Relationships Between Prior Driving Record, Driver Culpability, and Fatal Crash Involvement

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Abstract
Previous research from overseas has revealed consistent, yet limited, associations between prior driving records and subsequent crash involvement. Few of these studies have investigated relationships with driver culpability. Using South Australian data, this study aimed to examine relationships between prior crash and traffic offence history and driver culpability for fatal crashes. The identification of characteristics predictive of crashes from driver records may assist in identifying and developing countermeasures for such drivers before crashes occur.

Databases were matched to allow examination of the past driving records of 388 licensed drivers and riders involved in a multiple vehicle fatal crash in South Australia from 1999 to 2002. The crash and traffic offence history of each driver was tracked for five years prior to the fatal crash. The number and type of prior crashes and traffic offences for culpable and non-culpable drivers were compared to identify any differences related to driver culpability. Driver and fatal crash characteristics were also analysed by culpability status to determine whether different populations of drivers were involved.

Drivers culpable for a multiple vehicle fatal crash were more likely than non-culpable drivers to have been aged less than 25 years or over 75 years, to have consumed alcohol before the crash, and to have been killed in the crash. Culpable drivers appeared to be more likely to have had a prior drink driving offence than non-culpable drivers although few drivers actually had a prior drink driving offence. Prior crash involvement was not found to be associated with multiple vehicle fatal crash culpability.

1. INTRODUCTION
The ability to predict future crash involvement from past driving records (both offences and crashes) is important because it is the basis of many driver related interventions and licensing control systems. A review of studies that identified variables correlated with increased crash risk concluded that prior driving records, particularly prior traffic offence records, were the most consistent and powerful predictor of subsequent driver crash involvement (Peck, 1993). Although traffic offences were the strongest predictor, it was acknowledged that no single driving record variable or combination of variables contributed to a large percentage of the variation in crash risk.

Consistent with this review, most other research examining prior driving records and subsequent crash involvement has found prior traffic offences to be a better predictor of crash involvement than prior crashes (Coppin & van Oldenbeek, 1966; Elliot, Waller, Raghunathan, & Shope, 2001; Garretson & Peck, 1982; Harrington, 1972;

Peck & Kuan, 1983; Peck, McBride, & Coppin, 1971) but see Flowers, Sparks, Sitton and Cook (1980), and Hauer, Persaud, Smiley and Duncan (1991).

It has been argued that prior traffic offences are a better predictor of subsequent crashes than prior crashes because of their greater frequency of occurrence and the inclusion of crash related behaviour in offence frequency; offences are often incurred as a result of a crash (Peck et al., 1971). Other research has suggested that traffic offences are more closely related to variations among individuals than are crashes because offences are more likely to involve intentional behaviours (Burg, 1970; Harrington, 1972). Drivers generally do not try to be involved in a crash. In contrast, behaviour leading to apprehension for a traffic offence (e.g. speeding or drink driving) may be considered under greater volitional control.

Some research has considered whether the driver was responsible or 'culpable' for the crash. Culpable crash involvement may be identified by previous driving behaviour, reflected in prior driving records, because the behaviour of the driver contributed significantly to the crash. Crashes where the driver is not responsible or non-culpable may be viewed as largely a function of driving exposure. Therefore, these crashes cannot be predicted by any variable because they are not consequences of any specific behaviour (Elander, West, & French, 1993).

Assessment of driver culpability for a crash usually relies heavily on police evaluations. However, it has been argued that police assessment of driver culpability may lack objectivity and does not follow a consistent scoring protocol. A study compared the results of culpability analysis, using the method developed by Robertson and Drummer (1994), with police evaluations of responsibility. Despite following a scoring protocol and considering contributing factors, agreement between this method and police evaluation of culpability was found in 97.2 per cent of non-fatal crashes occurring in South Australia (Longo, 2001).

Fatal crashes are investigated much more thoroughly by police than other crashes. However, there are few studies specifically examining whether prior driving records can identify drivers culpable for a fatal crash. Nonetheless, it has been shown that drivers who were found to be legally culpable for a fatal crash had incurred significantly more prior traffic offences than non-culpable drivers, or drivers from the general driving population (Banks et al., 1977; Garretson & Peck, 1982; Rajalin, 1994). The relationship between prior crash history and fatal crash culpability is not as clear. Garretson and Peck (1982) observed that although drivers involved in a fatal crash had more prior crashes than drivers in the general driving population, prior crash history did not discriminate between culpable and non-culpable driver fatal crash involvement.

Studies comparing the ability of prior offences and prior crashes to identify driver culpability for crashes are rare, and the findings inconsistent. While a couple of studies reported prior offences were more strongly associated with fatal crash culpability than prior crashes (Garretson & Peck, 1982; Perneger & Smith, 1991), another study examining only prior culpable crashes found that they were a better predictor of future crash culpability than prior offences (Chen, Cooper, & Pinili, 1995). Even when investigating whether specific types of prior offences could identify culpable drivers, research findings have been inconsistent. Results have varied from

2

no relationship between prior offence types and driver culpability status (Bailey, 1992) to findings of an association between driver culpability and prior drink driving offences (Longo, 2001; Perneger & Smith, 1991), 'right of way' offences (Chen et al., 1995) and licence suspensions or disqualifications (Perneger & Smith, 1991).

Discrepancies between previous studies may be attributed to certain limitations associated with driver records. Driver records contain only the number of times a driver was caught offending and therefore not all relevant offences are recorded. Additionally, not all offences are enforced equally and this may bias the data such that some groups of drivers are over-represented (Smiley, Hauer, Persaud, Clifford, & Duncan, 1991). Moreover, it is possible that the contrasting findings from previous research reflected differences in the quality and thoroughness of enforcement, or the crash reporting policies of different regions and countries (Peck, 1993). For these reasons, it is important to investigate, in a South Australian context, the role of traffic offences and crash involvement in identifying culpable fatal crash involvement.

In summary, this study was based on the premise that drivers culpable for a fatal crash may be a subset of high-risk drivers and that these drivers can be identified by their past driving records. Previous international research has generated modest associations between prior driving records and crash involvement. However, few of these studies have investigated any associations with driver culpability. Using South Australian data, this study aimed to determine any relationships between prior driving records, both crashes and offences, and driver culpability for a fatal crash. The identification of high-risk drivers from driver records may assist in identifying and developing new licensing approaches or countermeasures for such drivers before a crash occurs.

2. METHODOLOGY
2.1 Sample
The original study sample consisted of 425 drivers and motorcycle riders involved in a multiple vehicle fatal crash in South Australia, from 1999 to 2002. Drivers and riders will subsequently be referred to collectively as 'drivers'. The drivers were identified from the Transport SA crash database (Traffic Accident Reporting System - TARS) based on police reports on road crashes. A total of 37 drivers were excluded from the analysis because their driving records could not be obtained (i.e. overseas or interstate licence, never held a drivers licence, unknown licence number). Thus, the final sample consisted of 388 drivers who held a South Australian driver's licence and were involved in multiple vehicle fatal crashes in South Australia, from 1999 to 2002.

The mean age of all drivers involved in a multiple vehicle fatal crash was 41.7 years (SD=18.7). There were 299 male drivers and 89 female drivers. A total of 36 motorcycle riders were included in the final sample of 'drivers'. Forty one per cent of drivers were killed in the fatal crash.

Drivers involved in a multiple vehicle fatal crash were selected for analysis so that each crash involved one culpable or 'case' driver (n=182) and at least one non-culpable or 'control' driver (n=206), except in crashes where a driver was omitted due to the absence of driver records. Driver culpability was determined by police assessment of legal responsibility for the crash. When more than two vehicles were

involved in a single crash, only one driver was deemed to be culpable. Consequently, using this research design, potentially confounding situational variables such as weather conditions or the time and location of the crash were matched for the majority of drivers involved in a given crash.

2.2 Procedure

The crash and traffic offence history of each driver involved in a multiple vehicle fatal crash was tracked for five years prior to the fatal crash. The crash record of each driver was traced by linking the driver licence number with crash records on the TARS database. Traffic offence records were traced by linking the driver licence number with DRIVERS, the licence and traffic offence database maintained by the Registration and Licensing section of Transport Services.

The available crash and traffic offence data did not include crashes and driving related offences detected on roads outside of South Australia nor did it include parking offences. Speeding offences detected by speed cameras were not included because the resulting infringement notices were posted to the vehicle owner who may not have been the driver at the time of the offence. Thus, the number of prior speeding offences was under-reported. Furthermore, traffic offences resulting from the fatal crash were removed from the data set. In some cases, more than one offence may have been detected and recorded from a single apprehension event. These 'derived' offences were not excluded from the analysis due to possible delays in offence processing and the consequent difficulty in matching offences by the date of apprehension.

Some drivers (n=47) were suspended during the study period and may not have been driving for the entire five year period. However, many drivers have been reported to continue to drive while suspended or disqualified (Watson, 2002). Furthermore, many drivers receive licence disqualifications or suspensions as the result of traffic offences. Excluding these drivers would result in an underestimation of drivers with offence records. For these reasons, drivers with licence suspensions or disqualifications during the five year period were not excluded from analyses. Therefore, the resulting number of prior driving incidents was probably conservative for disqualified drivers who abided by the driving sanctions imposed.

The number and type of prior crashes and traffic offences for culpable and non-culpable drivers involved in a multiple vehicle fatal crash were compared to identify any differences related to crash culpability status. Changes in enforcement strategies or enforcement regulations over the five year period may have influenced the number of offences recorded. However, it would be expected that such fluctuations affected both culpable and non-culpable drivers equally.

In addition to prior driving records, driver and fatal crash characteristics were also analysed by culpability status to determine whether different populations of drivers were involved.

3. RESULTS
3.1 Driver Characteristics
There was little difference between the mean age of culpable drivers (M=42.3 years, SD=20.6) and non-culpable drivers (41.2 years, SD=17.0). Figure 1 shows the age distribution of culpable and non-culpable drivers involved in a multiple vehicle fatal crash, across five year age groups. The age distribution of culpable drivers was bimodal indicating that drivers in the young (under 25 years) and very old (75 years and over) age groups were more likely to be culpable than non-culpable for a fatal crash while the distribution for non-culpable drivers was unimodal and more centred.

Figure 1: Age Distribution of Drivers Involved in a Multiple Vehicle Fatal Crash by Driver Culpability
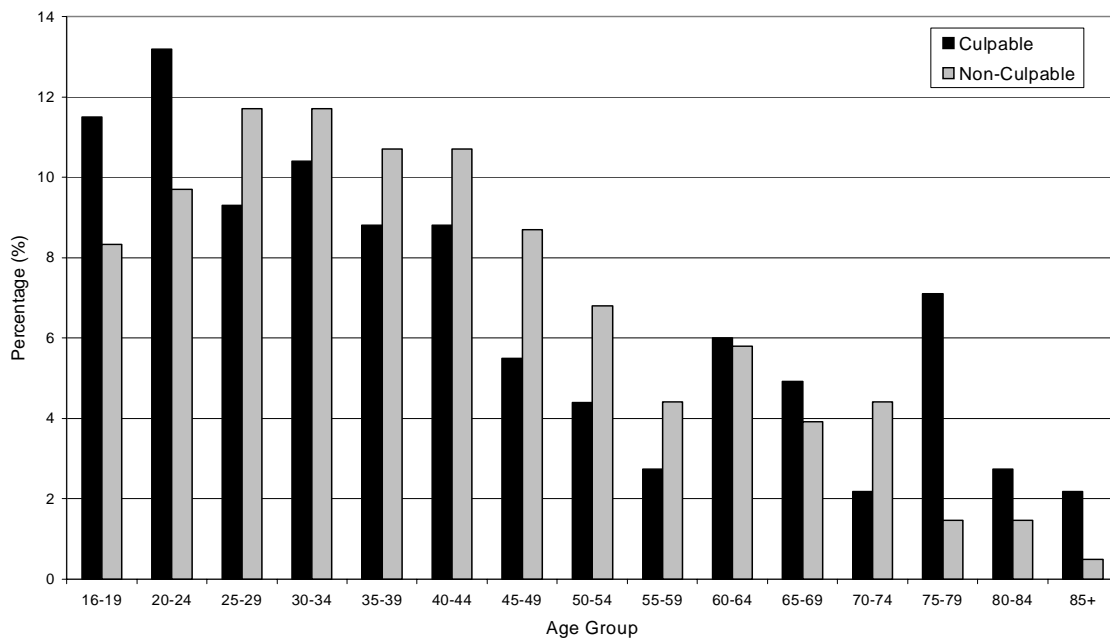
There were approximately three times as many males as females in each driver culpability group. Just over 76 per cent of culpable drivers were male compared to 78 per cent of non-culpable drivers. Figure 2 shows the percentage of drivers culpable for a fatal crash by age and sex. Despite the large difference in percentages between males and females aged less than 25 years and over 75 years, the differences were not statistically significant.

Figure 2: Distribution of Drivers Culpable for a Multiple Vehicle Fatal Crash by Age and Sex
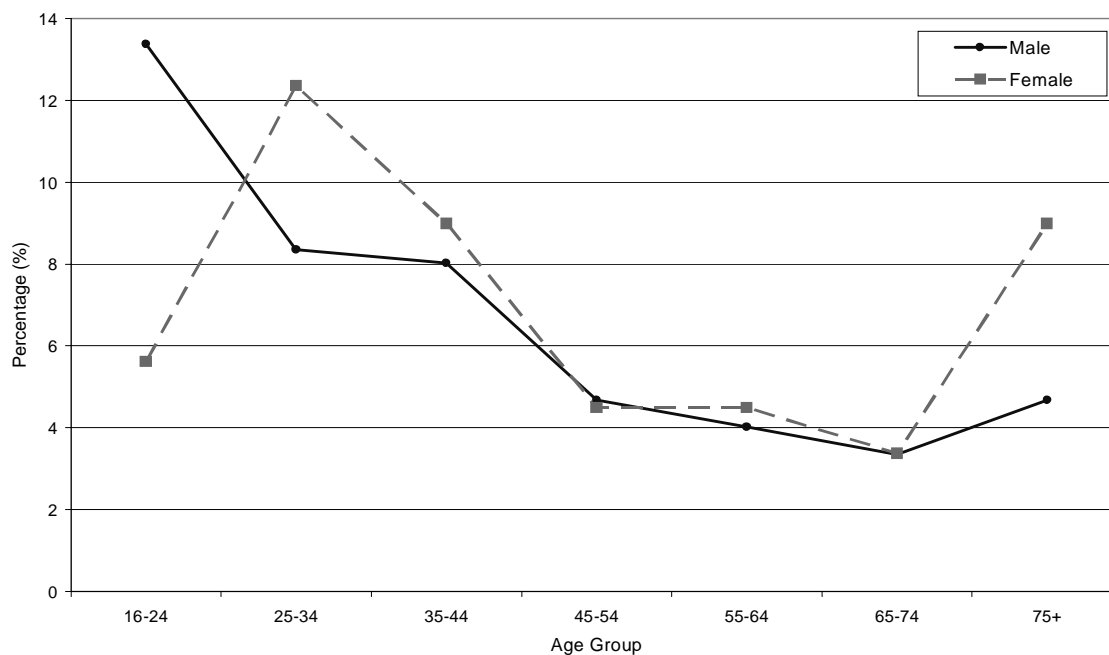
3.2 Crash Characteristics

Culpable drivers (56%) were more likely to have been killed in the multiple vehicle fatal crash than were non-culpable drivers (27%) ($\chi^2_{(1}$=32.2, p<.001).

Of the drivers with a known BAC reading (n=255), culpable drivers (21%) were about seven times more likely than non-culpable drivers (3%) to have a BAC at or above 0.05 ($\chi^2_{(2)}$=18.5, p<.001). Of the drivers with a positive BAC level (n=48), culpable drivers had a significantly higher mean BAC level (M=0.127mg/L, SD=0.085) compared to non-culpable drivers (M=0.054mg/l, SD=0.091) ($t_{(15)}$=2.36, p=.032). Just over 77 per cent of the alcohol positive drivers were deemed culpable for the fatal crash.

3.3 Prior Crashes and Traffic Offences

A summary of the percentage of drivers incurring at least one prior crash, traffic offence or licence disqualification in the five years prior to the multiple vehicle fatal crash, is provided in Table 1, by driver culpability status in the fatal crash. The estimated odds of being culpable in the fatal crash for each prior driving record variable is reported with 95 per cent confidence intervals.

In the five years prior to multiple vehicle fatal crash involvement, drivers culpable for the fatal crash were slightly more likely than non-culpable drivers to have had at least one previous crash (30% vs. 28%) or previous culpable crash (21% vs. 17%) although these differences were not statistically significant.

Table 1: Percentage of Drivers Detected for at Least One of the Listed Incidents During the Five Years Prior to Multiple Vehicle Fatal Crash Involvement by Driver Culpability in the Fatal Crash

Type of prior incident	All (N=388)	Culpable (n=182)	Non-culpable (n=206)	Odds ratio	95% Confidence interval
Crashes	28.9	30.2	27.7	1.13	(0.73-1.76)
Culpable crashes	18.6	20.9	16.5	1.34	(0.80-2.23)
Traffic offences	41.8	41.2	42.2	0.96	(0.64-1.44)
Drink driving offences	3.6	5.5	1.9	2.94	(0.91-9.53)
Speeding offences	33.2	32.4	34.0	0.93	(0.61-1.42)
Careless driving offences	5.9	6.0	5.8	1.04	(0.45-2.42)
Seat belt/helmet offences	7.5	8.8	6.3	1.43	(0.67-3.06)
Licence disqualifications	12.1	13.7	10.7	1.33	(0.72-2.45)

Culpable drivers were more likely than non-culpable drivers to have committed a prior drink driving offence (5% vs. 2%); this difference approached statistical significance ($\chi^2_{(1)}$=3.5, p=.061). Although the odds ratio suggested that incurring a prior drink driving offence, relative to no offences, nearly tripled the odds of being culpable for a subsequent fatal crash (by 294%), it was not statistically significant. Relatively wide confidence intervals can be attributed partly to the small number of drivers with prior driving incidents.

The actual number of prior drink driving offences is given in Table 2 by driver culpability status in the multiple vehicle fatal crash. Very few drivers had prior drink driving offences.

Table 2: Number of Drink Driving Offences for Drivers During the Five Years Prior to the Multiple Vehicle Fatal Crash, by Driver Culpability in the Fatal Crash

Drink driving offences	Culpable		Non-culpable	
	N	%	N	%
None	172	94.5	202	98.1
1	9	4.9	4	1.9
2	1	0.5	0	0.0
Total no. drink driving offences	11		4	
Total	182	100.0	206	100.0

3.4 Prior Crash and Traffic Offence Rates

Differences in prior driving records by driver culpability may be neglected when examining 'indicative' dichotomous data only. Therefore, the actual number of crashes and traffic offences recorded during the five years preceding multiple vehicle fatal crash involvement were examined. However, a number of drivers (*n*=71), particularly younger drivers, had not actually been driving for the entire five year reporting period. In an attempt to control for differences in driving experience, the length of time since each driver first acquired a Learner's Permit was used as a proxy measure of driving experience. For each type of prior driving incident, the total number of prior incidents was divided by the actual number of years' driving experience and then multiplied by five to give a rate for the five year period. A summary of the mean rates is presented in Table 3 by driver culpability status. One

culpable driver was omitted from the analysis because the date of first licensure could not be obtained.

Table 3: Driving Incident Rates for Five Years Prior to Fatal Crash Involvement by Driver Culpability in the Fatal Crash

Type of prior incident	Culpable (*n*=181)		Non-culpable (*n*=206)		*t*-value	*p*-value
	Mean	SD	Mean	SD		
Crashes	0.46	0.83	0.44	0.93	0.26	0.793
Culpable crashes	0.27	0.56	0.24	0.65	0.49	0.623
Traffic offences	1.26	2.03	1.18	2.71	0.33	0.740
Drink driving offences	0.06	0.28	0.02	0.14	1.98	0.049
Speeding offences	0.77	1.45	0.76	1.89	0.07	0.946
Careless driving offences	0.12	0.54	0.09	0.40	0.79	0.433
Seat belt/helmet offences	0.10	0.35	0.08	0.31	0.82	0.411
Licence disqualifications	0.28	0.85	0.31	1.57	0.30	0.766

Drivers culpable for a fatal crash had a statistically significantly higher mean rate of drink driving offences in the previous five years than non-culpable drivers. There were no statistical differences by driver culpability status for any of the other prior driving incident rates. It is acknowledged that the calculation of prior driving incident rates for drivers with less than one year of driving experience (*n*=13) may result in disproportionately high rates. For example, if driving for six months, one driving incident would be calculated as 10 for the five year rate. The results for prior drink driving offences were not affected by inflated rates as none of the first-year drivers incurred a prior drink driving offence.

4. DISCUSSION

Prior driving records will not accurately predict who will be involved in a fatal crash. However, they may assist in identifying groups of drivers with an increased risk of fatal crash involvement. Given that a fatal crash had occurred, the first part of this study aimed to determine what driver-related factors were associated with the 'culpable' status of the driver. Culpable drivers were more likely to be aged less than 25 years or over 75 years. At the time of the fatal crash, culpable drivers were more likely than non-culpable drivers to have consumed alcohol and to be killed in the crash. The driving errors identified at the time of the fatal crash were found to be typical of certain high-risk groups previously recognised in studies of fatal crash involvement (Williams & Carsten, 1989; Zador, Krawchuk, & Voas, 2000).

Drivers culpable for a fatal crash may be a subset of high-risk drivers and these drivers may be identifiable by their past driving records. However, prior crash involvement and prior culpable crash involvement was not found to be associated with multiple vehicle fatal crash culpability. Prior drink driving offences was the only type of prior offence associated, albeit weakly, with culpability for multiple vehicle fatal crashes. Most noteworthy, culpable drivers had over three times as many prior drink driving offences as non-culpable drivers although few drivers actually had prior drink driving offences. This relationship persisted when accounting for years of driving experience. Prior drink driving offences have been reported to have a strong association with driver culpability in previous research (Longo, 2001; Perneger & Smith, 1991). One study that found prior 'driving while intoxicated' offences and prior

licence suspensions were associated with an increased risk of fatal crash culpability also reported that the risk estimates almost halved when examining fatal crashes without alcohol involvement (Perneger & Smith, 1991). Since a strong relationship between culpability and drinking alcohol prior to the crash was noted in this study, further research using this data should consider excluding drivers with a positive alcohol level at the time of the crash to avoid potential confounding effects.

Drivers involved in a fatal crash may not have differed by driver culpability status, apart from age and prior drink driving offences, because even non-culpable drivers may have been partly responsible for the crash. Based on prior driving records, drivers involved in a fatal crash may differ from the general driving population, regardless of driver culpability, as suggested by some research (Rajalin, 1994). Further research should consider comparing driving records of those involved in fatal crashes with the general driving population.

Several methodological issues and limitations were identified: the assessment of driver culpability, the absence of a driving exposure measure, and factors contributing to incomplete prior driving records. The assessment of driver culpability relied on police judgement of legal responsibility. Thus, the determination of driver culpability relied heavily on the quality of crash investigation. Driver records do not indicate how frequently a driver is actually driving or what environments or road types the driver was driving in. As a result, an induced-exposure method was utilised such that non-culpable drivers were considered to be 'controls', or an approximate exposure sample. Although driving exposure would not be expected to be similar for each set of drivers involved in a given crash, it is likely that driving exposure was comparable for the entire sample of multiple vehicle crashes. Furthermore, time spent interstate or overseas and licence disqualifications or suspensions may contribute to reduced driving exposure and the underestimation of prior driving records for some drivers. However, potential underestimation of driving records would be expected to affect both culpable and non-culpable drivers equally.

In conclusion, based on prior driving records, prior drink driving related offences appeared to have the only association with driver culpability and multiple vehicle fatal crashes in South Australia.

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