Fatigue as a crash factor: Applying the ATSB definition for a fatigue-involved crash to Victoria's crash data

Mark Symmons
Bionics & Cognitive Science Centre, Monash University

Abstract

Without in-depth investigation, fatigue is a particularly difficult variable to assign as a crash factor. Some Australian mass crash databases (but not Victoria's) include fatigue as a variable, however it is usually reflects the conclusion of the attending police officer, based on information such as witness statements. A method of deriving a fatigue-involved crash from a number of other crash factors was proffered by the Australian Transport Safety Bureau. That method was applied to Victoria's mass crash database. Depending how the definition is used, 6-16% of all crashes and 17-27% of fatality crashes in Victoria were the result of fatigue. Fatigue also seems to be a relatively greater issue for both heavy vehicles and motorcycles than for cars.

Introduction

Given the gains made in combating speeding, drink driving and other road safety issues, fatigue has proportionally become an increasingly significant issue. One critical feature of fatigue and driving is that there are no on-road objective mechanisms for its detection – no tool that acts in a similar manner to speed cameras as a speeding countermeasure and breath tests to deal with drink driving. In addition, unlike speeding and drink driving, fatigue or driving while fatigued is not an illegal behaviour per se, although heavy vehicle drivers have mandated maximum hours of work and driving that they must comply with and document in a log book. Accordingly, authorities must rely in particular on voluntary behaviour modification. In an evidence-based approach to this issue the starting point would be an understanding of the nature and extent of the problem.

Consistent with other jurisdictions, Victoria maintains a database of all crashes that are attended and documented by police officers. The mass crash database describes demographic details of the individuals involved, descriptions of the vehicles, time and location of the incident, and the circumstances of the crash in terms of vehicle manoeuvres, weather, and so on at the time of the crash. These and a range of other variables are all “non-controversial facts of the crash” (Hanowski, Olson, Hickman & Dingus, 2006) in that they objective. However, there is generally little insight into driver behaviour or disposition immediately prior to the crash; factors such as degree of fatigue. Thus Victoria’s crash database describes the crash outcome(s) rather than the cause per se.

A police officer attending a crash (in Victoria or elsewhere) may collect witness statements that suggest factors such as excessive speed or fatigue may have been involved as a causal or contributory factor to the crash, but this information may not always be objectively and systematically collected and entered into the crash database. Additional information is collected for some fatal crashes where a coroner makes further investigations and/or units such as Victoria Police’s Major Collision Investigation Unit (MCIU) conducts in-depth investigations of crashes, however their involvement is dependent upon the nature of the collision – MCIU are more likely to investigate crashes in which three or more persons are fatally injured (Bugeja, Symmons, Brodie, Thorne, & Ibrahim, nd). As a high proportion of fatigue-involved crashes are likely to be single vehicle crashes, most would not fall within the purview of such in-depth investigation, regardless of vehicle type.

The crash databases of a number of Australian jurisdictions, but not Victoria, do specify whether fatigue was suspected by the attending officer as a possible crash factor. For example, Tasmania has included a crash factor variable that can include causes such as excessive speed or fatigue, and New South Wales has had separate variables to indicate whether excessive speed was suspected or fatigue was suspected. However, as there is no universally accepted definition of fatigue as a crash factor (Dobie, 2002), this information must be treated with a degree of caution. An alternative method of coding fatigue and other somewhat subjective variables such as excessive speed is to derive it from other variables already present in the collected data.

The Australian Transport Bureau (ATSB) proposed a definition of fatigue as a likely crash factor based on several crash characteristic variables (Dobie, 2002). This definition consists of two "types" of fatigue-related crashes. One of these crashes is based on the knowledge of the effects of circadian rhythms and specifies that a single-vehicle crash that occurs within the periods of midnight-6am or 2pm-4pm is more likely to be fatigue-related. The second type of fatigue-related crash involves head-on crashes in which neither vehicle was overtaking at the time of the collision. The ATSB definition of a fatigue-related crash also specifies a number of exclusory criteria (Dobie, 2002) such that the following types of crashes should not be counted:

- Crashes where the driver had a BAC greater than 0.05g/100ml
- Crashes involving any unlicensed drivers or unlicensed motorcycle riders
- Crashes involving a pedestrian
- Crashes at locations where the speed limit was less than 80 km/h

Victoria's mass crash database does not currently include a variable that specifies whether fatigue may have played a contributory or causal role in the crash. The aim of the current study is to apply the ATSB definition of a fatigue-related crash to Victoria's crash data.

Data preparation

The analyses described here were conducted on Victoria's mass-crash database for the years 2001-2004 inclusive. Table 1 shows the number of cases to be discarded based on each of Dobie's (2002) exclusion criteria as a function of year, along with the average and standard deviation as an indication of fluctuations in the data across the four years. Table 1 also indicates the percentage of the total number of crashes to be excluded from the data as non-fatigue related. It should be noted that these values can not be simply added for a total number of excluded cases as a particular crash may be counted more than once; for example, a drunk, unlicensed driver who crashed in a 60 km/h speed zone would be excluded by three of the criteria.

Table 1. Number of crashes per year, on average and as a percentage of all crashes to be discarded according to Dobie's (2002) exclusion criteria

Exclusion	2001	2002	2003	2004	Average	SD	Total	% of all crashes
BAC>0.05	874	645	807	518	711	161	2,844	4%
Unlicensed	203	119	129	109	140	43	560	1%
Pedestrian involved	1,622	1,619	1,565	1,433	1,560	88	6,239	9%
Speed limit <80	11,739	11,793	11,389	10,921	11,461	402	45,842	67%

Overall, in 4% of all crashes (an average of 711 crashes per year), the driver (note that this also includes motorcycle riders, but the term "driver" will be used to include both unless otherwise specified) had a recorded BAC level of greater than 0.05 (to take account of changes in Victoria's regulations, this exclusion criteria could be updated to include BAC readings of 0.05 and above, which would result in twelve more cases being discarded from the current data). The largest cull of cases – two-thirds of all cases were removed – arose from excluding all crashes that occurred in locations in which the speed limit was less than 80 km/h.

Results & Discussion

Table 2 corresponds to Dobie's (2002) definitions of a likely fatigue-involved crash: involvement in a head-on crash in which no overtaking was taking place, and a single-vehicle crash occurring within the period of midnight to 6am or 2pm-4pm. Non-fatigue crashes are shown for comparison. (Note that unless otherwise specified, from this point on the use of the phrases "fatigue-involved" and "fatigue-related", and the matching non-fatigue equivalents, refer to fatigue as defined by the ATSB in Dobie 2002.)

Table 2. Number of fatigue-involved crashes per year based on Dobie's (2002) definitions, on average and as a percentage of all crashes

Fatigue type	2001	2002	2003	2004	Average	SD	Total	% of all crashes
Head-on no overtaking	313	278	238	247	269	34	1,076	2%
Single-vehicle, hours	621	604	617	609	613	8	2,451	4%
No fatigue	16,433	16,525	16,042	15,467	16,117	481	64,467	95%
Total crashes	17,367	17,407	16,897	16,323	16,999	506	67,994	100%

Overall, 6% of all crashes met Dobie's (2002) definition for a likely fatigue-involved crash (see Table 2). Of these 3,527 crashes, 31% (1,076 crashes) were the result of a head-on collision in which neither vehicle was overtaking. The remaining 69% of fatigue-involved crashes involved a single vehicle crashing during the defined fatigue hours. It is important to note that the ATSB definition specifies that a fatigue-related crash can not occur in a speed zone less than 80 km/h. When non-fatigue-related crashes are also restricted to speed zones of 80 km/h or greater then fatigue-related crashes comprise 16% of all crashes (made up of 4.9% head-on and 11.1% fatigue hours crashes), almost three times the previous estimate of 6%.

Tables 3 to 6 show fatigue-related crashes overall and separately for the two types of fatigue-related crash – head-ons without overtaking and single vehicle crashes during fatigue hours – as well as the number of non-fatigue crashes, for a variety of crash database variables.

Table 3. Fatigue vs non-fatigue crashes as a function of crash severity.

Crash Severity	Non fatigue		Fatigue-involved		Fatigue Head-on		Fatigue hours		Total	
	No	%	No	%	No	%	No	%	No	%
Fatal	1,137	1.8	234	6.6	159	14.8	75	3.1	1,371	2.0
Serious	20,126	31.2	1,567	44.4	485	45.1	1,082	44.1	21,693	31.9
Other	43,204	67.0	1,726	48.9	432	40.1	1,294	52.8	44,930	66.1
Total	64,467	100.0	3,527	100.0	1,076	100.0	2,451	100.0	67,994	100.0

Fatigue-involved crashes (as per the ATSB definition) are relatively more severe than non-fatigue crashes, particularly those that result in a head-on crash, where 15% of head-on fatigue crashes involved a fatality compared with 1.8% of non-fatigue related crashes (see Table 3). It should be noted that one of Dobie's (2002) exclusion criteria was to discard crashes that occurred in speed zones of less than 80km/h. When non-fatigue crashes are also limited to higher speed zones the severity profile worsens, with 3.5% of these crashes resulting in a fatality, 35% a serious injury, and 62% an other injury. Fatigue crashes based on the time of the crash now become comparable to the non-fatigue profile, but head-on fatigue crashes and all fatigue crashes are still relatively more severe. The travelling speed profiles of the two types of fatigue crash are likely to be similar, however the energy inherent in a head-on crash may be doubled as the relative closing speed of the two vehicles determines the eventual severity of the crash. Dobie (2002) notes that fatigue-related crashes are often more severe than other crashes due to reduced reaction times or the absence of attempts to avoid the crash – in both cases the crash is likely to happen at a higher speed.

Table 4. Fatigue vs non-fatigue crashes as a function of vehicle type.

Vehicle type	Non fatigue		Fatigue-involved		Fatigue Head-on		Fatigue hours		Total	
	No	%	No	%	No	%	No	%	No	%
Car	47,636	94.9	2,583	5.1	861	1.7	1,722	3.4	50,219	100
Truck	2,304	91.1	226	8.9	68	2.7	158	6.2	2,530	100
Motorcycle	4,414	87.7	619	12.3	106	2.1	513	10.2	5,033	100
Total	54,354		3,428		1,035		2,393		57,782	

Note: Non-fatigue and fatigue crashes sum to 100, and fatigue head-on and fatigue-hours crashes sum to fatigue-involved.

Table 4 displays the crash involvement of the three most common vehicle types – cars (including light vans, 4WDs, etc), trucks (articulated and rigid), and motorcycles. Compared to the crash involvement profile for cars, both trucks and motorcycles are relatively more likely to be involved in a fatigue-related crash, motorcycles substantially so. Fatigue crashes based on the time of the crash are the most conspicuous – while just over 3% of car crashes involve fatigue, 10% of motorcycle crashes and 6% of truck crashes are fatigue-related due to the time of the crash. This might be expected for trucks as they are often worked late at night. However, it is less clear why relatively more motorcycle crashes involve fatigue based on the fatigue hours definition than is the pattern for car crashes.

Table 5. Fatigue vs non-fatigue crashes as a function of location.

Location	Non fatigue		Fatigue-involved		Fatigue Head-on		Fatigue hours		Total	
	No	%	No	%	No	%	No	%	No	%
Metro	50,381	78.4	1,252	36.0	438	41.2	814	33.7	51,633	76.2
Rural	13,870	21.6	2,226	64.0	626	58.8	1,600	66.3	16,096	23.8
Total	64,251	100.0	3,478	100.0	1,064	100.0	2,414	100.0	67,729	100.0

Over 75% of non-fatigue crashes occur in metropolitan areas, where the metropolitan/rural distinction is based on local government area (see Table 5). In contrast, the majority of fatigue-related crashes occur in rural areas, including 59% of fatigue head-on crashes and 66% of fatigue hours crashes.

Table 6. Fatigue vs non-fatigue crashes as a function of licence type.

Licence type	Non fatigue		Fatigue-involved		Fatigue Head-on		Fatigue hours		Total	
	No	%	No	%	No	%	No	%	No	%
L/P	6,895	93.6	471	6.4	136	1.8	335	4.5	7,366	100
Standard	27,881	94.3	1,680	5.7	478	1.6	1,202	4.1	29,561	100
Total	34,776		2,151		614		1,537		36,927	

Note: Non-fatigue and fatigue crashes sum to 100, and fatigue head-on and fatigue-hours crashes sum to fatigue-involved.

Learner and probationary drivers/riders were relatively more likely to be involved in a fatigue crash compared with their full licence counterparts (see Table 6), although the differences are not large.

Conclusions

Using the ATSB definition, 6% of crashes that occur in Victoria involve fatigue as a crash factor. This is significantly less than other estimates. For example, Baulk, Biggs, van den Heuvel, Reid and Dawson (2006) suggest that fatigue actually accounts for around 20% of all crashes, and believe that this is likely to be a significant underestimate. The ATSB definition specifies that crashes occurring in speed zones of less than 80 km/h should not be included in fatigue calculations. This requirement is based on a body of literature that concludes that fatigue crashes are more likely on rural highways (perhaps then the exclusion criterion should have included all crashes in speed zones less than 100 km/h rather than 80 km/h). It is of course non-sensical that imply that fatigue-related crashes can not occur in urban areas or speed zones of less than 80 km/h. Having specified two types of fatigue-related crashes, one based on time of day and the other type of crash, Dobie (2002) combined them. Perhaps they should be treated separately, as is the case in this paper, and not limiting the time of day crash type to speed zones of 80 km/h or more in order to “allow” for fatigue-related crashes in metropolitan areas.

Dobie’s (2002) calculations were based on the ATSB fatality file (and so only included fatalities). Those calculations were based on 1998 data and resulted in the conclusion that 15.6% of fatal crashes in Victoria involved fatigue. The current analyses determined that an average of 17.1% of fatal crashes in the period 2001-2004 involved fatigue. This figure increases to 26.9% when non-fatigue crashes are also limited to speed zones of 80 km/h or greater. The latter figure is more consistent with the 20-30% crash fatigue involvement often noted in the literature (Dobie).

While it may require further refinement, the ATSB definition for determining whether a crash is likely to have involved fatigue provides a useful tool. The current definition is probably an underestimate, but provides a lower bookend against likely overestimates based on the attending officer’s investigations. The latter method is likely to include a number of “false positives” since a crash that seems to have no other obvious cause and no obvious or significant evidence of crash avoidance, such as long braking skid marks, is often assigned fatigue as the likely cause (Dobie, 2002). The author plans a future paper that takes account of the aforementioned shortcomings of the ATSB definition of fatigue and will suggest alternative definitions that can also be derived from mass crash databases. Another useful element not presented here due to space limitations (but will be included in a follow-up paper) is the application of the ATSB definition to databases that also include fatigue as a crash factor based on the attending officer’s investigation. A comparison of various derived and police-reported methods of coding fatigue may yield a realistic middle-ground of the actual involvement of fatigue in road crashes.

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