What is the Involvement of Heavy Trucks in Crashes in NSW?

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Biography
Ann Williamson has published widely in the area of road safety and work-related injury. In particular she has extensive experience in the area of fatigue and driving. She was founding Director of the Injury Risk Management Research Centre.

Abstract
This study used information in the NSW RTA's Traffic Accident Database System to examine the major patterns of crashes involving heavy trucks in NSW over the period 1996 to 2000 and compared them with crashes involving other road users. Heavy trucks had higher crash rates than seen for all crashes when expressed as rates per registered vehicle, but rates per kilometre travelled, which is probably a better measure of road exposure, did not show great differences between heavy truck crashes and all crashes. Articulated heavy trucks, B-doubles and roadtrains showed higher rates per registered heavy truck for all levels of crash severity compared to rigid trucks and all vehicles but rates per kilometres travelled were only higher for fatal articulated truck crashes. In addition, injury crash rates per registered truck increased over the five years for heavy rigid and heavy articulated trucks but rates per kilometres travelled did not and non-casualty heavy truck crash rates per kilometres travelled decreased overall and for articulated heavy trucks. The patterns of truck crashes reflected the distribution of truck numbers and patterns of road usage across the state and across time. For example, higher proportions of heavy truck crashes occurred in country areas, between midnight and dawn and on higher speed roads. Heavy truck crashes also showed different causal patterns and these differed depending on the severity of the crash. Where the heavy truck was judged to be the vehicle playing the major role in fatal crashes, the most common crash patterns involved an off path on curve movement or were pedestrian-related. In contrast the most common pattern for fatal crashes for other vehicles involved vehicles approaching on the incorrect side of the road from opposite directions. Crashes involving heavy trucks were just as likely to involve fatigue, and slightly more likely to involve speeding compared to crashes involving other vehicles. Alcohol was a component in a very small proportion of crashes compared to other vehicles.
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1. INTRODUCTION

Heavy vehicles are a common feature of today's roads as more freight is moved around the country and as more freight is moved by road. Previous RTA analyses of the Traffic Accident Database System (TADS) data indicated that heavy trucks are involved in nearly 20 percent of all fatal crashes and number approximately 3,000 crashes in NSW each year (5 to 6 percent of all crashes). Just under 100 heavy truck crashes involve at least one fatality and around 100 people are killed in heavy truck crashes each year. The aim of this study was to examine the major patterns of crashes involving heavy trucks over the period 1996 to 2000. It looked at the involvement of different types of heavy trucks, at crashes with different severity outcomes and heavy truck crashes where the truck played the major role (i.e., was the 'key' participant) and where another road user was the key traffic unit.

2. METHOD

The data used in this study was the Traffic Accident Database System (TADS) from the NSW Roads and Traffic Authority. This is a computerised database containing information on all

road traffic accidents that are required to be reported to the NSW Police. In TADS heavy trucks are defined using vehicle and weight classifications, with heavy trucks defined as having a tare weight greater than 4.5 tonnes. Within heavy trucks, three subgroups, Rigid, Articulated, and Bdoubles/Roadtrains, were treated separately for some analyses. Heavy Rigid trucks included Large Rigid Lorries and Rigid tankers. Heavy Articulated trucks included Articulated tankers and Semi-trailers or low loaders, and the standard TADS definition of Bdoubles and Roadtrains was used.

When comparing heavy truck crashes with other types of crashes, the total number of crashes recorded in the TADS database was used as the comparison. This figure includes accidents that do not involve motorised vehicles, but may involve other road user classes (e.g., pedal cyclists). Because there is little difference between total crash numbers and the numbers of crashes involving only motorized vehicles, the total figures were used. Rates were calculated using two types of available denominator data:
1) The number of heavy trucks on register with the NSW RTA in June each year. Mid year registration figures were selected to provide an estimate of the average number of vehicles registered over the whole year. It is acknowledged that there may be problems with using only NSW registrations as the base for rate comparison since there may be trucks registered in other states travelling, and consequently crashing, on NSW roads, however as it is also likely that at any time many NSW registered trucks will be travelling outside NSW, these two factors may balance one another out.
2) The total number of kilometres travelled annually by vehicles operating in NSW, up to the 31 July 1998, the 31 July 1999 and the 31 October 2000, according to the Australian Bureau of Statistics (ABS) Survey of Motor Vehicle Use, Australia.
Some of the analysis looked at accidents involving heavy trucks as the key traffic units. The key vehicle is defined as the traffic unit considered to have played the major role in the accident (generally recorded as Vehicle '1' by the police on the accident report; RTA, 2000). Some caution should be exercised when interpreting the results for key and non-key traffic units. Although the key traffic unit was determined to generally have played the major role in the accident, this may not necessarily be consistent with a lay attribution of responsibility (e.g., pedestrians are never defined as the key traffic unit). Further, responsibility for any given crash may lie with more than one accident participant, but only one is coded as key.

3. RESULTS

Heavy trucks had higher crash rates than seen for all crashes when expressed as rates per registered vehicle (see Table 1). Fatal crash rates per registered heavy trucks were around five times higher than the fatal crash rates for all registered vehicles and injury and non-casualty crash rates for registered heavy trucks were two to three times higher than for all vehicles. When rates were expressed in terms of kilometres travelled, which give better estimates of actual road exposure, the differences between heavy truck crashes and all crashes were much smaller. Crash rates per million kilometres travelled were slightly higher only for fatal heavy truck crashes compared to all fatal vehicle crashes, whereas injury and non-casualty crashes per kilometres travelled were similar between heavy truck and all vehicle crashes.

Table 1: Heavy truck crash rates compared to crash rates for all vehicles with rates expressed per registered vehicles and per kilometer travelled.

		1997	1998	1999	2000
Rates per 10,000 registered vehicles					
Fatal	Heavy trucks	10.59	9.46	9.95	11.6
	All vehicles	1.54	1.41	1.43	1.49
Injury	Heavy trucks	106.11	120.34	121.11	135.33
	All vehicles	53.63	56.3	56.06	59.99
Non-casualty	Heavy trucks	184.48	202.85	205.35	191.9

	All vehicles	91.5	92.8	91.65	83.71
Rates per 1,00,000 km					
Fatal	Heavy trucks		2.21	2.13	2.49
	All vehicles		0.97	1	1.04
Injury	Heavy trucks		28.13	25.9	29.08
	All vehicles		46.16	46.31	49.68
Non-casualty	Heavy trucks		47.42	43.92	41.24
	All vehicles		47.13	47.31	50.72

Comparing truck types, when expressed as rates per registered heavy truck, articulated heavy trucks, Bdoubles and roadtrains showed higher rates for all levels of crash severity compared to rigid trucks and all vehicles (see Table 2). Rates per kilometres travelled were higher for fatal articulated truck crashes but not for fatal rigid truck crashes. Across the period 1996 to 2000 injury crash rates per registered truck increased for heavy rigid and heavy articulated trucks but rates per kilometres travelled did not. Instead, non-casualty heavy truck crash rates per kilometres travelled decreased overall and for articulated heavy trucks.

Table 2: Crash rates per registered vehicle and per kilometer travelled for different types of truck.

	1997	1998	1999	2000
	Rates per registered vehicle			
Rigid trucks				
Fatal	4.51	3.8	4.58	4.91
Injury	65.68	69.95	71.89	79.29
Non-casualty	116.33	123.1	125.74	120.14
Articulated trucks				
Fatal	40.72	42.42	39.6	45.1
Injury	339.08	412.38	414.22	468.75
Non-casualty	577.13	672.37	661.33	636.28
Bdouble/road trains+				
Fatal	101.81	31.85	39.32	77.73
Injury	305.43	286.62	222.8	349.81
Non-casualty	373.3	406.05	491.48	305.39
	Rates per km travelled			
Rigid trucks				
Fatal	*	1.39	1.48	1.64
Injury	*	25.56	23.32	26.48
Non-casualty	*	44.97	40.79	40.12
Articulated trucks				
Fatal	*	3.34	2.98	3.61
Injury	*	32.28	30.08	33.61
Non-casualty	*	51.87	49.32	44.01

* denominator data unavailable for this year + km travelled denominator data unavailable for Bdoubles/road trains.

Characteristics of heavy truck crashes

Heavy trucks were somewhat less likely than other accident participants to be key vehicles in fatal crashes (Table 3) but were somewhat more likely to be key vehicle for injury and non-casualty crashes. The involvement of different types of trucks almost certainly reflects the relative numbers of each type of truck on each road-type. Just over half (57.8%) of all fatal truck crashes involved semi trailers followed by large rigid lorries (28.6%) and very small numbers of fatal truck crashes involved roadtrains or Bdoubles (6.5%). Analysis of the crash rates for heavy truck involvement as key vehicles shows that the rates per registered vehicle and per distance travelled were much lower than the rates for all crashes in which they were involved (Table 4).

Table 3: Heavy truck as key or non-key traffic unit in crash by severity of crash showing number and percentage of crashes (1996 to 2000)

Truck role	Fatal		Injury		Non-casualty		Total	
	n	%	n	%	n	%	n	%
Key	199	2.2	3375	37.2	5499	60.6	9073	100.0
Non-key	250	5.0	1830	36.6	2922	58.4	5002	100.0

Table 4 Rates for crashes where the heavy truck was key controller

	1997	1998	1999	2000
Rates per 10,000 registered vehicles				
Fatal	4.26	5.13	3.96	5.02
Injury	69.4	76.13	78.82	92.27
Non-casualty	118.54	137.32	131.85	124.4
Rates per 1,000,000 km travelled				
Fatal	*	1.2	0.85	1.08
Injury	*	17.79	16.86	19.83
Non-casualty	*	32.1	28.2	26.73

Timing and location of truck crashes

Most truck crashes occurred on state highways (36.0%) and classified roads (36.0%), and overall, most occurred in the Sydney metropolitan area (56.3%). Fatal truck crashes showed a somewhat different pattern with more than half occurring on state highways (55.9%) and in country areas, especially the North Coast and Hunter regions. Only about one-third of fatal truck crashes (34.7%) occurred in the Sydney region. In this same vein, most country Local Government Areas (LGA) had proportionately more fatal heavy truck crashes than metropolitan LGA's.

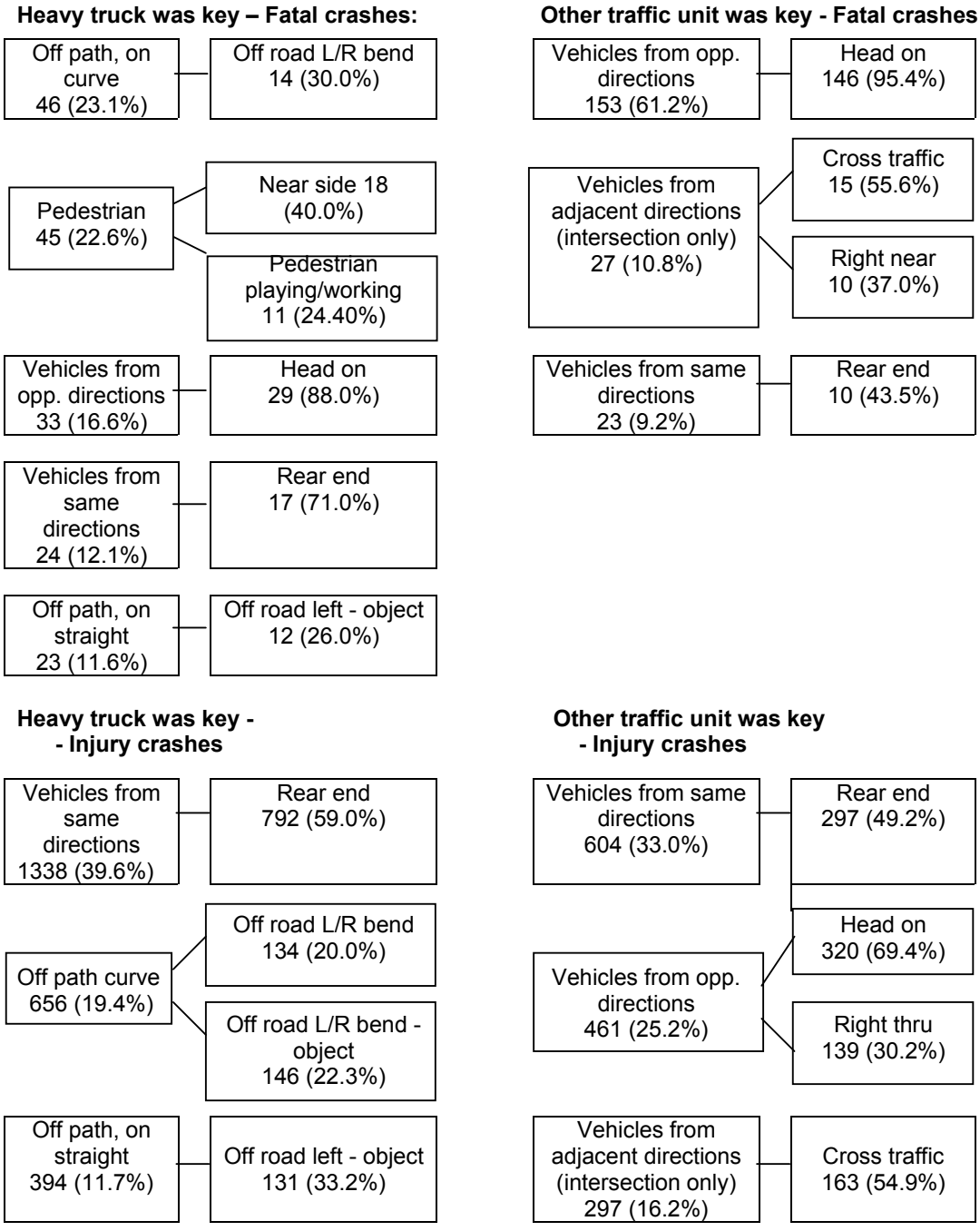
Truck crashes of all severity mostly occurred during the week rather than the weekend, and showed a peak during the daytime. For fatal crashes, especially where the truck was key vehicle, a higher proportion of crashes occurred between midnight and dawn (27.1% when truck was key compared to 17.2% when another vehicle was key). Nearly two-thirds of fatal truck crashes occurred on 2-way undivided roads (64.8%) and fewer than one in five occurred at intersections (18.9%). Truck crashes on divided roads only rarely resulted in fatalities (9.6%). The greater majority of all truck crashes involved multiple vehicles. Where the truck crash only involved the truck, it was most likely to be an articulated truck (63.8%) although a higher percentage of crashes involving Bdoubles/roadtrains were single vehicle crashes (33.9%) compared to the other types of heavy trucks (23.6% and 10.3% for articulated and rigids respectively). Most truck crashes occurred on straight roads (76.2%) with no special features and in fine weather conditions (75.5%). Around half of all heavy truck crashes occurred in areas where the speed limit was 60kph (51.0%), but around one in five crashes occurred in 100 or 110kph zones (23.2%) and crashes in areas where higher speeds are permitted were more likely to be fatal (51.9% fatal compared to 34.0% injured and 19.0% non-casualty).

Road user movements involved

The road user movements leading to fatal truck crashes were very different to those leading to injury or non-casualty crashes and they differed depending on whether or not the heavy truck was the key vehicle (see Figure 1). Fatal heavy truck crashes where the truck was key mainly involved off path movements on curves or straight roads or involved pedestrians. In contrast, where the other vehicle was key more than half of heavy truck crashes involved vehicles approaching from opposite directions and resulted in a head on crash.

For injury and non-casualty heavy truck crashes there was less difference between those where the heavy truck was key and where the other vehicle was key. No matter which vehicle was key, around one-third of injury crashes and nearly one-half of non-casualty crashes involved vehicles coming from the same direction and mainly resulted in a rear end collision. As for fatal truck crashes, where the truck was key vehicle, a significant proportion of injury and non-casualty heavy vehicle crashes also involved off path movements on curves or straight. Where the truck was not key, significant proportions of injury and non-casualty crashes involved the vehicles approaching from opposite directions or adjacent directions at intersections.

Figure 1: Main categories and related subcategories of road user movements for fatal and injury heavy truck crashes



Involvement of behavioural factors

In heavy truck crashes involving speeding, the truck was more likely to be the speeding controller than another vehicle (Table 5). Where the truck controller was speeding, however, the crash was less likely to result in a fatality and more likely to result in injury or even no casualty, whereas when the other controller was speeding, fatalities were more likely to be the result.

Where illegal levels of alcohol were involved in truck crashes, it was much less likely to be the truck controller who was affected and affected heavy truck controllers were more likely to have lower levels of alcohol (Table 5). Again, fatal crashes were less likely to result when the truck controller was above the legal limit for alcohol, whereas when another vehicle was above the limit in truck crashes, all crash outcomes were roughly equally likely.

The patterns for fatigue-related truck crashes were similar to that seen for speeding crashes (Table 5). While truck drivers were more likely to be the fatigued controller in fatigue-related truck crashes, the crash involving fatigued truck controllers was less likely to be fatal and more likely to involve injury or non-casualty compared to crashes when another vehicle was fatigued.

Table 5: Illegal blood alcohol, speeding and fatigue involvement in crashes for heavy truck and Other controllers in heavy truck crashes: percentage of total controllers in alcohol, speeding or fatigue-related heavy truck crashes for each level of crash severity.

Behavioural factors and crash severity	Total controller	Heavy truck controllers		Other traffic unit controllers	
		All	Key only	All	Key only
Illegal alcohol involvement					
Fatal	75	3 (4.0%)	2	34 (45.3%)	30
Injury	335	49 (14.6%)	44	142 (42.4%)	123
Non-casualty	202	35 (29.4%)	32	84 (41.6%)	71
Total	*612*	*87 (14.2%)*	*78*	*260 (42.5%)*	*224*
Speeding involvement					
Fatal	230	54 (23.5%)	46	72 (31.3%)	65
Injury	1195	642 (53.7%)	627	222 (18.6%)	186
Non-casualty	1429	685 (47.9%)	651	321 (22.5%)	263
Total	*2854*	*1381 (48.4%)*	*1324*	*615 (21.5%)*	*514*
Fatigue involvement					
Fatal	239	42 (17.6%)	42	80 (33.5%)	79
Injury	804	393 (48.9%)	392	180 (22.4%)	179
Non-casualty	766	450 (58.7%)	450	141 (18.4%)	141
Total	*1809*	*885 (48.9%)*	*884*	*401 (22.2%)*	*399*

[1] Illegal levels of alcohol for heavy truck drivers include the special range of 0.02 to 0.049%BAC

4. CONCLUSIONS

This analysis demonstrated that crash rates for heavy vehicles are similar to rates for other vehicles if level of exposure to the road is taken into account. In addition, heavy vehicles are less likely to be judged the key or most responsible controller in crashes in which they are involved and the rates for crashes involving heavy trucks as key are also lower than for other vehicles. The characteristics of crashes for heavy vehicles reflect the distribution of truck numbers and patterns of road usage across the state and across time. For example, heavy truck crashes are more likely during the week, on country and two-way undivided roads and at night.

The type of crash depended on whether or not the heavy truck was the key controller. Where the truck was key, crashes were most likely to involve off path movements, whereas when the other vehicle was key they were more likely to involve vehicles from opposite directions. Similarly, the severity of the crash depended on the type of crash and which was

the key controller. Where the truck was key, a significant proportion of fatal crashes involved pedestrians, but a significant proportion of injury crashes involved rear end collision and vehicles from the same direction.

The pattern of crashes when a heavy truck controller is affected by alcohol, fatigue or is speeding is interesting. It indicates that heavy trucks are, in general, considerably less likely to be the cause of fatal crashes due to these factors, although they play a larger role in injury crashes. It also indicates, however that where the behaviour of the other traffic controller is impaired due to alcohol, fatigue or speeding, the crash with a heavy truck is more likely to result in a fatality. The reason for this pattern is not entirely clear. It is possible that heavy truck controllers do not generally reach the same levels of behavioural impairment as other traffic unit controllers. For example, as suggested in this analysis, they are not as likely to reach higher BAC levels, and other analysis of traffic survey data also reported at this meeting, shows that heavy truck controllers are less likely to speed to the same degree as other traffic units. Alternatively it is possible that heavy truck controllers respond differently to factors that are likely to impair their behaviour and are better able to compensate for them. Or it may be due to a combination of these factors.

Keywords
Heavy vehicles, trucks, crashes, speeding, alcohol, fatigue