban roads in westernised countries, the relationship between speed and crash risk held, but to a lesser extent than was predicted by the power model. It is important to note, though, that this meta-analysis focused on countries that did not experience high pedestrian injury rates in urban areas.

The UK TRL Report 421 (Taylor et al. 2000) based its study of speed-crash relationships on a two part study: Data were collected separately on road-based and driver-based studies. The road-based studies were founded on road injury data obtained from UK national records. A relationship was then developed to predict the number of crash-related injuries likely to occur. The driver-based studies related individual data collected on each driver to their personal crash history and speed preferences (Taylor et al. 2000).

The result of this study found that the faster the average traffic moves, the more crashes there are. Furthermore, the larger the spread of speeds around the average speed are – again – the higher the number of crashes (Taylor et al. 2000).

Aarts (2006) compares the work of Maycock et al. (1998) and Quimby et al. (1999) both of whom applied a self-report method to their studies, whereby the crash likelihood is determined in vehicles travelling at different speeds. Maycock et al. (1998) inconspicuously measured the speed of 6435 vehicles with a laser gun on 43 roads (Aarts, 2006). The measured data was then classified into 5 categories, which made up the total traffic distribution. An equal number of drivers from each category were randomly selected and given a questionnaire about their crash history.

The researchers then translated the raw data into a “*rule of thumb*” that a 1% increase in speed relates to a 13.1% increase in crash liability (Aarts, 2006).

2.2 Impact of Speed Limits

Speed limits remain the most elementary method to control vehicle speeds (Archer, 2008) however their prime purpose is to promote safety (Wilmot, 1999). Nilsson (2004) refers to traffic safety with respect to three measures; namely: exposure, risk and crash consequence. A speed limit change will influence all three measures. A speed limit increase will cause the crash risk and consequence to increase as well. Thus a limit increase can potentially reduce or even nullify the effect of other road safety measures (Nilsson, 2004).

2.3 Speed limits and pedestrian fatalities

The largest group of road user fatalities worldwide are pedestrians (Rosén, Sander 2009; Rosen, Stigson and Sander 2011). Young child pedestrians are most at risk of death or injury, with vehicle speeds contributing significantly to the severity of child pedestrians' injuries, particularly at speeds above 50km/h (Connelly et al. 1998). The laws of physics maintain that higher speeds unleash more kinetic energy upon impact than lower ones. The fact remains that the energy dissipated by a car travelling at 40mph ($\approx 64.4\text{km/h}$) on a vulnerable road user (pedestrian or cyclist) is 78% greater than at 30mph ($\approx 48.3\text{km/h}$) (Mountain, 2005).

In order to develop effective countermeasures to save pedestrian lives, a proper understanding of car-to-pedestrian crashes is needed. When estimating the potential benefits of new countermeasures, the pedestrian fatality risk as a function of car impact speed is of particular interest (Rosen, Stigson and Sander 2011). Thus there is a compelling need for worldwide implementation of effective pedestrian injury mitigation and crash avoidance countermeasures (Rosén, Sander 2009).

Anderson et al (1997) reported that the speed reduction in Zurich, during the early 80's, resulted in a 20% reduction in pedestrian casualties and a 25% decrease in pedestrian fatalities. Furthermore, Anderson et al (1997) points to the study conducted by Fieldwick and Brown (1987) which involved the crash fatality and casualty rates of 21 countries. From this data they developed a regression model based on population, number of vehicles and speed limits in both urban and rural areas. They concluded that nations with a 60km/h speed limit could reduce pedestrian crashes by 25% if they lowered the limit to 50km/h (Anderson, 1997).

According to Gårder (2004), the risk of pedestrian injury when highways pass through villages or towns increases by some 50 times, when compared with a low speed environment, such as a university campus. Furthermore, the link between speed and driver-pedestrian awareness is a direct one. In the state of Maine, it was observed that if the average speed was less than 11mph, 100% of drivers yielded to pedestrians about to cross crosswalks. Where the speed was 18 – 24 km/h 28% stopped; 26 – 32 km/h 23% do; and for 34 – 48km/h only 17% of drivers yielded to pedestrians looking to cross sidewalks (Gårder, 2004).

2.4 Effects of lowering urban speed limits

Speed is a major factor in road crashes (Moore, 1995; Aarts 2006) and in particular pedestrian safety (Anderson et al. 1997; Pilkington, 2000; Rosén, Sander 2009; Rosen, Stigson and Sander 2011). Along with alcohol and fatigue, speed has been identified as one of Australia's biggest contributors to traffic crashes (Woolley, 2005).

There is a considerable push in the UK to lower urban speed limits from 30mph (48km/h) to 20mph (32km/h) (Pilkington, 2000). In Australia casualty crashes have been reduced by 20% on residential roads that have adopted the default 50km/h limit with significant benefits for vulnerable road users (Woolley, 2005). Speed reductions remain the most effective means of reducing road crashes (Archer, 2008).

It is estimated that about 70% of motorists exceed the present 30mph (48km/h) urban speed limit in the UK (Pilkington, 2000). Furthermore, two thirds of all crashes in the UK where people are killed or injured happen in area with a 30mph limit (Pilkington, 2000).

Pilkington cites the British government's Department of the Environment, Transport and the Regions' research when examining traffic crash casualties with lower speed limits. The research showed that a 20mph (32km/h) zone reduced the incidence of traffic crashes by 60% and cut child pedestrian and child cyclist crashes by 67% (Pilkington, 2000).

In Australia a national decrease from 60km/h to 50km/h was modelled on local streets, collector roads and arterial roads. The result, which assumed a 5km/h reduction in travel speed, was the estimated prevention of 3000 casualty crashes and a minimal impact on travel time (Archer et al, 2008). This finding is particularly important given that most drivers believe that exceeding the posted limit will significantly decrease the journey time (Forward, Henriksson, Bimpeh, 2012). The results of this research clearly indicate otherwise.

The effects of the Default Urban Speed Limits in Australia have seen positive results. Recent findings suggest that in Queensland initial annual reductions in casualty crashes of 23% and an 88% reduction in fatal crashes had been sustained (Woolley, 2005). Overall, Western Australia has indicated a 21% reduction in casualty crashes and a 51% decrease in pedestrian crashes as a result of reduced speed limits (Archer, 2008).

Imposing lower speed limits in isolation will, however, have only limited impact. If Pilkington is correct, and 70% of all drivers currently exceed the 30mph speed limit, in the UK, this may be a reflection of the relatively lenient attitude of the courts towards driving offences. Proper enforcement is as important as setting the limits in the first place (Pilkington, 2000).

4. METHODOLOGY

The analysis of South African road authorities' attitudes towards reduced urban speed limits was carried out by utilising self-reported behaviour and attitudinal measures. This was done in the form of an electronically-distributed survey, which allowed for the collection of qualitative data. The survey results were then analysed with the aim of identifying practical obstacles that may influence the adoption of lower urban speed limits in South Africa. This section shows how these attitudes towards urban speed limits were assessed and analysed.

4.1 Questionnaire

An online self-reported style questionnaire was adopted for this project. It was based on a similar one conducted by Fleiter and Watson (2006), which examined the misalignment between driver attitudes and speeding behaviour through an online survey. Although self-reported measures have been criticised for potential inaccuracy, they have also been described as a valuable methodological tool for exploring illegal behaviour - such as speeding (Fleiter, 2006).

The criteria for the participation in this survey were based on vocation and nationality. Participants needed to be a transport specialist of some kind (engineering, planning, academic and/or members of local/national government involved in transportation) involved in the South African transport industry and a South African national citizen.

Delegates of the 32nd Annual Southern African Transport Conference were used as the base source for survey participants. The list of potential respondents comprised a total of 450 people ranging from members of government, consulting engineers, international delegates, academics and transport and traffic planners. A total of 84 responded, representing a response rate of 1 in 6 people.

A 10-item questionnaire was composed using the online interactive website, Survey Monkey (found at www.surveymonkey.com). The questionnaire collected data regarding attitudes and perceptions towards urban speed limits, and road safety. Questions about drivers' speeding behaviour, speed compliance and international and local knowledge were also incorporated in the questionnaire. A range of scales, opinion boxes and available select-answers were specifically constructed for this study.

All respondents completed all ten questions.

Participants were asked to classify themselves personally according to "*years driving experience*" and "*job description*". The sample representation across the *driving experience* groups was: 0 -10 years (21.4%); 10 – 20 years (23.8%); 20 – 30 years (15.5%); 30 – 40 years (20.2%); 40+ years (19%). On the assumption that all participants received their drivers' licences by age of 18, the sample representation across age groups was: 18 – 28 years (21.4%); 28 – 38 years (23.8%); 38 – 48 years (15.5%); 48 – 58 years (20.2%); 58 + years (19%).

The occupations of the respondents were initially organised into nine categories. However no substantial comparisons or conclusions could be drawn from this sample. This was due to it being too wide. Occupations were then consolidated into four broad categories, namely: *engineers, executive directors, specialists and other. These are illustrated in Figure 1 below.*

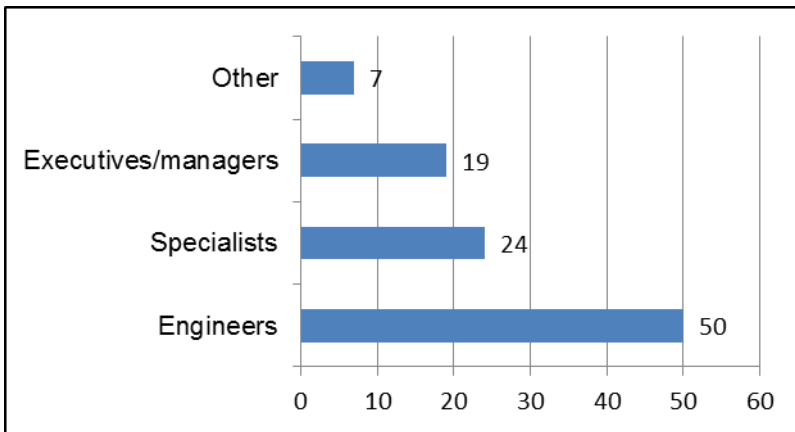


Figure 1: Broad job categories

4.2 Data analysis

All data was extracted from Survey Monkey and imported into Microsoft Excel 2010, where it was refined and made more user-friendly. The data was then managed in Statistica 11 (2012 version), where probable comparisons were made. From this data Excel graph functions were used to compile summary statistics. The survey data was then grouped according to certain similar responses. These new “likeminded” sub groups were then assessed according to how they responded towards other questions. The aim of the project was to assess, in more detail, which respondents believed speeding to be a major factor in causing urban crashes; and those who believed that lower urban speed limits had the potential to significantly reduce injuries and fatalities.

5. RESULTS

5.1 Perceived causes of urban crashes

One of the first questions asked was: “*What, in your opinion, do you believe to be the most common cause of urban vehicle crashes?*” (no restriction on number of entries). The results were categorised and are presented in Figure 2.

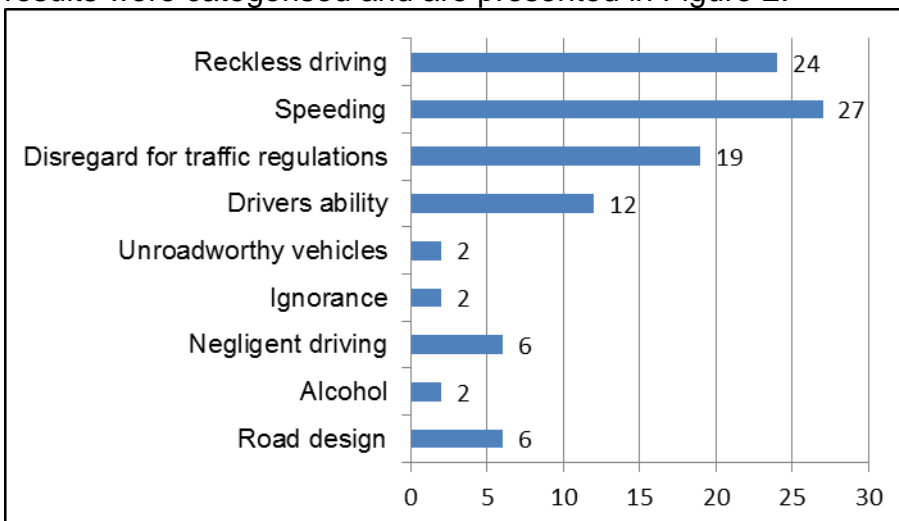


Figure 2: Perceived causes of crashes in SA

The most common perceived crash cause was “speeding” (27%). “Reckless driving culture” was a close second (24%). The two causes are closely related. More than half of the sample thus identified a culture of recklessness and speeding as primary causes of crashes.

5.2 Attitudes to the applicability of international experiences regarding speed limits and crashes in the SA context

The survey asked: “What, in your opinion, do you believe to be the reason why South Africa has not followed developed nations in reducing its urban speed limits?” Figure 3 indicates the reasons that emerged.

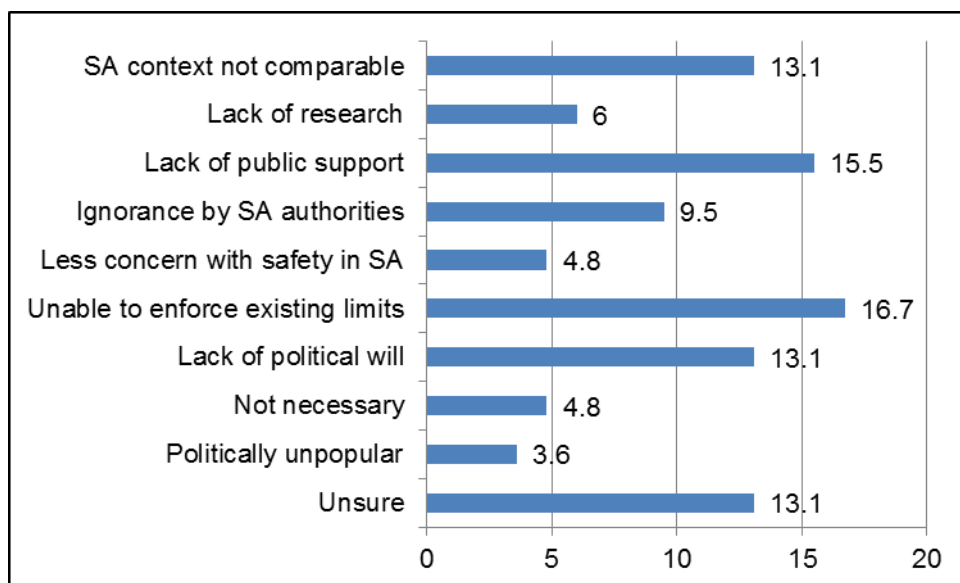


Figure 3: Why South Africa has not followed international limit trends

Some 16.7% of respondents seemed to deflect the question by referring to South Africa’s inability to enforce its current speed limits. A total of 31% (*Ignorance by SA authorities*: 9.5%; *Less emphasis on public health and safety*: 4.8%; *Lack of political will*: 13.1%; *Politically unpopular*: 3.6%) pointed to some form of poor or overstretched governance. A further 34.6% of respondents claimed that South Africa was incapable of implementing reduced limits. These responses were as follows: *SA context not comparable*: 13.1%; *Lack of research*: 6%; *Lack of public support*: 15.5%. Apart from the latter, a somewhat negative attitude towards lower urban speed limits is evident in these responses. The former group dismissed international experience out-of-hand, while the middle is clearly not aware of international research and experience concerning reduced urban speed limits.

5.2 Potential of lower urban speed limits

Respondents were asked to complete the statement: “I believe that a lower urban speed limit has the potential to:” by selecting one of the following three options: (1) “Significantly reduce fatal and serious injuries”; (2) “Somewhat reduce fatal and serious injuries”; (3) “Make very little difference”. This question was intended to assess what exactly the perceived impact of reduced urban limits is. Figure 4 shows the results to this question.

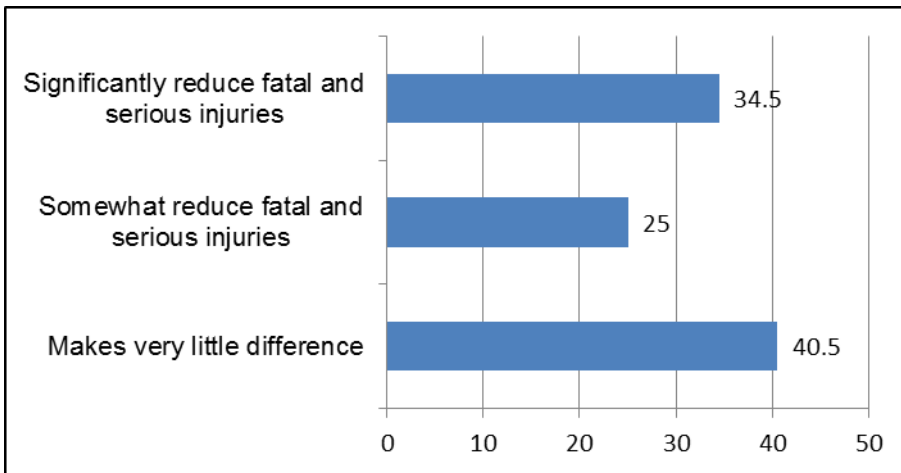


Figure 3: Potential of a lower urban speed limit

What is interesting is that the difference between those who believe lower urban limit will and will not have an impact is only 6% (40.5% - little difference; 34.5% - significantly reduce). It appears that 25% of respondents are sitting on the fence. This may be the group that can bring about a limit reduction, should their perception change.

40.5% of respondents believe that lowered urban speed limits will not reduce fatal and serious injuries. It is alarming that more than a third of the overall sample believe this in spite of international research and experience. There appears to be a fundamental lack of understanding.

Respondents were asked to complete the statement, *“I believe that South Africa should...”* by selecting one of the following options: *“Leave urban speed limits as they are”*; *“Leave urban speed limits as they are but enforce them better”*; *“Increase its average urban speed limit”*; *“Decrease its urban speed limit”*.

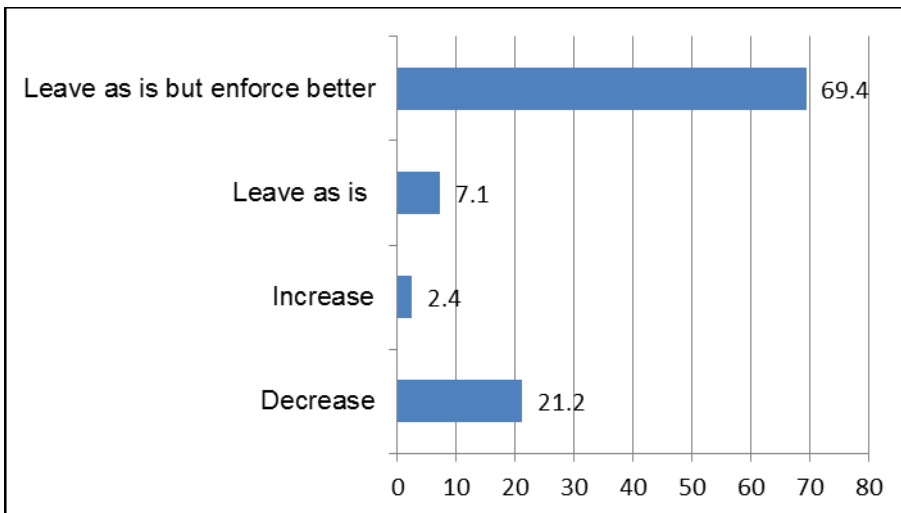


Figure 4: Perceptions regarding SA urban speed limits

This question was intended to assess exactly what the respondents felt most strongly about. Figure 4 indicates that the majority of participants (69.41%) feel urban speed limits should be kept as they are but enforced better. Only 21.2% were in favour of reducing urban speed limits.

This was in spite of the fact that 34.5% of respondents had indicated that lower urban speed limits will significantly impact fatal and serious injuries, and another 25% thought they would have some impact, only 21.2% of the sample called for reduced urban limits.

When correlating job description with opinion about changing/leaving speed limits (refer for Figure 5), specialists were clearly more likely to call for change than engineers, executives or 'other's.

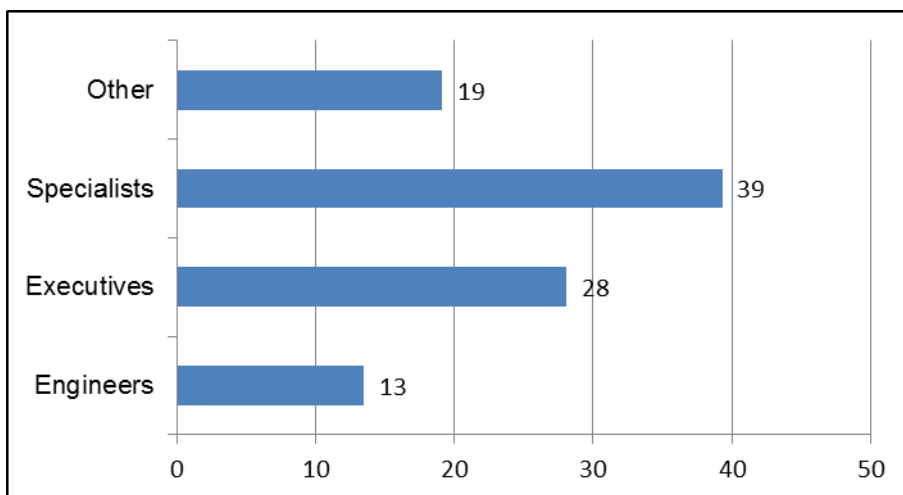


Figure 5: Percentage of respondents by profession who believed limits should be reduced

5.3 Reduced limits perceived as ineffective

Respondents who indicated that reduced speed limits would be ineffective were asked to elaborate on why they believed this to be the case.

Interestingly, a number of individuals stated that reduced limits would be effective if South Africa had the capacity to enforce them. Since they believed South Africa did not have the capacity they felt reduced urban speed limits would be ineffective in reducing fatal and serious injuries. Furthermore, 32.4% of the sample stated a “*culture of non-compliance*” as the reason for reduced limits being ineffective. A further 10.8% stated driver’s bad attitudes as the reason why reduced limits would be ineffective. Both of these are behavioural root causes making up 43.2% of this sample. This non-compliant behavioural culture may also spill into drivers’ unwillingness to see speed limits change and their lack of personal accountability on why lower limits have not been adopted in South Africa.

5.4 Factors ensuring speed compliance

Participants were allowed to select multiple options in deciding what would ensure their own speed limit compliance. Interestingly, 64.7% say a posted limit will ensure their speed compliance and 67.1% state that the limit must be compatible with the design speed. These two groups are related. Both point to posted speed limits as the overall compliance factor, while the latter group believed that the road design must reinforce the speed limit. This suggests that approximately two thirds of this sample believe that speeding can be solved with speed limits and road compatible limits alone. When comparing this perception to the attitudes regarding lower limits, a general negative attitude can be seen. Only 21.2% of participants called for lower urban speed limits.

Furthermore, 64.7% point to pedestrian activity as a speed deterrent and 58.8% claim regular speed enforcement will ensure their compliance. This suggests that in general people will comply with a lower speed limit when they are aware of higher pedestrian activity. Regular speed enforcement on a road that requires a reduced travel speed, such as an area with heavy pedestrian traffic, may ensure compliance with the majority of drivers.

6. CONCLUSION

South Africa is in urgent need of effective methods to reduce road deaths and injuries. Despite road crashes being a major cause of death and injury, and putting an immense strain on the national economy (Seedat et al. 2009), few effective interventions have been found in South Africa to reduce injury crashes. Due to increased motorisation, road traffic crashes are likely to get worse (Bunn, 2003).

This project has presented a summarised discourse regarding the role of speed in crashes, and the effects reduced speeds have on injury levels. International research and experiments have been referred to in discussing the relationship between speed and crashes; the impact of speed limits; the impact of speed limits and pedestrians and the effects of lowering urban speed limits. This research has shown that a direct relationship exists between speed limits and crash rates and severity. It describes that those set to benefit most from urban speed limit reductions are vulnerable road users, such as pedestrians (Anderson et al., 1997). Pedestrians currently make up 40% of all road fatalities in South Africa (Seedat et al. 2009). The positive effects of lowering urban speed limits have been discussed and international experiments have shown that lower limits, if properly enforced, can significantly reduce road fatalities and injuries (Nilsson, 2004; Archer, 2008). A misalignment (paradox) in driver attitude towards speed and actual behaviour has been identified (Fleiter, 2006). This is particularly relevant to the second part of this research.

The results from the survey point to a general mismatch between speeding perceptions and actions. Participants were generally aware of the risks and dangers related to higher speeds, but the majority were not willing to see reduced speed limits implemented. The knowledge of participants regarding international speed trends was relatively high; however their willingness to see South Africa follow international speed trends was not as high. This suggests that participants are unaware of how effective reduced limits can be in combatting road crashes. Alternatively they feel that current speed limits pose an acceptable risk, and are not willing to be inconvenienced by further speed limit reductions.

The majority of respondents who believe that limit reductions would be ineffective felt this was so because of South Africa's inability to enforce these limits. When asked what would ensure enforcement, no participants proposed solutions other than "*effective enforcement*" or "*visible enforcement*" or "*harsher penalties*". These are all symptomatic treatments of an underlying non-compliant culture. Few responses actually looked at redressing the root cause of speeding.

For limits not to be disregarded the majority of the driving public must perceive them to be legitimate and comply with them voluntarily (Archer, 2008). Long-term solutions involve improved driver education concerning the consequences of excessive speed and speed variation (Mountain, 2005).

This study suggests that the misalignment between the attitudes regarding the effects and implementation of reduced speed limits is a significant obstacle in reducing South African urban speed limits. To understand the factors that contribute to this apparent misalignment in attitude and behaviour, within the transport engineering community, a broader study focussing on this phenomenon is required.

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