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The accuracy of determining speeding directly from mass crash data and using the NSW Centre for Road Safety method

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Abstract

Exceeding the posted speed limit, or speeding, is generally accepted as a major cause of road crashes and in particular fatal crashes. However, the actual proportion of crashes in which one or more vehicles was speeding is not easily determined. The exact travelling speed of a vehicle prior to a crash can only be determined by detailed crash reconstruction. Such a reconstruction is considered beyond the scope of regular traffic police who record the majority of the crash data that makes up the mass crash databases such as the South Australian Traffic Accident Reporting System (TARS). It is therefore thought that speeding is under-reported in the mass crash data. A method was developed by NSW to identify, from mass data, crashes that involved speeding as a factor. This method was subsequently used by other states, including South Australia. The Centre for Automotive Safety Research conducts the crash reconstructions required to determine speed as part of its at-scene in-depth crash investigation work. This paper compares the actual proportion of speeding crashes in the most recent set of at-scene in-depth crash investigation cases with that found by using the mass data and the method developed by the NSW Centre for Road Safety. It was found that the error 'excessive speed' recorded in the TARS database is not accurate in identifying crashes where a vehicle was speeding. The NSW Centre for Road Safety method of determining speeding in crashes was also found to lack accuracy, though it was more accurate than simply relying on the error 'excessive speed' in the TARS database.

Keywords

Speed, Speeding, Crash data

Introduction

Higher vehicle travel speeds have been shown to elevate the risk of being involved in an injury crash [4-6]. Travelling at a speed above the legal speed limit, or speeding, is considered to be one of the major factors in fatal crashes. For these reasons speeding has been the focus of major enforcement efforts (more than 100,000 hours of enforcement per year [3]) and media campaigns in South Australia, and similarly around Australia.

However, the actual proportion of crashes in which one or more vehicles was speeding is not easily determined. The most reliable method of determining a vehicle's speed, and therefore if it was speeding or not, is a detailed crash reconstruction conducted by a suitably qualified person. Such a reconstruction is considered beyond the scope of regular traffic police and is usually only conducted by dedicated police officers in circumstances where a driver will be charged with a serious driving offence. It

is therefore thought that speeding is under-reported in the mass crash data, such as the Traffic Accident Reporting System (TARS) database in South Australia.

A method was developed by the NSW Centre for Road Safety to identify, from mass data, crashes that involved speeding as a contributing factor. This method was subsequently used by other states, including South Australia. It is important to note that this method includes "excessive speed for the prevailing conditions" [1] in its definition of speeding. The concept of "excessive speed for the prevailing conditions" is problematic; it is subjective in nature, it is not easily enforceable, and it is contrary to the general understanding of speeding. It has also been criticised by Diamantopoulou et al. [2] for having an insufficient scientific basis, though an analysis of its accuracy was not conducted.

This paper will examine the accuracy of determining speeding directly from the mass crash data and using the NSW Centre for Road Safety's method by comparing their results with the results of detailed reconstructions undertaken as part of the Centre for Automotive Safety Research's (CASR) at-scene in-depth crash investigations. The difference in the definition of speeding in the NSW method means that the comparison conducted is not of the accuracy of the method in determining speeding by the definition it uses, but by the general definition (speed above the legal speed limit).

Method

Crashes from CASR's most recent at-scene in-depth crash investigations study, conducted between July 2006 and April 2012, that had been reconstructed were identified. The speed of each vehicle, the applicable speed limit for each vehicle and the TARS number were extracted from CASR's database (the TARS number is an identifier that allows a specific crash record to be extracted from the TARS database).

Because the involvement of speeding in a crash is a crash based variable only one vehicle needs to fulfil the requirements for the crash to be deemed as involving speeding. It is therefore useful to come up with a speed metric that is not vehicle specific but represents the crash as a whole. This metric was termed 'speed relative to the speed limit' and is determined by Equation 1. The actual proportion of crashes involving speeding could then be calculated.

$$\textit{speed relative to the speed limit} = max(V_1 - SL_1, \ldots, V_n - SL_n) \quad (1)$$

where
n=number of vehicles involved in crash
V=speed of vehicle
SL=speed limit applicable to vehicle

Next the actual proportion of speeding crashes was compared to the proportion directly identified in the mass data as speeding crashes. To accomplish this, the TARS number was used to look up the individual crash record and note the 'error'. This is the field in the TARS database that may identify if the police officer believed one of the vehicles was speeding, as one of the choices is 'excessive speed'.

Finally the proportion of speeding crashes as determined by the NSW Centre for Road Safety method was determined and compared to the actual proportion. The NSW Centre for Road Safety method is as follows [1]:

Speeding is considered to have been a contributing factor to a road crash if that crash involved at least one speeding motor vehicle.

A motor vehicle is assessed as having been speeding if it satisfies the conditions described below under (a) or (b) or both.

(a) The vehicle's controller (driver or rider) was charged with a speeding offence; or

the vehicle was described by police as travelling at excessive speed; or

the stated speed of the vehicle was in excess of that permitted for the vehicle controller's licence class or the vehicle weight (introduced 1 January 2010); or the stated speed of the vehicle was in excess of the speed limit.

(b) The vehicle was performing a manoeuvre characteristic of excessive speed, that is: while on a curve the vehicle jack-knifed, skidded, slid or the controller lost control; or the vehicle ran off the road while negotiating a bend or turning a corner and the controller was not distracted by something or disadvantaged by drowsiness or sudden illness and was not swerving to avoid another vehicle, animal or object and the vehicle did not suffer equipment failure.

This method only used information available from the TARS mass crash database: any information gained from CASR's at-scene in-depth crash investigation was ignored.

In TARS there is no field for offences, such as a speeding offence, associated with the crash to be listed therefore part (a) relied upon the police officers text description of the crash and the field where the speed of the vehicle is listed.

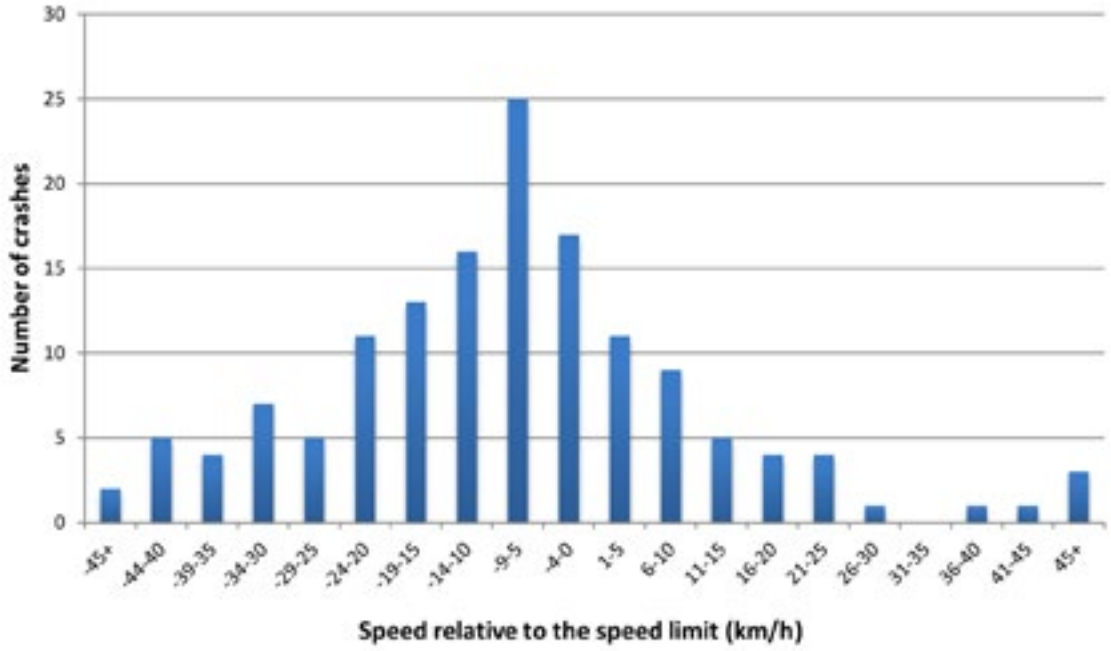

Figure 1: Distribution of speeds relative to the speed limit

Results

A total of 144 crashes where the speeds of the vehicles had been determined by reconstruction were identified in CASR's in-depth at-scene crash investigation database. Figure 1 shows the distribution of speeds relative to the speed limit. The distribution appears to roughly approximate a normal distribution centred on the negative nine to negative five range. There were five crashes where the speed relative to the speed limit was greater than 35km/h.

The error recorded in the TARS mass crash database relative to the results of the reconstruction (not speeding, speeding) are shown in Table 1. There are many different errors that can be chosen in TARS with the most frequent being 'inattention'. Excessive speed was only chosen in two of the 144 crashes, and in both cases the reconstruction showed that none of the vehicles involved were speeding. The error 'dangerous driving' is related to speeding as the legislation defines dangerous driving as "drive[ing] a vehicle recklessly or at a speed or in a manner which is dangerous to the public" [7]. This error was also chosen in two crashes but, unlike 'excessive speed', in both of these crashes the reconstruction showed that a vehicle was speeding. Other errors that appear to be good indicators of speeding are DUI (four of six were speeding) and 'change lanes to endanger', though the latter is only based on one crash that also happened to involve speeding.

Table 1: Error recorded in TARS mass crash database relative to reconstruction results

Error recorded in TARS mass crash database	Reconstruction		Total
	Not Speeding	Speeding	
Change Lanes to Endanger	0	1	1
Dangerous Driving	0	2	2
Died Sick or Asleep At Wheel	1	0	1
Disobey - Give Way Sign	9	3	12
Disobey - Stop Sign	6	3	9
Disobey - Traffic Lights	2	0	2
DUI	2	4	6
Excessive Speed	2	0	2
Fail to Give Way	13	3	16
Fail to Give Way Right	1	0	1
Fail to Keep Left	7	7	14
Fail to Stand	8	2	10
Follow Too Closely	2	2	4
Inattention	43	9	51
Incorrect or No Signal	0	1	1
None	5	0	4
Overtake Without Due Care	3	2	5
Vehicle Fault	1	0	1
Total	105	39	144

The NSW Centre for Road Safety method for determining speeding in crashes is compared to the results of the reconstructions in Table 2. While the predictive power of the NSW method was marginal it was in the right direction: 34% of the predicted speeding crashes were actually speeding compared to 24% of the predicted not speeding crashes; and 31% of actual speeding crashes were identified as speeding compared to 22% of actual not speeding crashes. Overall the NSW method predicted 24% speeding crashes - an underestimate of the actual 27%.

However, the method only correctly classified 65% of the 144 crashes and a Fisher exact test on the predictions gave a p-value of 0.281, which indicates that the method is not statistically significantly better than just randomly allocating cases.

Table 2: Determination of speeding involvement by the NSW Centre for Road Safety method compared to the reconstruction results

NSW Centre for Road Safety method	Reconstruction			
	Not Speeding	Speeding	Total	Percentage actually speeding
Not Speeding	82	27	109	24.8%
Speeding	23	12	35	34.3%
Total	105	39	144	27.1%
Percentage predicted speeding	21.9%	30.8%	24.3%	
Fisher exact test p = 0.281				

A comparison between the distribution of speed relative to the speed limit for incorrect identifications of speeding and not speeding made by the NSW Centre for Road Safety method is shown in Figure 2. The majority of the incorrect identifications of not speeding took place at speeds just over the speed limit. It is to be expected that these would be the hardest to correctly identify. Of concern is that a number of incorrect identifications of not speeding still occur when the speed is more than 20km/h above the speed limit. The distribution of incorrect identifications of speeding is much more even than might be expected, with many occurring at speeds far below the speed limit.

The accuracy of the NSW Centre for Road Safety method by injury severity and speed limit is shown in Table 3. The method was much more discriminating when determining speeding in fatal crashes; however the overall accuracy was only slightly better for fatal crashes than for other injury severities. When the accuracy is examined by speed limit the most striking result is that in low speed zones (40, 50 and 60 km/h) not a single crash that was determined by reconstruction to involve speeding was correctly identified as such by the NSW Centre for Road Safety method. Once again the overall accuracy varied very little between the categories of speed limits.

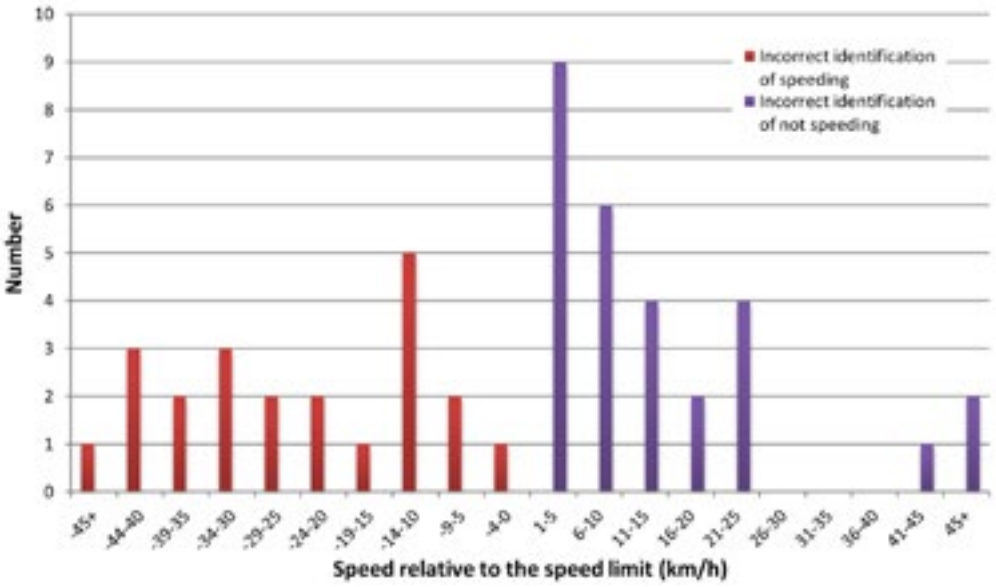

Figure 2: Comparison between the distributions of speeds relative to the speed limit for incorrect identifications of speeding and not speeding by the NSW Centre for Road Safety method

Table 3: Accuracy of NSW Centre for Road Safety Method by injury severity and speed limit

NSW Centre for Road Safety method percentage predicted as speeding		Reconstruction		
		Not Speeding	Speeding	Total % correct
Injury Severity	Minor injury	23.6 (n=38)	25.0 (n=8)	67.4
	Serious injury	23.5 (n=51)	22.2 (n=18)	62.3
	Fatal	12.5 (n=16)	46.2 (n=13)	69.0
Speed limit	40, 50, 60 km/h	4.8 (n=21)	0.0 (n=9)	66.7
	80 km/h	25.0 (n=24)	45.5 (n=11)	65.7
	100, 110 km/h	26.7 (n=60)	36.8 (n=19)	64.6

The accuracy of the individual criteria of the NSW Centre for Road Safety method is shown in Table 4. There are essentially four individual criteria that make up the method: if any of these are satisfied then the crash is deemed to involve speeding. The first criterion is that the vehicle was described by police as travelling at excessive speed. The second criterion is that the stated speed of the vehicle was in excess of the speed limit. The third criterion is that the vehicle, while on a curve, jack-knifed, skidded, slid or the controller lost control. The fourth criterion is that the vehicle ran off the road while negotiating a bend or turning a corner and there is lack of an explanation other than speed. Note that multiple criteria may be satisfied in a single crash. A stated speed in excess of the speed limit and ran off the road with lack of another explanation were the most accurate of the criteria though they were rarely used. The criterion that was most used - the vehicle lost control on a bend - was particularly inaccurate. The description was also not particularly accurate though, once again, the number of times it was used was low.

Table 4: The accuracy of the NSW Centre for Road Safety Method by the individual criteria

NSW Centre for Road Safety method	Criterion of method that was satisfied			
	Description	Stated Speed	Lost control	Ran off road
Correct identification of speeding	2	3	6	3
Incorrect identification of speeding	3	1	17	1
Total	5	4	23	4

Discussion

It is clear from the results that the 'excessive speed' error recorded in the TARS database is not indicative of a speeding crash and should not be relied upon to determine the proportion of crashes that involve speeding in South Australia.

The wording of this error, excessive speed, is somewhat ambiguous. On the one hand it could imply that it is only to be used when the vehicle is travelling well above the speed limit: on the other hand it could imply that the vehicle's speed does not need to be above the speed limit but could just be considered excessive for the conditions. Note also that generally only one error is selected per vehicle therefore it is generally thought of as the main error that is listed under this variable. This may hinder the accurate identification of speeding in the database.

The NSW Centre for Road Safety's method for determining the involvement of speeding in a crash was compared to the involvement of speeding according to the results of reconstructions. This method did identify a similar number of speeding crashes in the sample of 144 crashes as the reconstructions (35 compared to 39). However, this appears to be mostly due to chance as just under two thirds of the method's identifications of speeding were incorrect.

It might be expected that any method to determine speeding from mass crash data would struggle to do so accurately most often when the vehicles were travelling at speeds close to the speed limit. This was only true for the NSW Centre for Road Safety method when considering crashes that involved speeding, but the method failed to identify them as such. When considering the other type of possible error, identifying a crash as involving speeding when it does not, the errors were relatively evenly distributed between speed differences from the speed limit, the only real exception being a high proportion at 10 to 14km/h below the speed limit.

The overall accuracy of the NSW Centre for Road Safety method was relatively consistent between various levels of injury severity and speed limits. Of note, however, was the increased accuracy of predicting speeding in fatal crashes (though still below 50%) and the method's inability to identify any speeding crashes in low speed zones. The increased accuracy in fatal crashes may simply be a product of the higher proportion of such crashes involving speeding. The inability of the method to identify any of the nine speeding crashes in low speed zones may be a direct result of the criteria of the method. While speeding in a higher speed zone may be more likely to result in a single vehicle-loss of control crash, which would be identified as involving speeding if it happened on a bend, speeding in a low speed zone may be more likely to result in a crash with another vehicle, which will only be identified as speeding if

the police officer stated as such in the text description of the crash or recorded its speed as being faster than the speed limit.

Examining the accuracy of the NSW Centre for Road Safety method by the individual criteria of the method revealed that the criterion that was most used; the vehicle lost control on a bend, was particularly inaccurate. This is most likely due to the method defining speeding as including excessive speed for the prevailing conditions. While these cases may fit that definition this is not the general-use definition of speeding. Speeding is generally defined as travelling above the legal speed limit and this is the definition that was applied when considering speeding as determined by reconstruction. If the general definition of speeding is used, thought should be given to removing this criterion. The other criteria lacked the numbers to draw any firm conclusions on their accuracy.

The sample of crashes used has two main biases. CASR's at-scene in-depth crash investigations were only undertaken for crashes occurring between 9am and 4:30pm on weekdays within 100km of Adelaide. (The exception being fatal crashes that were followed up regardless of the time of day they occurred at the discretion of the project leader, which in turn produces a bias towards fatal crashes). This bias in the CASR at-scene in-depth crash investigation database should not have an obvious effect on the comparisons performed. It does, however, mean that the percentage of crashes involving speeding found by the reconstructions can not necessarily be generalised.

The second main bias is the ability to reconstruct crashes. Only about half the crashes in the at-scene in-depth crash investigation database could be reconstructed. The two main reasons that reconstructions could not be confidently performed were a lack of physical evidence, and the crash involving complex mechanisms. A common crash type that lacks the physical evidence needed to reconstruct is rear end crashes. These crashes tend to be lower severity crashes. A common crash type that has complex mechanisms that cannot be easily replicated in a reconstruction are motorcycle crashes, particularly single vehicle motorcycle crashes. Conversely, crashes where a vehicle has lost control or struck another vehicle at an intersection can be readily reconstructed. The reconstruction bias may have had some effect on the comparison. A vehicle that lost control will be over-represented in the sample and will also satisfy the NSW Centre for Road Safety method for determining speeding if it occurred on a bend.

An underlying assumption of the results is that the speeds determined by reconstruction are accurate. Error in reconstruction speed can come from several sources: the quality of evidence collection; the skill of the person(s) undertaking the reconstruction; and the computer programs or equations used to perform the reconstruction. The error in the reconstructed speeds cannot be quantified, however, every effort was taken throughout the process to ensure that errors were minimised. Scene evidence was recorded using highly accurate surveying equipment, experienced staff performed the reconstructions, and the programs and equations used are arguably the most accurate (Generally SIMON and DyMESH within HVE, SMAC on occasion, and the critical speed equation). In any case, errors in the reconstruction speed would only change the result at speeds close to the speed limit. The errors in the method's identification of speeding occurred at many speeds, close and not close to the speed limit alike. Therefore any errors that may be present in the reconstructed speeds would not be expected to have a meaningful effect on the overall findings.

Conclusions

The error 'excessive speed' recorded in the TARS database is not accurate in identifying crashes where a vehicle was speeding.

The NSW Centre for Road Safety method of determining speeding in crashes was also found to lack accuracy in determining speeding, though it appears to be more accurate than simply relying on the error 'excessive speed' in the TARS database.

Recommendations

It would be worthwhile to invest in developing methods that can more accurately determine the involvement of speeding in a crash from the mass crash data.

Improvements could also be made to the data collection for the mass crash database to assist the determination of speeding in a crash. This may include a specific field dedicated to speeding that needs to be filled out in all crashes as either speeding or not speeding. This would at least ensure that a police opinion on the topic is recorded. Another improvement could be to require the field where the vehicle's speed is recorded to always be filled in: currently this field is often not used to record a speed.

New equipment is becoming available that allows data from the vehicle's airbag control module to be downloaded, including pre-impact speed. In the future such equipment may present a relatively simple and quick method by which regular traffic police can ascertain the speed of a vehicle prior to a crash.

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Mobile phone use and driving: the message is just not getting through

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Abstract

Previous research has shown that mobile phone use while driving can increase crash risk fourfold while texting results in 23 times greater crash risk for heavy vehicle drivers. However, mobile phone use has changed in recent years with the functional capabilities of smart phones to now also include a range of other common behaviours while driving such as using Facebook, emailing, the use of 'apps' and GPS. Research continues to show performance decrements for many such behaviours while driving, however many Australians still openly admit to illegal mobile phone use while driving despite ongoing enforcement efforts and public awareness campaigns. Of most concern are young drivers. 'Apps' available to restrict mobile phone use while in motion do not prevent use while a driver is stopped at traffic lights, so are therefore not a wholly viable solution. Vehicle manufacturers continue to develop in-vehicle technology to minimise distraction, however communication with the 'outside world' while driving is also perhaps a strong selling point for vehicles. Hence, the safety message that drivers should focus on the driving task solely and not use communication devices is unlikely to ever be internalised by many drivers. This paper reviews the available literature on the topic and argues that a better understanding of perceptions of mobile phone use while driving and motives for use are required to inform public awareness campaign development for specific road user groups. Additionally, illegal phone use while driving may be reinforced by not being apprehended (punishment avoidance); therefore stronger deterrence-focussed messages may also be beneficial.

Keywords

Mobile phone; Cell phone; Road safety; Enforcement; Public education

Introduction

The level of crash involvement from using a mobile phone while driving is difficult to establish from data commonly collated by transport authorities. This is due to the under-reporting of mobile phone use during crash events. Unless a police officer or witness expressly notes that mobile phone use contributed to a crash, it is unlikely that it will be reported. Elvik [6] noted that there is a lack of firm evidence to accurately quantify the degree of crash