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Session Title: Crash and Injury Analysis

The Accuracy Of Driver Accounts Of Vehicle Accidents

Abstract

Eyewitness evidence is often used in court and by researchers to reconstruct the events of a road accident. That eyewitnesses are often unreliable has long been known, but the extent of eyewitness reliability and the variables that affect reliability are not well understood within the field of road accident investigation. This study investigated the accuracy with which crash involved drivers could recall the pieces of information that are often required by crash investigators to reconstruct and understand the causes of a vehicle accident. Driver reports of vehicle speed, weather conditions, time of crash, impact points and vehicle position and movements have been assessed for accuracy against objective physical evidence and crash reconstructions based on this physical evidence. The results of this study show that drivers recall many of the events of a crash and the details of their environment accurately. However, drivers significantly underestimate their travelling speed. A number of factors were identified that influence the amount of information that drivers recall and the accuracy of this information.

Introduction and Aims

The aftermath of a vehicle accident can seem like a mass of tangled metal. Crash investigators attempt to make sense of such scenes by primarily using the physical evidence to piece together the events before, during and after impact occurred. In addition crash investigators often enlist the aid of observers of the crash, both drivers and bystanders. Crash observers have the potential to resolve ambiguities in the physical evidence, fill in gaps in crash events for which there is no physical evidence available and provide leads for the discovery of pieces of evidence that may have been overlooked. In accidents where physical evidence can not be used to sufficiently determine the causes of a crash or where there are conflicting pieces of evidence, observers may play a key role in determining the cause of the crash. It is possible that the testimony of a crash observer could be used in court to help determine the guilt or innocence of the prosecuted.

Given the weight that may be placed on the testimony of a crash observer it would be useful to have some idea of how accurate we can expect crash observers to be in recalling important details of a vehicle accident. Therefore the aims of the present study are to: (1) determine how accurate crash involved drivers are in recalling information important to reconstructing a vehicle accident; and (2) identify variables that may influence the recall accuracy of crash involved drivers.

Data

The data used for the analyses in the present paper come from the In-Depth Research into Rural Road Crashes (Lindsay et al., 2001) conducted within the Road Accident Research Unit for Transport SA. The study began in 1998 and was completed in 2000, it contained 236 cases. The study involved investigation of those crashes that an ambulance was called to and occurred within 100 km of Adelaide. For each case the in-depth investigation included the gathering and development of the following information: site diagrams (including final positions of vehicles, tyre and scrape marks left on the road by vehicles, objects struck by the vehicles, road layout and important environmental features such as traffic lights, give way signs, and trees), reconstructions of the accident using the Simulation Model of Automobile Collisions program (SMAC) whenever possible, speed estimates prior to crash and at impact, delta V values, transcribed interviews with drivers (interviews were semi structured), interviews with witnesses where necessary, photographs of the site and vehicles, police incident reports and analyses of the causes of the crash carried out by expert crash investigators.

Sample Characteristics

All crash involved drivers from the rural in-depth study were included if they met the following criteria:

- The crash they were involved in did not lead to a coronial inquest. These drivers were excluded due to the potential confounding factors introduced by being involved in a coronial inquest. In particular, the perceived seriousness of the case increases and drivers have to provide lengthy written statements that would complicate rehearsal effects.
- An M-SMAC reconstruction had been carried out.
- An interview had been carried out with the driver by a member of the Road Accident Research Unit.

73 participants from 53 cases were included in the study, 31 males and 42 females. The average age of the participants was 39.8 years (SD = 18.6) and ages ranged from 16 to 87.

Method

Information provided by each driver in their interview was categorised and recorded under various categories. These categories covered all the items of information that may be required of drivers by crash investigators. Three types of variables assessing the accuracy of this information were formed from these categories:

1. Variables that represented one piece of qualitative information like “weather conditions”. The accuracy of these variables was simply coded as accurate or inaccurate

2. Variables that represented one piece of quantitative information, like “accuracy of speed estimate prior to crash”. The accuracy of these variables was given a numerical value that was the objective value minus the recalled value.

3. Variables that represented multiple pieces of information that could be quantitative or qualitative. These variables were formed to determine the accuracy of the driver’s recall of the many events that occur prior to, during and after a crash. Eight variables were formed that described the possible events of a crash:

- Initial travelling position
- Avoidance movements
- Crash position and movements
- Point of impact on own vehicle
- Point of impact on other vehicle
- Other objects struck by own vehicle
- Movements after impact
- Final position

The accuracy of these variables was calculated as a percentage of accurate information recalled compared to all information recalled. The method used to calculate the accuracy of this information is commonly used in studies of real life memory. Initially all the relevant information recalled by drivers was separated into the eight categories above and then further divided into distinct idea units. An idea unit is 1 or more words that describe a single idea. For example, a driver’s description of the vehicle’s movements after impact may have been “our car rotated 90 degrees and left the road”. This statement can be broken into five distinct idea units: “our car/ rotated / 90 degrees / and left / the road /”. It should be noted that two of these idea units “our car” and “the road” will not be included as idea units in this category as this information can be assumed, it is not adding anything to our knowledge about the “movements after impact”.

Each idea unit was then evaluated for accuracy against the objective information available and given a accuracy score of 1 (accurate), 1/2 (partly accurate), or 0 (inaccurate). Half point marks were used sparingly and only when information was difficult to classify as either entirely accurate or entirely inaccurate. For example, if in the above description the car was actually determined to have rotated 45 degrees, a half mark would have been given. For each stage the total amount of information recalled and the amount of information recalled correctly was recorded and an overall accuracy percentage determined. Occasionally it was not possible to determine the accuracy of an idea unit due to a lack of objective information. These idea units were noted and excluded from any further calculations.

Results

Accuracy Of Driver Recall

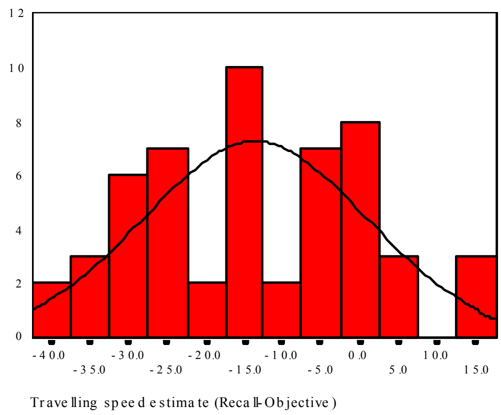
<u>Speed</u>

Figure 1 shows the difference between driver's estimates of their speed and their actual travelling speed. Negative values in this figure represent underestimations of speed. Drivers (N=53) underestimated their travelling speed prior to a crash by a mean of 13.6 km/h (SD= - 14.43). Mean travelling speed was 88.3 km/h (SD=29.6). 3.8% of drivers estimated their speed correctly, 73.6% of drivers underestimated their travelling speed and 22.6% of drivers overestimated their travelling speed.

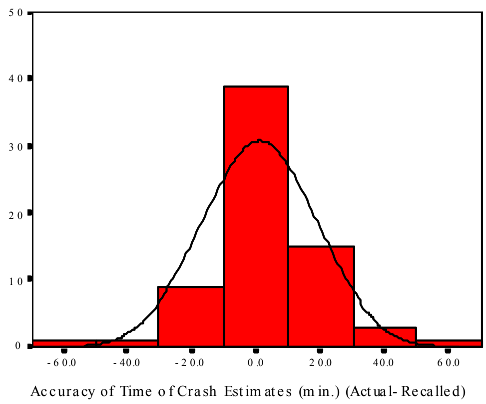
<u>Time of Crash</u>

Figure 2 shows the difference between driver's estimates of the time of crash and the actual time at which the crash occurred (N=69). 33.3% of drivers correctly estimated the time at which the crash occurred and 62.1% of drivers' estimates were within 10 minutes.

<u>Figure 1. The accuracy of driver estimates of their travelling speed prior to crashing.</u>



<u>Figure 2. The accuracy of driver estimates of their time of crash.</u>



<u>Speed Zone</u>

65.7% (N=44) of drivers correctly estimated the speed zone in which they were travelling. 14.9% (N=10) of drivers underestimated the speed zone in which they were travelling, all drivers underestimated by 10 km/h. 17.9% (N=13) of drivers overestimated the speed zone in which they were travelling, overestimates ranged from 5 km/h to 40 km/h.

<u>Environmental Information</u>

94.8% (N=55) of drivers accurately recalled the conditions of the road on which they were travelling when their crash occurred, only 5.2% (N=3) of drivers did not.

80.6% (N=50) of drivers accurately recalled the weather conditions at the time of their accident and 19.4% (N=12) of drivers recalled this information incorrectly.

98.6% of drivers (N=71) accurately recalled the lighting conditions present at the time of their accident, only 1 driver (1.4%) did not recall the lighting conditions correctly.

Events of the crash

Table 1 presents the mean percentage of information recalled correctly by drivers for the eight different crash stages and for their total recall accuracy over all stages. The average number of idea units recalled by participants over these eight stages is 5.7 (SD=4.3). A maximum of 17 idea units were recalled by one driver and thirteen drivers failed to recall any idea units. Excluding drivers who failed to recall any idea units, drivers who recalled at least 1 idea unit (N=60) recalled a mean of 7.0 (SD=3.7) idea units over the eight crash stages. Drivers who recalled at least one unit of information recalled a mean of 5.9 (SD=3.5) units of information correctly. In other words, drivers who recalled at least one unit of information in any of the crash stages recalled, on average 85.3% of this information correctly.

Table 1. Stages of the crash: Mean recall accuracy

	N	Mean recall accuracy	SD
Initial travelling position	31	87.1%	29.1%
Avoidance movements	13	91.0%	27.7%
Crash positions and movements	36	85.9%	30.3%
Objects struck, other than car	14	90.5%	27.5%
Point of impact on own car	46	86.6%	27.2%
Point of impact on other car	31	86.6%	31.5%
Position & movements after impact	33	83.3%	27.6%
Final position	32	79.9%	32.4%
Total per cent of information correctly recalled	60	85.3%	17.9%

Factors Influencing The Accuracy Of Driver Recall

The effect of culpability on recall accuracy of travelling speed

Two different tests were conducted to determine if culpability influenced driver's accuracy of recall of their travelling speed before impact (Table 2). Test (A) compared the accuracy of driver estimates of travelling speed between drivers who police determined to be in error and drivers not in error. Although drivers held in error by police underestimated travelling speed by 5.7 km/h more than drivers who were not held in error, this difference was not statistically significant $t_{(35)} = -1.19$, $p > 0.05$. Test (B) compared the accuracy of driver estimates of travelling speed between drivers who were speeding prior to the accident and drivers who were travelling at or under the speed limit prior to the accident. Drivers who were speeding prior to the accident underestimated their travelling speed by 13.8 km/h more than drivers travelling at or under the speed limit, this difference was statistically significant $t_{(48)} = -3.89$, $p < 0.01$.

Table 2. Descriptive statistics for driver recall accuracy for travelling speed prior to crash by culpability

	Culpability	N	Mean recall accuracy (km/h)	Standard Deviation
Police identified driver error	Yes	18	-16.78	13.53
	No	19	-11.08	15.49
Driver speeding prior to impact	Yes	22	-21.36	12.25
	No	28	-7.57	12.60

Effect of admission of memory loss on recall

Driver's recall accuracy was not diminished if they admitted to experiencing memory loss about the events of the accident. The eight participants who admitted to some memory loss but were still able to recall at least one unit of information accurately recalled 90.1% (SD=0.18) of the provided information correctly compared with participants (N=52) who did not admit to memory loss who recalled 84.5% (SD=0.18) of information correctly. The difference in accuracy between these groups was not statistically significant, $t_{(58)} = 0.89$, $p > 0.1$.

However participants admitting memory loss recalled far less units of information than did participants not admitting memory loss (see table 3). The difference in the amount recalled between drivers admitting no memory loss and drivers admitting to memory loss was significant, $t_{(67)} = -5.32$, $p < 0.05$. Even when excluding drivers who recalled no information, drivers who admitted to memory loss recalled significantly less information than drivers who did not make such an admission, $t_{(58)} = -2.15$, $p < 0.05$.

Table 3. Number of idea units of information recalled by driver by admission of memory loss.

	N	M	SD
A. No admission of memory loss	52	7.35	3.34
B. Admission of memory loss	17	2.06	4.19
C. Admission of memory loss but recalled at least 1 unit of information	8	4.38	5.34

Looking at the amount of information recalled by drivers admitting memory loss compared to those who did not across the different stages of the crash yields some interesting results (Table 4). Only when drivers admitting memory loss recalled information before impact occurred did they not recall significantly less information than drivers not admitting memory loss. Drivers admitting memory loss did not recall significantly less information when recalling information to do with their initial travelling position $t_{(65)} = 0.105$, $p > 0.1$ or avoidance movements $t_{(29)} = 0.829$, $p > 0.1$. All other comparisons were significant.

Table 4. Number of idea units recalled by drivers admitting memory loss and drivers not admitting memory loss for the 8 crash stages.

	Admission of memory loss	N	M	SD
Initial travelling position	Yes	17	0.41	0.80
	No	50	0.80	0.86
Avoidance movements	Yes	9	0.78	1.99
	No	22	0.91	1.31
Crash position and movements ***	Yes	17	0.24	0.75
	No	51	1.39	1.65
Objects, other than car, struck by vehicle *	Yes	6	0.50	0.84
	No	15	1.20	0.77
Point of impact on own car *	Yes	16	0.44	0.81

	No	52	1.37	0.84
Point of impact on other car ***	Yes	13	0.00	0.00
	No	44	1.18	0.90
Position and movement after impact ***	Yes	17	0.18	0.39
	No	47	1.40	1.28
Final position ***	Yes	17	0.24	0.44
	No	47	1.21	1.28

*** = p < 0.01
** = p < 0.05
* = p < 0.10

Effect of impact severity on recall accuracy

In the first test designed to look at the effect of impact severity on recall accuracy we looked at whether drivers who admitted that they could not recall any of the events of the accident would have experienced accidents of higher impact than drivers who did not make such an admission (Table 5). Although drivers who failed to recall the events of the accident in which they were involved were likely to have experienced a higher impact severity accident this was not a significant difference, $t_{(58)} = 1.466$, $p > .05$.

The second test sought to determine whether impact severity correlated with either driver's recall accuracy or the amount of information they recalled. There was a very weak negative correlation between delta V values and number of units of information recalled, $r_{(60)} = -0.02$, $p > 0.1$, and a weak correlation between delta V scores and overall accuracy of information recalled $r_{(53)} = -0.13$, $p > 0.1$.

Table 5. Delta V values of accidents involving drivers who could and could not recall the events of the accident in which they were involved.

Admission of failure to recall accident	N	Mean Delta V	SD
Yes	14	47	17.53
No	46	38.57	19.22

Effect of Recall delay on Recall Accuracy

There were no statistically significant correlations between recall delay (days between accident and interview) and recall accuracy or amount. The mean delay between accident and interview ranged from 24 days to 195 days with a mean of 107.18 days (SD=40.5 days). There was a very weak positive correlation between recall delay and number of idea units recalled, $r_{(71)} = 0.09$, $p > 0.1$. There was also a weak positive correlation between recall delay and overall accuracy of recall, $r_{(60)} = 0.20$, $p > 0.1$.

Discussion

Accuracy of driver recall

The results of this study indicate that the majority of the information recalled by crash involved drivers about the events of their accident will be accurate. Koriat, Goldsmith and Pansky report that output bound accuracy of free recall is remarkably high across many experiments, "typically ranging from 0.85 to 0.95. That is, over 85% of the items typically recalled are correct" (2000, p. 522). It is therefore not surprising that in the present study, on average, 85.3% of a driver's account of their crash is recalled accurately.

If we look at the recall accuracy across the different stages of a crash, information relating to the final position of the vehicle was recalled least accurately at, 79.9%, while avoidance movements were recalled most accurately at 91.0%. It is worth making mention here of the types of information that participants recalled inaccurately as it helps us to understand why recall accuracy may vary so much across stages.

Information recalled about the final position of a driver's car was often detailed and involved measurements of position relative to notable landmarks. A driver incorrectly recalled the following passage "I was about 2 metres from the sealed road". In fact, although most of the vehicle was off of the road the rear of it overlapped the sealed road. By comparison, avoidance movements tended to be clear statements of simple movements like "I swerved left". One of the only idea units recalled incorrectly in this category described vehicles position " [the car] was about half way over the centre line" when in fact tyre marks showed that the vehicle did not cross the centre line. This was one of the few descriptions of position included in the avoidance movements category. While the later category often involved the recall of physical movements the former category involved the recall of a number of objects in a spatial field, requiring perhaps a range of different and perhaps more complex cognitive skills in encoding, storing and recalling this information. It seems that the accuracy with which a driver can recall a piece of information may be partly determined by the nature and complexity of that piece of information.

Speeding and the accuracy of speed estimates

It is interesting, given the generally high levels of recall accuracy for the events of a crash, that drivers recalled so poorly their travelling speed prior to crashing. Under varying conditions a number of researchers have investigated people's ability to estimate speed while in a moving vehicle and have consistently found that they underestimate their travelling speeds. Underestimates range from 2.7 km/h when travelling between 10 mph and 60 mph (Evans, 1970), through to 5 km/h when travelling between 20 km/h and 120 km/h (Milosovic, in Recarte & Nunes, 1996) and 14.8 km/h when travelling between 60 km/h and 120 km/h (Recarte & Nunes). The finding of the present study, that drivers underestimate their travelling speed by 13.6 km/h, considering that their mean travelling speed was 88.3 km/h, is consistent with these results. Crash investigators should therefore treat with scepticism travelling speed estimates by crash involved drivers.

It is particularly interesting that underestimates of speed were greater when the driver was travelling above the speed limit prior to their accident. Speeding drivers underestimated their travelling speed prior to crashing by 21.4 km/h while drivers travelling at or under the speed limit underestimated their travelling speed by only 7.6 km/h, a significant difference ($p < 0.01$). Further research will need to be conducted in order to fully understand why this effect exists. However, it is proposed that speeding drivers, knowing that others perceive speed to contribute to the likelihood of being involved in an accident, wish to avoid being seen as contributing to the occurrence of their crash and therefore consciously or unconsciously underestimate their travelling speed.

Memory loss and recall

While the accuracy of driver's recall was not affected by the admission of memory loss the amount of information drivers recalled was. Previously, it may have been tempting to conclude that any information recalled by a driver admitting to memory loss would be inaccurate. In fact this is not necessarily the case and such drivers recall the events of a crash as accurately as drivers not admitting to memory loss. Results further reveal that while drivers admitting memory loss recall less information about the events of a crash after the initial impact occurs they recall a similar amount of information to do with events occurring prior to impact as other drivers.

Interestingly, drivers who admitted to memory loss were not involved in significantly higher impact severity crashes than drivers not admitting to memory loss. This may indicate that memory loss is not more likely to occur in higher impact severity crashes, which is a surprising result as we assume drivers involved in such crashes will be more likely to experience a loss of consciousness and will therefore fail to encode and subsequently recall some of the events of the crash. However, it may also be the case that not all drivers experiencing memory loss admitted to this fact and therefore this was not a true measure of memory loss.

Recall Delay

Eyewitness studies have found that delaying the interview of a witness to a crime or accident increases the likelihood that post event information or suggestion will distort their recall of the event (Kelloway, Stinson & MacLean, 2004). However, contrary to these findings there were no significant correlations between recall delay and recall accuracy or amount. It is possible however that the distortion that occurs to memory over time may occur over the fist few weeks after the event and plateau as time goes on. If this were the case, the fact that the minimum recall delay in the present study was 24 days and the mean delay was 107.2 days would mean that the majority of the distortion to drivers' memory would have occurred prior to the time that most drivers were interviewed. A study that includes a range of smaller recall delays perhaps down to same day recall will be necessary in order to determine whether distortion does occurs in the first few weeks after the event.

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