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Contributed articles

Safer speeds: an evaluation of public education materials

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Abstract

The association between speed and road safety outcomes is well documented, yet reductions in speed limits continue to meet with resistance from the public. This paper outlines the findings of a review of speed education resources undertaken in order to identify those that may be used to increase public acceptance of reduced speed limits. Relevant agencies throughout Australia were contacted and web searches were conducted in order to find speed education resources. Public media campaigns were excluded from the review. An initial search identified 203 potential resources; of these 70 were included in the study. All were evidence-based drawing on one or more of 27 central arguments. Based on consideration of the use of evidence, ease of understanding, potential to influence the general public, and the extent to which the resource supported the speed management principles of the National Road Safety Strategy, nine resources were identified as providing the best examples of speed education. In general the speed education resources were found to adopt predominantly safety-based arguments for reduced speed limits. It is suggested that the efficacy of these materials may be improved further by addressing the ways in which drivers rationalise their speeding behaviour.

Keywords

Evaluation, Speed, Speed limit, Road safety, Road user education

Introduction

The current Australian National Road Safety Strategy (NRSS) based on the Safe System approach to road safety has identified the setting of speed limits as an important measure. The NRSS aims to achieve “speed limits that reflect a better balance between safety and mobility”; that is speed limits that reduce the likelihood of a crash occurring and mitigate the consequences when they do with as little effect on travel time as possible. One of the aims of the strategy with regard to safe speeds is to increase community acceptance by explaining the rationale for lower speed limits and providing information about the safety, economic, and environmental benefits of lower speeds. The National Road Safety Council¹ commissioned the Centre for Automotive Safety Research to identify, collate and review speed education materials used by road agencies and government insurance agencies/commissions throughout Australia.

Background on speed

Within the field of road safety, the reduction of vehicle travelling speeds through the setting of appropriate speed limits is recognised as one of the simplest but most effective measures for reducing road trauma. Research has consistently demonstrated that vehicle travelling speeds affect both the likelihood of collisions occurring; (e.g., increased stopping distances and increased the likelihood of losing control of a vehicle at higher speeds); and the

severity of collisions when they do occur. Case-control studies undertaken in Australia by Kloeden and colleagues [1, 2] have demonstrated that minor increases in travelling speeds on urban (e.g., 5km/h over 60km/h) and rural (e.g., 10km/h over average speed) roads approximately double the risk of an injury crash. Other research drawing on the risk curves developed by Kloeden et al. has shown that reducing the speeds of vehicles travelling up to 5km/h over the speed limit would yield significant reductions in injury crashes, with the greatest reduction coming from reduced low-level speeding on high speed roads [3]. Large reductions in injury crashes can also be expected even if a full 5km/h reduction in travelling speed cannot be achieved [3, 4].

In an analysis of travelling speeds and injury outcomes for pedestrians, McLean, Anderson, Farmer, Lee, and Brooks [5] conducted detailed investigations of fatal pedestrian accidents occurring in the Adelaide area between 1983 and 1991. They found that reducing the travelling speeds of vehicles by 5km/h could be expected to yield a 30% reduction in the incidence of fatal collisions (with 10% being avoided entirely). In a more recent study, Anderson [6] demonstrated that a reduction in travelling speed would reduce the number of fatal pedestrian crashes in two key ways: slower speeds would allow more crashes to be avoided due to shorter stopping distances, and those crashes that would still occur would happen at more survivable speeds. The potential reduction in pedestrian fatalities is estimated to range from 13% if all drivers obeyed the 60km/h speed limit to 48% if all drivers were travelling 10km/h slower [6].

An effective way to lower the travelling speed of vehicles is to set lower speed limits. Evidence that setting speed limits affects the travelling speed of vehicles can be observed in the results of speed surveys undertaken in South Australia since 2002. Following the introduction of the default 50km/h speed limit on urban rural roads in 2003 a significant decrease in the average travelling speed of vehicles on these roads was found [7]. Evidence that changing speed limits also has a positive association with crash and injury rates can be found in studies analysing the change in these measures following a change in speed limit.

Studies analysing the change in crash and injury rates following the introduction of 50km/h speed limits undertaken in Queensland and Victoria have demonstrated that lower speed limits reduced the number of casualty crashes [8, 9], the number of young driver crashes in Queensland [8], and serious injury or fatal pedestrian crashes in Victoria [9]. Furthermore, Hosking et al. [8] found evidence that the reduction in crashes was due to the reduction of vehicles travelling in excess of 60km/h on 50km/h roads. A South Australian study evaluating the effect of a speed limit reduction from 100 to 80km/h in the Adelaide hills produced a number of estimates based

on assumptions of factors affecting crash rates following this change [10]. The estimated reduction in injury crashes ranged from 3-36% with the most likely change considered to be a 15% reduction [10].

There are also a number of studies examining the effect of increased speed limits on roads. In the USA the National Maximum Speed Limit law setting the maximum speed limit at 55mph was first introduced in the early 1970s as a means to conserve oil, however the subsequent reduction in traffic fatalities saw it adopted as a permanent road safety measure [11]. However, in the early 1980s the laws were relaxed which saw 44 states raise the speed limit to 65mph. The National Maximum Speed Limit law was later repealed in 1995 allowing states to control the setting of speed limits within their jurisdiction, many of which chose to raise the speed limits on some roads. As a result of this the maximum speed limit across the USA ranges from 55mph in some states to 75mph in others [12]. Three separate studies have demonstrated that raising the speed limits following the repeal has increased both the crash rates and number of fatal crashes on roads with increased limits [11-13]. Grabowski et al., [12] also found that increased speed limits were associated with an increase in young driver fatalities and that there is some evidence of an association with increased speeds and crash rates on other roads.

Vision zero, safe system, and speed limits

Vision Zero is a road safety strategy originating in Sweden during the mid-1990s. The underlying premise of this strategy is that, in a crash, no road user should be exposed to forces that could result in death or serious injury, with the ultimate vision of zero deaths or injuries due to road crashes. Based on research regarding the biomechanical tolerances of the human body, the maximum speeds allowable before the risk of injury or death is significantly increased are provided in Table 1 [14]. Based on the principles of Vision Zero the maximum proposed travelling speeds allowable under different traffic conditions are provided in Table 2 [15].

Table 1. Maximum impact speeds based on biomechanical tolerance [14]

Type of crash	Maximum impact speed
Car v pedestrian	20 to 30km/h
Car v motorcycle	20 to 30km/h
Car v tree or pole	30 to 40km/h
Car v car (side impact)	50km/h
Car v car (front impact)	70km/h

Table 2. Proposed maximum travel speeds based on Vision Zero [15]

Type of infrastructure and traffic	Maximum proposed travel speed
Location with potential conflict between pedestrians and cars	30km/h
Intersections with potential side impact between cars	50km/h
Roads with possible frontal impacts between cars	70km/h
Roads with no possibility of side or frontal impact (only impact with infrastructure)	100+km/h

As shown in these Tables the maximum safe speeds for urban roads are between 30 and 50km/h depending on the type of road, while for rural highways and other roads outside of built up areas the maximum safe speeds are between 70 and 100km/h. On well protected roads such as freeways, speeds greater than 100km/h may be appropriate.

Speed effects on travel time

One of the more common objections to a reduction in the speed limit is an expected increase in travel time [16]. Based on the simple assumption that $Travel\ Time = Distance/Speed$ an increase in travel time would be expected following a reduction in the speed limit. However, in a traffic environment there are a number of other factors that affect travel time such that the increase in travel time is not of the magnitude expected and in many cases the increase in travel time is negligible [17, 18]. For example, research has shown that other factors such as congestion, traffic delays and turning manoeuvres have the strongest effect on travel times and are largely unaffected by the posted speed limit [19]. Archer et al. [19] also suggest that under some conditions lower speed limits may improve travel time by, among other things, reducing lane-change friction and the speed dispersion of vehicles leading to a more harmonious traffic flow and a reduction in delays caused by crashes.

Dutschke and Woolley [17] developed a mathematical model to assess the impact of reduced rural speed limits on travel times (100km/h down from 110km/h). Using this model a simulation of travel times based on a distance of 100km with the fastest vehicles not exceeding the speed limit was undertaken. The results indicated that the lower speed limit was found to reduce the speed differential between faster and slower vehicles, reducing the likelihood of a faster vehicle being held up by a slower vehicle. The increase in travel time associated with the lower speed limit varied between 4% and 10%, or 2.2 and 5.5 minutes.

Environmental effects of speed

In addition to the safety benefits, lower speed limits have a positive environmental effect through reduced emissions and pollutants produced by cars and other motor vehicles. For example, research has shown that lower speed limits and smoother driving styles improve fuel economy, reduce emissions, and improve safety [20]. In an examination of the differences in travel time between aggressive and non-aggressive drivers Panwai and Dia [21] found that over the course of a 44km trip the fuel consumption and vehicle emissions of aggressive drivers were as much as four times that of non-aggressive drivers and resulted in a time saving of as little as one minute. Madireddy et al., [22] found that lower speed limits in residential areas reduced the distance travelled in these areas (due to vehicles using alternate routes) and also reduced carbon dioxide and nitrogen oxide emissions. Lower speed limits also reduced the distance travelled and vehicle emissions on major roads, although to a considerably smaller extent due to a change in traffic. This provides strong evidence that reduced speed limits can be expected to have a positive environmental benefit.

Purpose

Despite these benefits, the Australian driving public generally opposes plans to reduce speed limits. In order to change this we need to understand why people think that higher speeds are not that dangerous and how people justify or rationalise non-compliance with speed limits. The purpose of this paper is to provide an overview of a qualitative review of speed education resources in order to identify those that are most likely to influence public opinion in this area.

Method

Identifying resources

A detailed search of the world wide web was used to identify educational materials addressing the benefits of reduced speed limits or lower travelling speeds produced by road agencies, government insurance agencies/commissions, police forces and other private or government organisations concerned with road safety in Australia. Resources were identified by searching websites for content relating to: speed, speed limits, speed education, and speed enforcement. Relevant organisations were also contacted directly in order to identify other relevant materials that the initial search may not have located.

Inclusion and exclusion criteria

In order to be included in the study, resources were required to at least address the safety or environmental benefits of reduced speeds, or the minimal impact on travel time associated with small reductions in speed. Resources solely

dedicated to enforcement activity (e.g., speed cameras, fines, etc.) without addressing any of the other safety or environmental elements were excluded. Resources intended for use by the wider community were included, as were those developed for use in school curricula and by community groups. Television, radio, and print-form (including signs and billboards) mass media campaign materials were excluded from the evaluation.

A total of 203 potential resources were identified. Following a filtering process based on the inclusion/exclusion criteria described above, a total of 70 resources were included in the evaluation. For a list of all resources included in the review see the final report by Raftery, Kloeden, and Royals [23].

Justifications for speeding

It was considered that resources intended to reduce speeding or increase drivers' compliance with speed limits should address the reasons for and justifications used by drivers to rationalise their non-compliance. A small workshop involving several experts in the area was undertaken to identify the key arguments used by drivers to rationalise or justify their non-compliance with speed limits. This was done in order to identify the arguments necessary to counter these points of view, identify the evidence or information necessary to support these counter arguments, and compare these with the arguments and information presented in current speed education resources.

The workshop identified nine common justifications for speeding. These include (references provided where appropriate): normalisation [24-27], perception of risks as minimal [28, 29], a belief that excessive speed and hoon drivers are the real problem [30], variability in speed limits causes confusion [30], questioning the legitimacy of enforcement [31, 32], a belief that roads should be made safer, reductions in speed will increase travel time [16, 31], questioning the logic in the application of speed limits, and a belief that speeding is fun [27]. For a description of each of the justifications, refer to the final report by Raftery, Kloeden, and Royals [23].

Evaluation criteria

The following criteria were used to evaluate each of the resources.

1. Is it evidence based?

This criterion considers the extent to which the content of the resource is based on current scientific knowledge. Consideration was given to the use of recent statistics (e.g., police data regarding the role of speed in crashes), whether the content matches current knowledge and whether supporting evidence is

provided via reference to relevant research (including citations where appropriate).

2. Is it or can it be presented in a way that will be understood by the general public?

Judgements regarding the ease of understanding of the information presented in each document were made giving consideration to: the use of abstract concepts (e.g., "risk"), jargon or other scientific/mathematical terminology, whether the message is explicitly stated or relies on the individual to draw a conclusion from the information provided, and the general simplicity or complexity of explanations provided.

3. Is it likely to influence public opinion?

In order to rate the ability of each document to influence public opinion, consideration was given to the following issues: ease of understanding (i.e., criterion 2), the length of the document, the extent to which an individual must engage with the material, and the amount of information presented. Consideration was also given to the use of arguments to counter common justifications for speeding.

Furthermore, the OECD and ECMT [e.g.,12] report on speed management suggests that the most effective educational campaigns encompass the logical basis of speed limits, provide a rationale for speed management measures, and highlight both the positive safety outcomes and environmental benefits of speed management and moderated speeds. These factors were also considered when evaluating resources against this criterion.

4. Does it support the speed management principles of the National Road Safety Strategy 2011-2020?

The speed management principles outlined within the National Road Safety Strategy (NRSS) include a) the setting of speed limits that match the road and environment and reduce crash impact forces to within the range of human tolerance, and b) increasing compliance with speed limits. Evaluation against this criterion was primarily based on the extent to which the information provided was judged to be in line with or could be used to explain the theory behind the setting of speed limits to mitigate the role of speed in crashes. Consideration was also given as to whether the information provided might increase compliance with speed limits.

Results and Discussion

The initial search identified 203 resources addressing speed, all available via the internet. Of these, 70 met the criteria

for inclusion in the study. A review of these identified 27 evidence-based arguments used with some regularity (see Table 3). The most common argument or evidence addressed the reasons why travelling at faster speeds increases the risk of a crash (e.g., less time to react to hazards, increased stopping distances, loss of control, faster speeds lead to more crashes, and higher speeds increase the severity of a crash); followed by the speed risk curve of Kloeden et al. [18]; identifying low level speeding as a safety issue; the use of police crash statistics; explanation of the penalties for speeding (demerit points, fines, etc.); and the benefits of lower speeds for pedestrian crashes – the pedestrian argument [1]. The explanation of stopping distances and impact speeds accounting for reaction times was also common, as were describing the expected benefits associated with reduced speed [e.g., 6]. The frequency with which these arguments were encountered can be observed in Table 3. An overview of the evidence provided in each of the resources included in the evaluation is provided in the final report.

Table 3. Types of evidence used in speed education resources

Evidence	Number of documents
Reasons why speed causes crashes	39
Risk-curve (5km/h = double the risk)	31
Low level speeding	27
Statistics	23
Demerit points, fines, and other penalties	22
Pedestrian argument	19
Safety benefits (e.g., fewer crashes, lower severity, etc.)	17
Distance to stop 60 = 38-56m (dependent on reaction time)	16
Define speeding	15
Costs to community	14
Selection of sites based on safety	14
Safe following distance	14
Small reductions in speed	13
Risk of fatality curves	12
Energy at impact	12
Minimal travel time effects	10
Expected safety benefits (e.g., projected reduction in crashes or casualties)	10
Safe system 30/50/70/100km/h	9
Speed cameras work	7
Excessive speed	6
Change from 60 to 50 produces 20% reduction	6

Evidence	Number of documents
Emissions	6
Compare to alcohol risk	5
Fuel economy	5
Speed survey data	4
Nilsson's power model	3
50km = 3 storey building	2

Given that all resources included in the study were found to draw on the same general pool of evidence, differences in the quality of the resources was determined by the range of information presented and the accessibility of this information to the general public. Further determination of the quality of the resources was based on an assessment of the ease with which the information could be understood, the likelihood that the information will influence the general public and the extent to which the information presented supports the speed management principles of the NRSS. Nine resources were considered to provide the best examples of speed education information. An overview of the evidence contained in these is provided in Table 4. A more complete summary including comments relevant to the evaluation criteria and copies of each resource are included in the full report.

Table 4. Exemplar resources and the evidence they contained

Evidence	Resource ^a								
	1	2	3	4	5	6	7	8	9
Risk of fatality curves	X		X			X	X		X
Pedestrian argument	X		X	X		X		X	X
Risk-curve (5k = double)	X				X	X	X	X	X
Reasons why speed causes crashes	X	X	X	X	X	X	X	X	X
Low level speeding	X		X				X	X	X
Excessive speed			X					X	X
50km= 3 storey building					X				
Safe system 30/50/70/100	X	X			X				
Change from 60 to 50 produces 20% reduction				X	X				
Compare to alcohol risk	X			X					
Speed cameras work		X		X	X				
Distance to stop 60 = 38m-56m				X			X		X

Evidence	Resource ^a								
	1	2	3	4	5	6	7	8	9
Costs to community						X		X	
Emissions	X	X		X		X			
Minimal travel time effects	X	X		X		X		X	
Demerit points, fines, and other penalties					X	X		X	
Crash statistics	X	X		X	X		X		X
Selection of sites based on safety				X			X	X	
Speed survey data							X		
Expected safety benefits	X	X	X	X					
Fuel economy	X	X							
Safety benefits		X	X		X			X	X
Define speeding			X		X			X	X
Energy at impact					X			X	X
Safe following distance									
Small reductions in speed		X	X	X	X	X			X
Nilsson's power model					X		X		
Note: ^a resources are arranged in no particular order									
Resource 1: Road safety: Speed facts (DPTI, SA)									
Resource 2: Towards zero together - safer speeds (DPTI, SA)									
Resource 3: Community safety: Speed (Victoria Police)									
Resource 4: 50km/h general urban speed limits: FAQ (DIER, Tasmania)									
Resource 5: Speeding (ORS, WA)									
Resource 6: Speeding and safety (Vicroads)									
Resource 7: The danger of speeding (Justice and Community Safety, ACT)									
Resource 8: Why is speeding a problem? (RMS, NSW)									
Resource 9: How does speeding increase the chances and severity of a crash? (RMS, NSW)									

While the majority of resources reviewed tended to focus on the safety aspects of speeding (e.g., risk of crashing, injury severity and benefits of reduced speed) the better resources tended to address a wider range of evidence and often included information regarding the environmental impacts of speed (e.g. emissions and noise), fuel economy and travel time. The better resources were also considered to be more accessible to the public both in how the information was presented aesthetically and in terms of

the content. It is evident that the present focus of publicly available speed education resources is to promote adherence to speed limits in order to achieve a level of safety on our roads. While there is nothing inherently wrong with such an approach, it is possible that this could be strengthened further with the addition of evidence or information that addresses drivers' justifications for speeding and offers some counter arguments.

Conclusion

Current speed education resources generally draw on the same pool of evidence in order to highlight the safety benefits of adhering to speed limits or setting lower speed limits. The better resources tended to address a wider range of evidence and often included information regarding the environmental impacts of speed (e.g. emissions and noise), fuel economy and travel time. The better resources were also considered to be more accessible to the public both in how the information was presented aesthetically and in terms of the content. While there is nothing inherently wrong with an approach that promotes adherence to speed limits in order to achieve a higher level of safety on our roads, the efficacy of resources could be strengthened further with the addition of evidence or information that addresses the reasons why people speed, or offers some counterpoint to the manner in which they rationalise their speeding behaviour. Several options with regard to the use of existing educational materials (that vary from using resources unchanged or with some amendments to the development of a new, comprehensive resource) are provided in the final report.

A copy of the full report can be obtained from Jaime Royals at: Jaime@casr.adelaide.edu.au.

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Notes

1. Due to the disbanding of the NRSC the project was completed under the oversight of the Department of Infrastructure and Transport.

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