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FACTORS CONTRIBUTING TO CRASHES INVOLVING INTERNATIONAL DRIVERS IN QUEENSLAND

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ABSTRACT

Motor vehicle crashes consistently emerge from the travel medicine literature as the most common cause of injury death for tourists. Yet worldwide there has been very little empirical research into the factors contributing to such crashes. In some respects this is not surprising - crashes involving overseas visitors usually represent only a small proportion of any jurisdiction's annual road toll. Nonetheless, there is a growing awareness of this issue in Australia, particularly in response to the increase in tourists that will accompany the Sydney 2000 Olympic Games.

Consequently, an analysis was undertaken of all reported crashes involving international drivers that occurred in Queensland between 1993 and 1998. The results support the growing body of evidence suggesting that overseas driver crashes are less likely to involve high risk driving behaviours such as alcohol or speeding. Rather, they appear to be the product of unfamiliarity with Australian driving conditions. In particular, international drivers were over-represented in crashes where disorientation may have been a factor, including 'failure to keep left' and 'head-on' crashes. This was most pronounced among drivers from countries where they drive on the right side of the road. The implications of these findings for countermeasure development are discussed.

INTRODUCTION

Recent work by the Federal Office of Road Safety (Ellis, 1999) indicates that there are approximately 45 international visitors killed on Australian roads each year. In absolute terms this is not a large problem, representing only 2.5% of Australia's annual road toll. The full extent of injuries experienced by overseas visitors in Australia is more difficult to establish. The road crash databases in many states only identify those international visitors involved in crashes who were driving or riding a motor vehicle at the time, via their licence status (Watson *et al*, 1999). Consequently, little data is available about crashes involving international visitors as passengers, pedestrians or cyclists. Nonetheless, the available data suggests that international visitors do not represent a large road safety problem in Australia (with the possible exception of the Northern Territory where they have accounted for almost 10% of deaths and 6% of casualties over recent years) (Watson *et al*, 1999).

Although only a small problem, the road safety needs of international visitors should not be overlooked. Firstly, motor vehicle crashes consistently emerge from the travel medicine literature as the most common cause of injury death for tourists (Wilks, 1999). From a tourism perspective, the safety of visitors has important implications for Australia's reputation as a safe and attractive destination (Crick, 1999). Secondly, exploratory work undertaken by FORS (Ellis, 1999) suggests that international visitors experienced a death rate of 22.0 per 100,000 persons in 1994, compared with 10.8 for Australian road users. Finally, the number of international visitors to Australia is forecast to rise to 4.6 million in the year 2000, with the main attraction being the Sydney Olympic Games (Australian Tourism Forecasting Council, 1998). It has been suggested that this could increase the annual number of visitor deaths in Australia from 45 to approximately 70, with a further 1000 seriously injured (Ellis, 1999).

Previous research undertaken by FORS (1995) has suggested a link between international driver crashes and the difficulties associated with driving in unfamiliar surroundings. Based on data for 1988, 1990 and 1992, they found that the fatal crashes involving overseas drivers were more likely to involve the non-use of seat belts, driver fatigue and the overturning of vehicles than those involving local drivers. In contrast, while alcohol and speeding were still present in many cases, these factors were implicated less often in international driver crashes than those involving local drivers.

More recent research by FORS has confirmed most of these findings. "*The most prominent risk factor that differentiates between international and local drivers is seat belt usage. Fifty-two percent of international drivers killed were not restrained at the time of the crash. This compares with 38% for local drivers*" (Ellis, 1999). While alcohol (16%) and speeding (16%) were found to be factors, they were again under-represented relative to local drivers. An analysis undertaken by Queensland Transport (1999) of hospitalisation crashes supports the FORS findings relating to seat belts and alcohol use.

It has been suggested that the low seat belt wearing rates among overseas vehicle occupants may be indicative of their normal driving behaviour, shaped by poorly enforced (or indeed non-existent) seat belt laws in their home country (Wilks *et al*, 1999a). Alternatively, it is consistent with other evidence suggesting that people tend to engage in more risky activities (eg. alcohol and drug use, sexual practices) while travelling, than they do at home (eg. Fairhurst, 1992).

Limited international research has been undertaken into the factors contributing to visitor road crashes. Using hospital records, Petridou *et al* (1997) found that visitors from left-side of the road driving countries were at an increased risk of crashing when they drove a rented rather than an owned vehicle on the island of Crete (a right-side of the road driving jurisdiction). In addition, these drivers were involved in 2.5 times more crashes featuring overtaking or other direction-specific manoeuvres, compared with foreigners from right-side driving countries. In contrast to Australian findings, Petridou *et al* (1997) found a higher incidence of alcohol impairment in the crashes involving international drivers. The study concluded that road crashes are a major hazard during pleasure travelling and that crashes involving visitors have a distinct epidemiological profile compared with those of a similar nature involving locals.

Page and Meyer (1996) found that nearly 20% of fatalities involving foreign drivers in New Zealand were due to drivers not keeping to the left side of the road. They also found that not keeping left was a significant factor in non-fatal injury crashes involving foreign drivers.

In summary, there is a growing body of evidence suggesting that international driver crashes are less likely to involve high risk driving behaviours such as alcohol or speeding. Rather, they appear to be the product of unfamiliarity or disorientation with the driving environment. This appears to be particularly the case among visitors driving on a different side of the road than usual. However, these conclusions are largely based on studies with small sample sizes, often utilising fatal crashes alone, so further work is required to confirm the results. To address this need, the present study examines the factors contributing to the incidence of crashes involving international drivers in Queensland.

METHOD

An exploratory investigation was undertaken into the crash involvement of international drivers in Queensland during the period 1993-98. The data was extracted from Queensland Transport's road crash database that contains records for all crashes reported to the police in the state.

Age, gender and licence information was obtained for all controllers of motorised vehicles (including cars, car derivatives, trucks, buses and motorcycles) involved in crashes during the period, irrespective of whether they were judged by the police to be at fault for the crash or not. This ensured that the overall crash involvement of international drivers was assessed and avoided any biases related to the reporting or prosecution practices of the police. A range of information was obtained relating to the circumstances of the crashes, including the day, time, location, prevailing road and traffic conditions, and the contributing factors cited by the attending police. The term 'driver' is generally used in the paper to cover all controllers of motorised vehicles.

The road crash database does not explicitly record whether a driver was an international visitor. However, the licence status (local or international) of drivers involved in crashes is recorded. Based on this approach, it was possible to identify 2571 international drivers who were involved in a crash during the period. One shortcoming of the data set is that specific nationality is often not recorded. Despite this inherent weakness, it was possible to classify a total of 874 international drivers (34%) according to whether they were from left or right side of the road driving countries. The classification was based on available publications (eg. Kinkaid, 1986) and advice from travel experts.

Six years of data was analysed to ensure that general trends were identified and to provide sufficient numbers to permit meaningful comparisons among sub-groups of international drivers. In light of the multiple statistical tests undertaken, a conservative alpha (α) level of .005 was adopted for all analyses. The data was analysed using SPSS for Windows V.8.

RESULTS

During the period 1993-98, there were 37 international drivers involved in fatal crashes on Queensland roads. This represented 1.3% of all the drivers involved in fatal crashes during the period. A further 412 international drivers were involved in crashes resulting in a hospitalisation, 552 in minor injury crashes, and 1270 in property damage only crashes. Table 1 explores the differences between international and Australian drivers involved in serious casualty crashes (ie. those resulting in a fatality or a hospitalisation), in terms of a range of driver and crash-related variables.

Table 1: International vs Australian drivers by key driver-related and crash variables for serious casualty crashes: 1993-1998

VARIABLE	DRIVER CLASSIFICATION		Significance level ¹
	International (%)	Australian (%)	
Gender (N=31936)			χ^2 (df1) = 0.3, $p > .05$
Males	71.0	69.8	
Females	29.0	30.2	
Age (N=31935)			χ^2 (df2) = 13.4, $p < .005^*$
Under 25	33.8	30.5	
25 - 59	60.6	58.6	
60 and over	5.6	10.9	$\hat{e} = 3.6, p < .001$
Vehicle type (N=31939)			χ^2 (df2) = 619.7, $p < .001^*$
Car (and derivatives)	86.6	82.0	
Motorcycles	11.8	10.8	
Others	1.6	7.2	$\hat{e} = 4.6, p < .001$
Time of day (N=31939)			χ^2 (df1) = 3.7, $p > .05$
Day (6:00am - 5:59pm)	74.2	70.0	
Night (6:00pm - 5:59am)	25.8	30.0	
Speed limit (N=31939)			χ^2 (df2) = 57.3, $p < .001^*$
60 km/h or less	44.3	60.1	$\hat{e} = 6.8, p < .001$
70 - 90 km/h	12.0	11.9	
100 - 110 km/h	43.7	27.9	$\hat{e} = 7.3, p < .001$
Alcohol or drugs (N=31929)			χ^2 (df1) = 8.1, $p = .005^*$
Yes	3.1	6.4	
No	96.9	93.6	
Exceed speed limit & excessive speed for conditions (N=31929)			χ^2 (df1) = 1.6, $p > .05$
Yes	5.1	3.9	
No	94.9	96.1	
Driver fatigue (N=31929)			χ^2 (df1) = 8.2, $p < .005^*$
Yes	4.2	2.2	$\hat{e} = 2.9, p < .005$
No	95.8	97.8	$\hat{e} = 2.9, p < .005$
Failure to Keep Left (N=31929)			χ^2 (df1) = 108.0, $p < .001^*$
Yes	9.4	2.1	$\hat{e} = 10.4, p < .001$
No	90.6	97.9	$\hat{e} = 10.4, p < .001$

¹ The results of all chi-square (χ^2) tests are shown, with significant results marked with an asterisk (*). Only the significant adjusted standardised residuals (\hat{e}) are shown.

Serious casualty crashes were utilised to maximise the sample size, while still focussing on serious incidents. Drivers with an unknown licence status were excluded from the analysis to reduce the possibility of misclassifying any international drivers. An overall chi-square (χ^2) was conducted to determine whether there was a significant difference between the international and Australian drivers for each variable. Post-hoc analyses were then undertaken within each variable using an adjusted standardised residual statistic (\hat{e}).

As shown in Table 1, there was no significant difference between international and Australian drivers involved in serious casualty crashes in terms of gender. However, there was an age-related difference, with international drivers significantly less likely to be 60 years of age or over. Similarly, these drivers were less likely to be involved in a crash while driving a vehicle other than a car (or car derivatives such as station wagons) or a motorcycle. There was no significant difference in terms of the time of the day of the crash. However, there was a significant difference between the two groups in relation to the prevailing speed limit at the time of the crash. International drivers were more likely to be involved in a serious crash on 100 km/h and 110 km/h speed limited roads and less likely on 60 km/h and less roads. This suggests that rural, rather than urban conditions represent more of a problem for international drivers than Australian drivers.

Serious casualty crashes involving international drivers were significantly less likely to involve alcohol than those involving Australian drivers. There was no significant difference between the groups in relation to excessive speed or exceeding the speed limit. However, international drivers were significantly over-represented in crashes involving driver fatigue and 'failure to keep left'. Although not reported, a similar result was found for crashes where the police judged 'inexperience or lack of expertise' to be a factor. This finding requires further exploration, since it may simply reflect an assessment based on the international status of the driver's licence.

Table 2 confirms that there was an overall significant difference between international and Australian drivers in relation to the nature of the crash. In particular, international drivers were significantly more likely than Australian drivers to be involved in 'head-on' and 'overturned' serious crashes. Conversely, they were less likely to be involved in 'angle', 'hit pedestrian' and 'rear-end' crashes.

In order to explore differences among international drivers, the serious casualty involvement of drivers from left-side driving countries was compared with those from right-side countries for all the variables detailed in Table 1. The only significant difference found between the groups related to 'failure to keep left'. Drivers from right-side driving countries were significantly more likely [χ^2 (df1) = 11.0, $p = .001$] to be involved in crashes featuring this violation, than their left-side driving counterparts (22.3 cf. 4.9%).

Table 3 further examines the differences between drivers from left-side and right-side driving countries, in relation to the nature of the crash. In order to avoid violating a sample size requirement for the Chi-square test, this analysis utilised total crashes rather than serious casualty crashes. As can be seen, the only significant difference between the drivers from left-side and right-side driving countries related to their involvement in 'head-on' crashes. Drivers from right-side countries were particularly over-represented in these crashes, accounting for 16.3% of their total crash involvement. (Similarly, head-on crashes accounted for 31.9% of the serious casualty crashes involving right-side drivers, compared with 11% for left-side drivers). Interestingly, there was no difference between the groups in relation to 'overturned'

crashes. While this type of crash is a problem for international drivers in general, it does not appear to be specific to either left-side or right-side drivers.

Table 2: Nature of crashes involving International vs Australian drivers, for serious casualty crashes: 1993-1998

NATURE OF CRASH	DRIVER CLASSIFICATION		Significance level ¹ χ^2 (df9) = 74.6, $p < .001$
	International (%) N=449	Australian (%) N=31490	
Angle	29.4	36.5	$\hat{e} = 3.1, p < .005$
Sideswipe	6.9	5.1	
Head-on	15.1	9.3	$\hat{e} = 4.2, p < .001$
Hit fixed obstruction	18.0	16.6	
Hit pedestrian	4.0	7.6	$\hat{e} = 2.9, p < .005$
Hit parked vehicle	1.1	1.7	
Hit animal	0.9	1.0	
Overturned	12.0	6.8	$\hat{e} = 4.3, p < .001$
Rear-end	7.3	12.8	$\hat{e} = 3.5, p < .001$
Miscellaneous	5.1	2.4	$\hat{e} = 4.6, p < .001$

¹ Only the significant adjusted standardised residuals (\hat{e}) are shown.

Table 3: Nature of crashes involving International drivers from left-side vs right-side driving countries, for total crashes: 1993-1998

NATURE OF CRASH	DRIVER CLASSIFICATION		Significance level ¹ χ^2 (df9) = 467.0, $p < .001$
	Left-side drivers (%) N=377	Right-side drivers (%) N=497	
Angle	32.1	36.2	
Sideswipe	5.3	8.0	
Head-on	5.3	16.3	$\hat{e} = 5.0, p < .001$
Hit fixed obstruction	20.7	13.5	
Hit pedestrian	2.4	0.4	
Hit parked vehicle	1.3	1.0	
Hit animal	1.1	0.4	
Overturned	11.4	10.5	
Rear-end	16.7	11.5	
Miscellaneous	3.7	2.2	

¹ Only the significant adjusted standardised residuals (\hat{e}) are shown.

DISCUSSION

Two potential constraints may have affected the quality of the data utilised in this study. Firstly, the identification of international drivers was based on their licence status, rather than place of residence. As such, it was impossible to distinguish between drivers who represented genuine tourists and those who may have been longer-term visitors or new residents who had failed to obtain a local licence. While this may lead to some uncertainty, it is likely that the large bulk of these drivers were short-term visitors. In addition, the ratio of tourists to residents should remain relatively stable, ensuring the reliability of trends over time (Watson *et al*, 1999). Secondly, the comparison of drivers from left-side and right-side of the road countries was based on the one third of international drivers for whom it was possible to identify a country of origin. While this proportion was less than ideal, there was no evidence of a systematic bias in identification toward either group of countries.

Over and above these concerns, the results obtained in the study both confirm and extend the findings of previous research. They support the growing body of evidence suggesting that crashes involving international drivers are less likely to be a product of risk-taking *per se*, but rather a lack of familiarity with Australian driving conditions. For example, alcohol was under-represented in the serious casualty crashes involving international drivers, compared with those involving Australian drivers, while there was no significant difference in relation to speeding. In contrast, the international drivers were over-represented in serious crashes involving driver fatigue, 'failure to keep left', 'head-on' collisions and 'overturning'.

While driver fatigue was implicated in only a small proportion of international driver crashes (4.2%), this factor is notoriously difficult to identify. In addition, anecdotal evidence from motor vehicle rental companies suggests that fatigue is a major factor in crashes involving international drivers (eg. Matcham, 1999). It has been argued that driver fatigue is often exacerbated by a lack of familiarity with the distances and conditions encountered while driving in Australia.

Nearly one-eighth (12%) of the serious casualty crashes involving international drivers featured the 'overturning' of a vehicle. The over-representation of this crash type is consistent with results obtained by FORS (1995), who also found that fatal crashes involving international visitors were more likely to feature four wheel drive vehicles, minibuses and utilities. (Unfortunately, the Queensland crash database does not permit the identification of these vehicles.) This led FORS (1995) to suggest that the over-representation of overturning among international drivers may reflect a lack of familiarity with the road-handling characteristics of these vehicles and the conditions encountered on Australian roads.

Over 15% of the serious casualty crashes involving international drivers featured a 'head-on' collision, while 'failure to keep left' was implicated in almost 10% of the crashes. The over-representation of these two factors suggests that international drivers may experience problems with orientation under some circumstances. For example, it is possible that the combined effect of fatigue and lack of familiarity with different driving conditions and road rules may contribute to disorientation among some international drivers.

More specifically, the problem of disorientation appears quite acute among international drivers from right-side driving countries. Over 30% of the serious casualty crashes and 16% of the total crashes involving drivers from 'right-side' countries featured a 'head-on'

collision, compared with 11% and 5%, respectively, for their left-side driving counterparts. Similarly, 'failure to keep left' was implicated in 22.3% of the serious crashes involving right-side drivers, compared with 4.9% for left-side drivers. This difference does not appear to be a product of alcohol impairment or speeding, since there was no significant difference between the two groups on these variables. Rather, the findings lend credence to anecdotal evidence that people used to driving on the right-side of the road can automatically revert to this side in emergency situations or drift to the right when fatigued (Wilks and Watson, 1999).

IMPLICATIONS FOR COUNTERMEASURE DEVELOPMENT

Previous research has indicated that many of the international drivers and passengers killed on Australian roads fail to wear a seat belt. Consequently, this remains a priority issue for reducing the severity of injuries sustained by visitors to this country (Watson *et al*, 1999). In addition, the present study has identified a number of priorities for reducing the incidence of crashes involving international drivers. While the effects of alcohol and speeding remain concerns for all road users, effort needs to be directed at reducing the level of driver fatigue and disorientation experienced by international drivers. This latter point appears particularly relevant for drivers from right-side driving countries.

Educational initiatives in the area should focus on encouraging international drivers to:

- be mindful of the effects of medication, alcohol and jet-lag when they reach their destination;
- take a rest after a long distance flight, especially before taking charge of a motor vehicle;
- familiarise themselves with Australian road rules;
- request a full familiarisation of their rental vehicles (particularly if it is unfamiliar to them or a 4 wheel drive or campervan) and a briefing on their travel route from staff of the hire company before leaving the airport or car depot;
- drive a rental vehicle around the car park before heading onto a public road for the first time;
- plan to drive only in daylight hours; and
- build in rest stops every two hours to counter driver fatigue (Wilks *et al*, 1999b).

In some cases, these initiatives have been incorporated into the policies of vehicle rental companies (Matcham, 1999). International drivers will also benefit from the wider application of anti-fatigue engineering countermeasures, such as audible edgelines and the enhancement of rest areas.

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