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Risk assessment in work-related fleet driving settings: can self-report questionnaires be used to predict crash involvement?

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Abstract: Fleet and work related motor vehicle crashes represent a substantial physical, emotional and financial cost to the community. Given this burden, researchers are directing increasing focus towards investigating the attitudes and behaviours of fleet motorists’, as well as determining the value of such self-reported data to predict crash involvement and general aberrant driving behaviours. This paper reports on a study examining the predictive utility of predominant self-report questionnaires to identify individuals involved in work-related crashes within an Australian organisational fleet setting (N = 4195). The Manchester Driver Behaviour Questionnaire (DBQ), Driver Attitude Questionnaire (DAQ) and Safety Climate Questionnaire (SCQ) were distributed through the company’s internal mail system to employees who volunteered to participate in the study. Univariate analyses identified a possible fleet “speeding culture”, as drivers were most likely to report engaging in speeding behaviours and also believed that speeding was more acceptable compared to drink driving, following too closely or engaging in risky overtaking manoeuvres. However, multivariate analyses implemented to determine factors associated with crash involvement revealed that increased work pressure as well as driving mistakes (i.e., errors) were predictive of crashes, even after controlling for exposure to the road (i.e., kilometres driven per year). This paper further outlines the major findings of the study and highlights the implications and difficulties associated with utilising driver behaviour measurement tools within organisational fleet settings. For example, many scales are increasingly becoming antiquated as contemporary issues that influence fleet drivers’ performance are not being included in assessment scales.

Keywords: fleet-safety, assessment tools, work-related crashes.

1 Introduction

Work-related drivers are often defined as those who drive at least once a week for work purposes and research suggests that up to 30% of registered vehicles in Australia are work vehicles[1]. Such vehicles often travel considerable distances, comprising up to half the vehicle traffic stream at any one time, and as a result, are often disproportionately represented in crash statistics[1]. Not surprisingly, fleet and work related motor vehicle crashes represent a substantial physical, emotional and financial cost to the community. Previous estimations have indicated that the total cost of work related road incidents in Australia was in the vicinity of $1.5 billion[2], while more recent research has calculated the average total insurance cost of a fleet incident to organisations and society to be approximately $28,000[3]. Additionally, the average cost of a fatal crash in the general Australian motoring community is estimated to be $2 million[4]. Furthermore, estimates of the true cost for work related crashes suggest that hidden costs may be somewhere between 8-36 times vehicle repair/replacement costs[5]. Of note is that a high proportion of work-related deaths and injuries within the overall road toll consist of work-related crashes[5,3], as work-related traffic injuries have been estimated to be twice as likely to result in death or permanent disability than other workplace accidents[1].

2 Driving Assessment Tools

Considering the above issues, researchers are increasingly developing and implementing self-report measurement tools in an attempt to understand the factors associated with work-related crashes. Published research has utilised a variety of assessment measures, including the Driving Skill Inventory [6], Driver Anger Scale[7], the Manchester Driver Behaviour Questionnaire (DBQ)[8], Driver Attitude Questionnaire (DAQ)[9] and the Safety Climate Questionnaire-MD (SCQ-MD) [10]. The latter three questionnaires are proving increasingly popular in identifying the factors associated with vehicle crashes and demerit point loss among fleet drivers in work settings, and will remain the focus of the present study.

In regards to the DBQ, the measurement tool has been extensively utilised within a range of driver safety research areas and has proven fruitful in identifying factors associated with crash involvement[6,11,12]. However, it is noted that such research has predominantly focused on general motorists, and such research has indicated that speeding violations are one of the most common factors associated with crash involvement[12]. Another measurement instrument that has received considerable attention within the road safety literature is the Driver Attitude Questionnaire[12]. Similar to above, research has begun to utilise the DAQ within a number of different applied settings ranging from speed awareness training[13] to fleet programs[14,15]. While only preliminary, research indicates that the DAQ has the potential to be utilised to investigate motorists’ attitudes towards key road safety issues, such as drink driving, risky overtaking, close following and driving above the speed limit, with motorists generally reporting the most lenient attitudes towards speeding violations[15,14,15]. Specifically in regards to work environments, the Safety Climate Questionnaire-Modified for Drivers (SCQ-MD) is also beginning to be used within road safety arenas, as researchers begin to recognise the importance of an organisation’s attitudes towards fleet and road safety issues. In simple terms, “climate” relates to how employees perceive the organisational
culture and practice of a company \[16\], and it is hypothesised that this perception impacts upon the way in which workers ultimately behave at work \[17\]. In regards to safety climate, a small but growing body of research is demonstrating a link between safety culture and a variety of outcomes, ranging from vehicle crash rates \[18, 19\], to injury severity \[20\]. Taken together, research is beginning to suggest that perceptions regarding the safety policies and practices of organisations may have a direct impact on driving outcomes.

Fleets

However, despite the prevalence of research currently focusing on identifying the self-reported attitudes and behaviours that influence crash involvement, little research has currently investigated the self-reported driving behaviours of those who drive company sponsored vehicles and/or spend long periods of time behind the wheel \[21, 22\]. The lack of research in this arena within the Australian context may in fact be considered an oversight as changes in industry/employer accountability, Occupational Health and Safety (OHS) legislation, Workers Compensation legislation, and public liability are requiring industry to develop better benchmarking along with more comprehensive intervention programs related to fleet safety. Without such endeavours, fleet organisations struggle to accurately assess current organisational risk and thus also experience difficulties developing and evaluating corresponding interventions.

Nevertheless, what is presumed is that drivers of employer owned vehicles who drive for work-related purposes generally engage in a higher prevalence of aberrant driving behaviours such as speeding \[23\], and are at a greater risk of crash involvement due to their exposure to the driving environment \[21, 26\]. Currently, early research has demonstrated that fleet drivers are most likely to engage in aberrant speeding behaviours \[23, 26, 27\]. However, little is known about which self-reported assessment tools are most useful within fleet settings as well as what specific attitudinal and behavioural factors predict crash involvement within such settings. As a result, the present research aimed to utilise three prominent driving measurement tools to investigate the relationship between self-reported attitudes, behaviours and crash involvement. More specifically, the study aimed to:

a) examine a group of fleet drivers’ attitudes and behaviours regarding road safety issues via three measurement tools (i.e., DBQ, DAQ & SCQ-MD);

b) investigate the relationship the sub-factors of the measurement tools have with self-reported crash involvement; and

c) report on the associated difficulties utilising behaviour measurement tools in fleet settings.

3 Method

Participants

A total of 4195 individuals from a large Australian company volunteered to participate in the study. There were 4195 males (88.9 %) and 553 females (11.1%). The average age of the sample was 43.7yrs (range 18 – 66 yrs). Participants were located throughout Australia in both urban and rural areas. The sample consisted of approximately equal numbers of office workers, \( n = 2244 \), (44.8 %) and field workers, \( n = 2264 \), (47.2 %), with \( n = 284 \), (5.9 %) respondents not indicating their employment type. Examination of vehicle types revealed that the largest proportion of the sample reported driving sedans \( n = 2872 \), (61.2%), followed by station wagons \( n = 1375 \), (28.6%), vans \( n = 861 \), (18%), and “customer service vehicles” (CSV) \( n = 518 \), (11%), with only a small percentage indicating usage of four wheel drive vehicles 1, utes or heavy vehicles. The majority of driving by participants was reported to be within the city \( n = 1988 \) (42.4 %), or in the city and on country roads \( n = 1867 \) (39.82%), with only 767 participants (16.36%) reporting driving on rural roads. On average participants had held their licence for 26 years. A total of 588 participants reported being involved in a crash while driving for work in the past 12 months.

Questionnaire

Driver Behaviour Questionnaire (DBQ)

A modified version of the DBQ was used in the current study that consisted of 20 items. Questions relating to lapses were omitted due to previous research indicating that this factor is not associated with crash involvement \[28\]. In addition, the authors of the current paper made minor re-wording or rephrasing modifications, in order to make the questionnaire more representative of Australian driving conditions. For example, references to turning “right” were removed on some items as there are instances where drivers may attempt to overtake someone who is turning left\( ^2 \). Respondents were required to indicate on a six point scale (0 = never to 5 = nearly all the time) how often they commit each of the errors (8 items), highway code violations (8 items) aggressive violations (4 items).

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1 Other than the “CSV” body type.
2 Previous research has demonstrated that the DBQ is robust to minor changes to some items in order to reflect specific cultural and environmental contexts \[29, 30\].
Driver Attitude Questionnaire (DAQ)
The DAQ is a 20-item self-report questionnaire designed to measure attitudes regarding a range of driving behaviours which are collated to identify four factors: drink driving, close-following, dangerous overtaking and speeding. Respondents are required to indicate on a six point likert scale (0 = strongly disagree to 5 = strongly agree) their agreement with statements regarding the appropriateness of various driving behaviours.

Safety Climate Questionnaire (SCQ)
A 29 item version of the SCQ was utilised in the research project. Minor modifications ensured that the questions related specifically to “work-related driving”. The SCQ contains 5 sub-factors that aim to measure perceptions towards fleet safety rules, communication and support, work pressures, adequacy of fleet safety procedure and management commitment. A growing body of research has demonstrated that the SCQ is a reliable tool to measure fleet drivers’ attitudes towards the safety climate of an organisation [17].

Demographic Measures
A number of socio-demographic questions were included in the questionnaire to determine participants’ age, gender, driving history (e.g., years experience, number of traffic offences and crashes) and their weekly driving exposure (e.g., type of car driven, driving hours).

Procedure
The organisation provided a list of individuals who expressed an interest in participating in the research. A letter of introduction, the study questionnaire and a reply paid envelope were distributed through the company’s internal mail system to the participants. In total, 1440 were mailed out and 443 were returned indicating a 30% response rate.

4 Results
Structure and Reliability of the Questionnaires for an Australian Sample
The internal consistency of the DBQ, DAQ & SCQ-MD scores were examined through calculating cronbach’s alpha reliability coefficients, and are presented in Table 1. The SCQ factors, which specifically relate to safety, appear to exhibit the highest level of internal consistency. Similar to previous Australian research [11, 29], and on professional drivers [24], the DBQ factors also appear to exhibit relative internal consistency. In contrast, there has been little research to determine the psychometric properties of the DAQ, and although only moderate, the alpha coefficients are similar to previous research [13].

Table 1 also displays the overall mean scores for the DBQ, DAQ and SCQ-MD factors. Higher means on the DBQ indicate more deviant driving behaviours, while higher scores on the DAQ and SCQ-MD indicate more appropriate road safety attitudes, and positive perceptions regarding the organisation’s road safety culture, respectively. Firstly, an examination of the mean scores reveals that for the DBQ scale, participants were most likely to engage in speeding offences while at work, which was significantly more likely compared to committing driving errors $F(1, 4195) = 70.73, p < .01$ or aggressive violations $F(1, 4195) = 83.42, p < .01$. The results indicate that speeding is the most common form of aberrant behaviour reported by the fleet drivers in the current sample, and similar to previous research on professional drivers [24, 31], speeding remains a major road safety concern [14].

Secondly, an examination of participants’ attitudes (DAQ) revealed respondents were most concerned about close following ($M = 4.00$), however it is noted that the sample also believed it was generally unacceptable to drink and drive, speed, as well as engage in risky overtaking manoeuvres in some circumstances. The results indicate that attitudes towards drink driving are the most stringent reported by the fleet drivers in the current sample, and similar to previous research [12, 13], speeding is the most accepted aberrant driving behaviour. However, it is noted the differences between the factors are relatively small and may therefore diminish the practical significance of the findings. In contrast to the self-reported behaviours and attitudes, participants reported the organisation promoted positive and adequate road safety rules ($M = 4.14$), fostered a commitment to road safety ($M = 4.18$), and were able to communicate and receive support regarding road safety issues ($M = 3.83$). However, it is also noted that participants reported some level of work pressure ($M = 3.53$). These differences between the various questionnaires’ factors will be examined further in the following section.

3 However, it is noted that the mean scores for all three DBQ factors are relatively low, which indicates participants generally reported that they did not regularly engage in the specified aberrant driving behaviours.
Table 1. Alpha reliability coefficients of the Measurement Scales

<table>
<thead>
<tr>
<th>Measurement Scale</th>
<th>Alpha</th>
<th>M</th>
<th>SD</th>
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<tr>
<td>Highway Code Violations</td>
<td>.77</td>
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<td>.47</td>
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<tr>
<td>Aggressive Violations</td>
<td>.56</td>
<td>1.38</td>
<td>.43</td>
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<td>DAQ Alcohol</td>
<td>.67</td>
<td>3.84</td>
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<tr>
<td>Close Following</td>
<td>.67</td>
<td>4.00</td>
<td>.59</td>
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<tr>
<td>Overtaking</td>
<td>.55</td>
<td>3.84</td>
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<tr>
<td>Speeding</td>
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<td>3.55</td>
<td>.66</td>
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<td>SCQ Fleet Safety Rules</td>
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<td>Communication &amp; Support</td>
<td>.89</td>
<td>3.83</td>
<td>.50</td>
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<td>.93</td>
<td>3.53</td>
<td>.18</td>
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<td>Adequacy of Procedures</td>
<td>.86</td>
<td>4.14</td>
<td>.43</td>
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<tr>
<td>Management Commitment</td>
<td>.93</td>
<td>4.18</td>
<td>.60</td>
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</table>

Intercorrelations between Variables

An examination was undertaken to determine the bi-variate relationships between the DBQ, DAQ, SCQ-MD factors as well as socio-demographic variables. While the association between the major factors and crash involvement are examined in the following logistic regression analyses, some notable bi-variate relationships are reported below.

As expected, strong relationships appeared evident between the DAQ factors, with the highest correlation being between close following and risky overtaking \((r = .69^{**})\). That is, those who reported an unwillingness to engage in risky overtaking manoeuvres were also unlikely to perceive close following as an acceptable driving behaviour. Similar results were also found between the DBQ factors, with the strongest bi-variate relationship identified between highway code and aggressive violations \((r = .53^{**})\).

In regards to bi-variate relationships between the questionnaires, significant negative correlations were evident between all the DBQ and DAQ subfactors (e.g., behaviours vs attitudes), as those who perceived aberrant driving behaviours such as speeding as serious were subsequently less likely to actually engage in such behaviours over the previous six month period \((i.e., r = -.33^{**})\). Similar negative correlations were identified between the DBQ and SCQ-MD factors, as the positive work environment which provided fleet safety rules, procedures and support resulted in lower levels of self-reported aberrant driving behaviour. For example, adequate fleet safety rules were negatively correlated with driving errors \((r = -.21^{**})\), highway violations \((r = -.23^{**})\) and aggressive violations \((r = -.15^{**})\). In regards to sample characteristics, a similar negative relationship was found between age and the DBQ factors, as older drivers were less likely to engage in aberrant driving behaviours as well as report positive attitudes towards road safety, as measured by the DAQ. Finally, participants who drove further distances were less likely to report positive driving attitudes as measured by the DAQ, although this did not necessarily result in a higher frequency of engagement in aberrant driving behaviours, such as speeding and aggressive violations as measured by the DBQ. However, making a higher number of driving errors in the last six months was positively associated with self-reported work pressure \((r = .25^{**})\).

Prediction of Work Crashes

The third part of the study aimed to examine the relationship between participants’ driving attitudes and behaviours as measured by the DAQ, DBQ, SCQ-MD and self-reported work crashes. A total of 588 participants reported being involved in a crash while driving for work in the last year. A logistic regression analysis was performed to examine the contributions of the DAQ factors (e.g., overtaking, speeding, close following and alcohol), DBQ factors (e.g., highway code violations, aggressive violations and errors), SCQ-MD factors (rules, communication, work pressure, procedures and management commitment) as well as exposure to driving (e.g., kilometres driven each year & hours driving per week) to the prediction of self-reported crashes in the past 12 months.

Table 2 depicts the variables in each model, the regression coefficients, as well as the Wald and odds ratio values. Self-reported number of kilometres driven each year and hours of driving per week were entered in the first step to examine, as well as control for, the influence of driving exposure before the inclusion of the proposed attitudinal and behavioural factors. As expected, participants who reported a higher level of driving exposure (i.e.,
klms per year) were most likely to indicate that they had been involved in a work-related crash in the past 12 months, \( p = .000 \).

Next, the DBQ, DAQ and SCQ-MD factors were entered in the model to assess whether the proposed attitudes and behaviours improved the prediction of crash involvement, over and above exposure to driving (Step 2). The additional variables collectively were significant, with a chi-square statistic of \( X^2 (12, N = 4195) = 51.59, p = .000 \). The model indicates that participants who reported a higher number of driving errors were most likely to be involved in a work-related crash (\( p = .007 \)). Furthermore, reporting a higher level of work pressure was also predictive of crash involvement (\( p = .010 \)). However, it is noted that while the classification rate was high at 87.3% in both models (after controlling for kilometres driven), the overall model was more efficient at predicting drivers who are not involved in crashes, rather than those who reported engagement in traffic accidents (non-crash involvement = 87.3%, crash involvement = 10.0%).

Several additional regression models were estimated to determine the sensitivity of the results. A test of the full model with all 14 variables entered together, as well as the two models entered separately, confirmed the same significant predictors (e.g., exposure, errors and work pressure). The inclusion of gender, age and years driving experience did not increase the predictive value of the model.

### Table 2. Logistic Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>p</th>
<th>Odds ratio</th>
<th>95% CI</th>
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Note. * \( p < .05 \), ** \( p < .01 \). CI = Confidence level

## 5 Discussion

The present study aimed to examine the utility of popular self-report driving measurement tools (e.g., DAQ, DBQ & SCQ-MD) to predict self-report crash involvement among a group of Australian fleet drivers. In doing so, a number of issues emerged regarding conducting research in fleet settings, which will also be highlighted below.

Firstly, analysis of the measurement tools’ internal consistency indicated that the DBQ and SCQ-MD were moderately robust, with the results similar to previous research that has utilised the questionnaires \([11, 17, 24, 29]\). However, the DAQ’s internal consistency was relatively low, and as the scale has not been extensively validated within the literature, it appears that further research is necessary to determine the psychometric properties of the questionnaire, and its subsequent usefulness within fleet research.

Secondly, examination of the mean scores for the DBQ, DAQ and SCQ-MD factors revealed that participants generally reported positive attitudes and behaviours towards road safety. In regards to attitudes, similar to previous research \([13, 14]\), respondents reported close following and drink driving as the most serious driving behaviours. Participants also reported risky overtaking practices were an additional unacceptable behaviour, while...
attitudes towards speeding were more lenient. This finding is consistent with research which has indicated speeding is the most common form of aberrant driving behaviour reported by motorists [12, 25, 26].

In regards to the relationship between the measurement tools, negative associations were identified between attitudes and the corresponding behaviours. That is, participants who agreed with the seriousness of the specified aberrant driving behaviours were less likely to report engaging in such behaviours over the past six months (e.g., DBQ speeding factor). Furthermore, the bi-variate correlations also provided a preliminary indication that the culture of the organisation, in particular the direction provided by the management team, is associated with driving behaviours. For example, the collected data generally indicates that the current organisation provided clear fleet safety rules, appropriate communication and support as well as strong management commitment, which was negatively associated with engaging in the aberrant driving behaviours. While only preliminary, the results indicate that the “safety climate” of a fleet organisation has the potential to directly impact upon the driving outcomes exhibited by employees.

Despite the positive appraisal regarding the safety climate of the organisation, 588 participants reported being involved in a work-related accident in the past 12 months. In regards to the prediction of self-reported crash involvement while driving for work purposes, a number key factors were identified. Firstly, it appears that greater exposure to the road, such as driving more kilometres per annum, increases drivers’ chances of being involved in a crash. While not surprising, the results may provide an opportunity for fleet managers to identify those at risk of crash involvement through exposure, and ensure such drivers receive appropriate interventions and supervision to reduce the likelihood of being involved in an accident. Secondly, the logistic regression analyses indicated that making a higher number of errors as well as reporting higher levels of work pressure were both predictive of work crashes. Interestingly, these two predictive variables were also correlated at a bivariate level, as those who reported increased work pressure were also more likely to report committing a higher number of driving errors in the past six months ($r = .25^{**}$). Further research appears necessary to determine whether there is a causal link between work pressure and committing errors, as early evidence suggests fatigue related issues are a contributor to crash involvement [11]. However, it is also noted that the overall model was not very efficient at predicting those most likely to be involved in work-related crashes. While to some extent this may be expected as there is arguably a plethora of factors that may influence both driving performance and the likelihood of crash involvement, from a research perspective, the findings indicate that further research is required to determine the efficacy of current assessment tools to identify “at risk” drivers.

Implications and Difficulties

The present study forms part of a four-year program of research conducted at CARRS-Q that involved examining fleet drivers’ attitudes and behaviours from large Australian fleet companies. This research project has highlighted a number of implications and difficulties regarding conducting research and promoting safety within fleet settings. While it is noted that the following comments can only be considered subjective, the writers believe that a number of on-going issues within fleet settings need to be addressed. In relation to administering tests and generally gathering self-report data, these include:

a) The predominant driving assessment tools utilised in research, such as the DBQ, DAQ and Fleet Safety Climate Survey are not necessarily conducive for administration to large scale commercial driving environments due to their length. Fleet managers and fleet drivers are not willing or not able to devote the appropriate period of time necessary to accurately complete these driving assessment tools;

b) The scales are increasingly becoming antiquated as contemporary issues that influence fleet drivers’ performance have not been included in assessment scales (e.g., fatigue, time pressure); and

c) There is a lack of modern, easily administered and user friendly measures that can be utilised for diagnostic, evaluative or appraisal purposes that specifically measure the impact of fleet interventions as well as determine the assessment of associated driving risk.

Conversely, in regards to generally implementing fleet safety interventions, the writers note that within Australia:

a) Occupational Health and Safety representatives are often reluctant to address fleet safety concerns;

b) Safety Interventions usually rely heavily on engineering solutions;

c) Suppliers (by default) have often driven industry responses; and

d) There is a clear lack of current behavioural interventions to improve fleet safety.

Taken together, changing habitual behaviours is often a complex process which should be driven by evidence-based solutions that incorporate both official information (e.g., crash databases) and self-reported perceptions and experiences. In regards to the latter, currently only a relatively small (but growing) body of research has examined...
the self-reported driving attitudes and behaviours of fleet drivers, despite the potential for such data to be utilised in fleet interventions designed to reduce the burden of crash involvement.

Limitations
Some limitations should be borne in mind when interpreting the results of this study. The response rate of participants was relatively low, but consistent with previous research that has attempted to investigate fleet drivers \[21,26\]. Concerns remain regarding the reliability of the self-reported data, such as the propensity of professional drivers to provide socially desirable responses. Further research is also required to establish the reliability and validity of the scales for the Australian setting, especially the psychometric properties of the DAQ. Finally, it is also noted that a number of additional factors not examined in the current study, both personal and environmental, may influence as well as cause a vehicle-crash.

Despite such limitations, the results may prove to have direct implications for fleet interventions, not only through monitoring the driving performance of employees and the corresponding level of perceived work pressure, but also through proactive measures to reduce the likelihood of drivers making driving errors e.g., appropriate rest breaks, training, etc. Given the tremendous personal and economic cost of vehicle crashes in Australia, further research that endeavours to identify an appropriate balance between productivity and personal safety within fleet settings may prove beneficial at a number of levels.

References


