# Using a Conceptual Framework to Investigate the Factors Influencing Safety Performance in a Work Vehicle


## Abstract

Limited research has investigated the factors determining driving behaviour in the work-related driving setting. In a sample of 385 work-related drivers, this study applies a framework for systematically assessing drivers' perceptions of safety, integrating this framework with individual attributes, and using the combined set of variables to predict crashes in a work vehicle. The results revealed that motivation to drive a vehicle safely, but not safety knowledge influenced self-reported crashes. Safety motivation also mediated the link between self-efficacy and attitudes towards traffic safety and crashes in a work vehicle. The results of this study have provided a unique contribution to the safety and road safety literature by allowing for the systematic assessment of different types of employee perceptions and their relationship to crash involvement.



Key words: safety climate, fleet safety, safety performance



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Road accidents are now the most common form of work-related death, injury and absence from work in Australia (Haworth, Kowadlo & Tingvall, 2000). In the Australian State of Queensland, for example, over the period 2000 to 2001, 97 people were killed in work-related road crashes, and 5,917 people sustained permanent or severe injury (Travelsafe34, 2001). The annual cost of work-related road traffic injury is estimated to be over AUD$500 million and related property damage increases this figure to over AUD$1 billion (Travelsafe34, 2001).

The above figures suggest that road safety should be an important concern for all organisations where employees are engaged in work-related driving. Work-related drivers have been defined as those who drive at least once per week for work-related purposes (Murray et al., 2002). In seeking to understand work-related road safety outcomes, research which examines predictors of driving performance can contribute to the understanding of work-related road safety outcomes. However, limited research has investigated the predictors of driving performance in the work-related driving setting. Moreover, little or no conceptual framework was used in these evaluations, and without a strong theoretical foundation, the findings do not allow us to pinpoint the processes which explain why some initiatives were more effective than others and to generalise the results for future applications.

The current study addresses these limitations by examining a conceptual framework which incorporates a range of variables that are believed to influence safe driving behaviour. In particular, this study will be adopting a model developed by Griffin and Neal (2000) which examines perceptions of the safety climate as an antecedent of safety performance, and motivation and knowledge as determinants of performance. This study will be extending on the model and incorporating individual attributes as antecedents and investigating the combined influence of these variables in predicting self-reported crashes. In the following sections, we describe the variables under investigation, and present a model of the relationships among these constructs.

*Safety climate*

A wide range of work environment variables have been linked to safety behaviour ranging from leadership (e.g., Huang, Chen, Drauss, & Rogers, 2004), to job insecurity (eg. Probst & Brubaker, 2001). We will focus on safety climate as a large amount of research has supported its role in predicting safety performance (eg. Hoffman, Morgeson & Gerra, 2003; Neal & Griffin, 2001; Zohar, 2000). Safety climate has been described as an individual's perceptions of the organisations safety policies and procedures (Zohar, 1980).

Griffin and Neal (2000) argue that safety climate is an antecedent of safety behaviour, and that safety motivation and knowledge mediate the relationship between safety climate and safety behaviour. Drawing upon Vroom's (1964) expectancy-valence theory, Griffin and Neal define motivation as the degree of incentive to comply with policies and procedures. Safety knowledge can be conceptualised as an employees' understanding of the safety procedures (Hoffman, Jacobs & Landy, 1995). Based on this theory, individuals should be motivated to participate in safety activities and have knowledge on safety procedures if they perceive a positive safety climate. Further, if individuals perceive the intrinsic value associated with safety and have knowledge on the safety procedures, they will be less likely to have

workplace accidents. These findings have been supported in a number of studies (Griffin & Neal, 2000; Neal, Griffin & Hart, 2000; Neal & Griffin, in press). As such, this study will be investigating safety climate as an antecedent of safety performance, where motivation and knowledge mediate the relationship between safety climate and self-reported crashes. Therefore, it is hypothesised that:

H1: Motivation and knowledge will negatively predict self-reported crashes.
H2: Motivation and knowledge will mediate the relationship between safety climate and self-reported crashes.

Past research has suggested that other individual attributes are also likely to play a role in safety performance (Hoffman, Jacobs, & Landy, 1995), and safe driving behaviour in a work vehicle (Newnam, Watson, & Murray, 2004). This study will focus on two individual attributes: self efficacy and attitude towards traffic.

*Self efficacy*

Self-efficacy is defined as the belief in one's ability to perform a specific task through successfully executing the behaviour to produce the desired outcome (Bandura, 1977). The organisational literature has found that self efficacy predicts task effort and work performance (Gist & Mitchell, 1992; Stajkovic & Luthan, 1998). In particular, Stajkovic and Luthans (1998) stated that self efficacy may be a better predictor of work-related performance than the majority of personality trait-based constructs used in organisational research. Although self-efficacy has been widey used in the organisational literature as well as the general driving literature (e.g., Tay & Watson, 2002; Tay et al, 2004), it is rarely used in work-related driving.

In regards to the relationship between self efficacy and motivation, past research has considered self efficacy to be an inherently motivational construct, where positive correlations between performance and self efficacy are interpreted as a motivational effect of self-efficacy on performance (Bandura & Locke, 2003; Bandura, 1986). Other researchers have argued that motivation is a distinct construct, which can be used to explain variability in performance (eg. Brown & Leigh, 1996; Griffin & Neal, 2000), independent of self efficacy, or other psychological states. This study will be assessing self efficacy as an antecedent, rather than a determinant of self reported work-related crashes, distinguishing between self-efficacy as a belief in one's ability to drive safely, and the motivation to drive safely. Thus, it is hypothesised that:

H3: Motivation and knowledge will mediate the relationship between self-efficacy and self-reported crashes.

*Attitudes towards traffic safety*

Eagly and Chaiken (1993) state that an attitude is a favourable or unfavourable evaluation of an object (person, entity, or idea), which exerts a direct impact on social behaviour. The attitude concept has been widely used to predict actual behaviour. However, early research has indicated only a weak direct relationship between individuals' attitudes and their behaviour (eg. Wicker, 1969, see Eagle & Chaiken, 1993). It has been suggested that one explanation of the weak relationship between attitude and behaviour found in past research

may be due to the tendency to focus on large and varied groups, rather than task specific attitudes and behaviours (Ajzen, 1988).

As such, this study is interested in exploring task specific attitudes (namely, attitudes towards safe driving) as an individual construct within a safety performance framework. This study is based on a scale developed by Iversen and Rundmo (2004) designed to measure attitudes towards traffic safety. Iversen and Rundmo found that attitudes towards traffic safety, especially attitudes concerning rule violations and speeding, were associated with risky driving behaviour. While the connection between attitudes towards driving safety and self-reported driving outcomes has been made in previous research (e.g., Lawton et al., 1997; Parker, Lajunen, & Stradling, 1998; Tay et al, 2002, 2004) the aim of this study is to distinguish attitudes as an antecedent of driving performance. No research to date has investigated the relationship between attitudes and motivation and knowledge. Therefore, we predicted that:

H4: Motivation and knowledge will mediate the relationship between attitudes towards traffic safety and self-reported crashes.

*Control variables*

This study will also include a number of control variables, based on previous research. The control variables are kilometres driven per week in a work vehicle, age and gender. Work-related drivers, on average, accumulate higher mileage in comparison to the average private motorist (Griffin, 1997). Above average annual mileage has been suggested as a potential factor contributing to work-related vehicle crashes (Downs et al., 1999). In addition, younger drivers are known to have higher accident rates than older, more experience drivers (Lynn & Lockwood, 1998). Research has also found male drivers are more likely to report higher driving speeds, higher thrill-seeking, and more aggressive violations (Stradling, Meadows & Beatty, 1999). Overall, these findings support the argument for using these variables as controls within the current study.

## Methods

*Participants and procedure*

The research was conducted in partnership with a vehicle leasing agency, which is the Queensland Government's provider of vehicle leasing and fleet management services. The data collection was conducted using a sample of organisations from the Queensland Government population of agencies. The final sample included agencies that represented the following business portfolios: health, environmental protection, public works, roads, education and emergency services. These agencies consisted of individuals driving in rural and urban road environments, and on-road and off-road conditions. Although the drivers were a convenient sample, they are believed to be representative of work-related drivers in regards to age, gender and kilometres driven per week (eg. Newnam, Watson & Murray, 2004).

The surveys were distributed to drivers via the individual who was responsible for the coordination of fleet vehicles, and/or drivers' work vehicles. These individuals will be referred to as fleet coordinators. A total of 52 fleet co-ordinators were contacted and asked to distribute the survey to drivers. Due to confidentiality, fleet coordinators were not able to provide a list of the drivers within their agency, so fleet coordinators were asked to distribute the surveys to the drivers. It was requested that this distribution be conducted on a random

basis. An information sheet was provided to the fleet coordinators and drivers stating all relevant information in relation to the completion of the surveys. The final sample consisted of 385 drivers, all of whom drove a work vehicle at least once per week for work-related purposes.

*Measures*

*Safety knowledge and motivation*

Safety knowledge and safety motivation were each assessed by three items. These items were adapted from Griffin and Neal (2000). The safety knowledge scale had a reliability of .85, and the safety motivation scale had a reliability of .75. An example of a safety knowledge item was "I know how to improve my work related driving". An example of a safety motivation item was "I feel it is worthwhile to put in effort to improve my driving in a work vehicle". These items were measured on a 5-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5) and the mean of the items in each subscale were used to measure the safety knowledge and safety motivation constructs.

*Work-group safety climate*

Safety climate was assessed using 3 scales from the Griffin and Neal's (2000) measure of safety climate. The three dimensions of safety climate examined include: safety communication ($\alpha$=.88), safety training ($\alpha$=.85) and safety systems ($\alpha$=.80). An example of a safety communication item was "there is sufficient opportunity to discuss motor vehicle safety issues in meetings". An example of a safety training item in the driver survey was "work-related drivers receive comprehensive training in motor vehicle safety issues." An example of a safety systems item in the driver survey was "there are systematic procedures in place for preventing work-related accidents". All items were measured on a 5-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). Prior to the analyses, a composite variable was computed using the mean value from these three subscales to form the safety climate construct in the analyses.

*Self efficacy*

Self efficacy was assessed by three items adapted from Renn and Fedor (2001). This scale had an internal reliability of .86. An example item was "feel confident about your ability to drive safely in a work vehicle." These items were measured on a 5-point Likert scale, ranging from Never (1) to Very Often (5). Prior to the analyses, the items were combined, using their mean value, to form the self efficacy construct.

*Attitudes towards traffic safety*

Attitudes towards traffic safety were assessed by eleven items. These items were adapted from Iversen and Rundmo (2004) and were reworded to suit the sample of work-related drivers. This scale had a reliability of .78. An example of an item was "speed limits are exceeded because they are too restrictive". These items were measured on a 5-point Likert Scale, ranging from Strongly Disagree (1) to Strongly Agree (5). As this scale was negatively worded, the items were reversed for subsequent analyses. Prior to the analyses, the items were combined, using their mean value, to form the attitudes towards traffic safety construct.

*Analyses*

Analyses were conducted using the two-step Structural Equation Modelling (SEM) approach. First, the measurement model was assessed to discriminate between the constructs (analogous to performing a confirmatory factor analysis). Second, the SEM, specifying the causal relationships among the latent constructs was tested. The goodness of fit statistics reported in the SEM analyses include, the root mean square error of approximation (RMSEA), comparative fit index (CFI), non-normed fit index (NNFI), and the goodness-of-fit index (GFI).

## Results

*Descriptive data*

The majority of the participants were male (76%), and between the ages of 40-59 years (65%). A large proportion of the sample was classified as Administrative Officers (54%), with the highest percentage ranging from AO3-AO6 level (levels ranging from AO1 to AO8) (54%). Over 70% had held their licence for a minimum of 21 years, and the majority of the participants drove every day of the week (55%), with a driving average of 365 kilometres per week.

*Measurement model*

A nine factor model was conducted in LISREL VIII using maximum likelihood estimates (Joreskog & Sorbom, 1993). The results revealed a satisfactory fit to the data [$\chi^2$ (120)=241.43, p>.05, RMSEA=.05, CFI=.97, NNFI=.96, GFI=.94]. With the exception of the $\chi^2$ statistic, the remaining fit indices were all acceptable. All the factor loadings from the measurement model were large and statistically significant beyond the .01 level. The factor loading ranged from .74 to .91.

*Model comparison*

In this study, the models were tested using LISREL VIII (Joreskog & Sorbom, 1993). The hypothesised model, in which knowledge and motivation mediate the link between the antecedents of safety performance (safety climate, self efficacy and attitudes towards traffic safety) and crashes in a work vehicle, was compared with a saturated structural model in which the antecedents of safety performance directly predicted safety knowledge, motivation and crashes in a work vehicle. The saturated model did not provide a significantly better fit than the hypothesised model [$\chi^2$ (123)=243.80, p>.05]. Further, there were non-significant paths from climate, efficacy and attitude to self reported crashes. As such, the hypothesised model, which was the fully mediated model, was interpreted. The fit indices of the hypothesised model provided a good fit to the data [$\chi^2$ (120)=241.43, p>.05, RMSEA=.05, CFI=.97, NNFI=.96, GFI=.94]. With the exception of the $\chi^2$ the remaining fit indices were all acceptable. Age, gender and kilometres driven per week were controlled for in saturated and hypothesised models. The means, standard deviations and correlations are presented in Table 1.

Table 1
Means, standard deviations, reliabilities, and correlations between driver constructs

| Scale | M | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Crashes | .05 | .22 | - | | | | | | | | |
| 2. Safety motivation | 4.47 | .60 | -.11* | | | | | | | | |
| 3. Safety knowledge | 4.04 | .75 | -.03 | .61** | | | | | | | |
| 4. Safety climate | 2.76 | .88 | -.05 | .04 | .25 | | | | | | |
| 5. Self efficacy | 4.46 | .59 | .01 | .25** | .48** | .14* | | | | | |
| 6. Attitudes | 3.52 | .55 | .02 | .35** | .31** | .07 | .24** | | | | |
| 7. Gender | 1.23 | .42 | .03 | .01 | -.06 | -.01 | -.10 | .09 | - | | |
| 8. Age | 2.70 | .61 | .08 | .08 | .08 | -.05 | .07 | .08 | -.26** | - | |
| 9. Kilometres[1] | 3.67 | 3.43 | .07 | -.01 | -.02 | .02 | -.04 | .09 | -.27** | .13* | - |

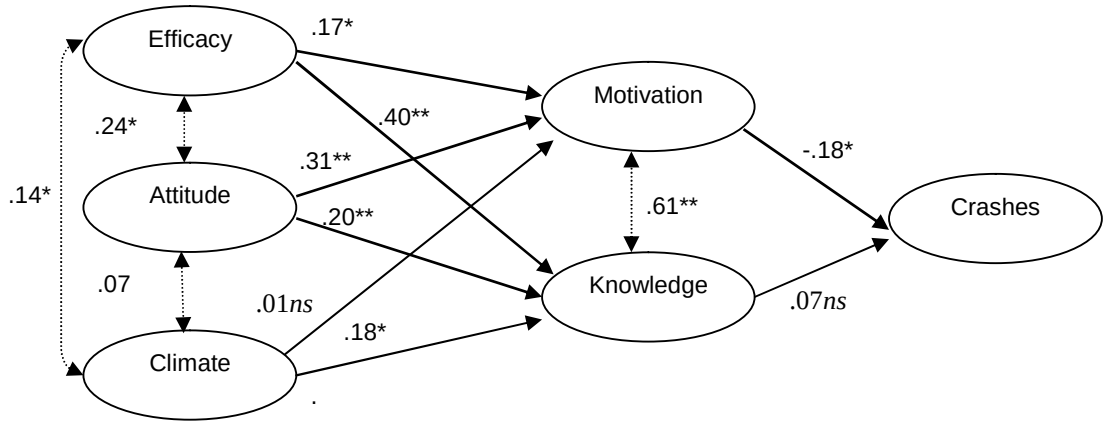
Note: * p<.05, ** p<.001,

*Parameter estimates*

The parameter estimates in the hypothesised model revealed that crashes in a work vehicle was predicted by motivation to drive safely in a work vehicle (B=-.15, p<.05), but not safety knowledge. These results suggest drivers are less likely to have a crash in a work vehicle if they are motivated to drive safely in a work vehicle, which is partially consistent with hypothesis one. In turn, motivation to drive safely was predicted by attitudes towards traffic safety (B=.31, p<.05), and self efficacy (B=.17, p<.05). As such, drivers are more motivated to drive safely in a work vehicle if they have favourable attitudes towards traffic safety and belief in their ability to drive safely in a work vehicle. These findings partially support hypothesis three and four, which predicted that attitudes and self-efficacy would be positively related to motivation. However, the results also revealed that safety climate was not a significant predictor of motivation, which meant that hypothesis two was only partially supported.

Although knowledge on how to drive safely in a work vehicle did not significantly predict crashes in a work vehicle, this construct was predicted by perceptions of safety climate (B=.18, p<.001), self efficacy (B=.40, p<.001) and attitudes towards traffic safety (B=.20 , p<.001). Thus, drivers are more likely to report knowledge on how to drive safely in a work vehicle, if they have higher safety climate perceptions, belief in their ability to drive safely in a work vehicle, and have a more favourable attitude towards traffic safety. Overall, these findings partially support hypothesis two, which predicted that safety climate would be positively related to knowledge. Hypotheses three and four were also supported as attitudes and self efficacy was positively related to knowledge. The path coefficients for this model are presented in Figure 1.

[1] Kilometres driven in a work vehicle per week were divided by 100 to reduce the variance.




Note: * p<.05, ** p<.01

Figure 1. Path estimates from the driver model.

## Discussion

This study has provided a unique contribution to the safety literature by applying a framework for systematically assessing drivers' perceptions of safety, integrating this framework with individual attributes, and using the combined set of variables to predict crashes in a work vehicle. Although research has addressed the process through which safety climate translates into safety outcomes, no study has included individual attributes in this investigation, or distinguished individual attributes from motivation and knowledge. Furthermore, very limited research has investigated the effects of these variables in a work-related driving sample. Mixed support was found for the hypotheses.

Past research has found consistent links between safety motivation and safety outcomes (Griffin & Neal, 2000; Neal et al., 2000). It has been found that if an employee has strong motivation to engage in safety behaviours, they will be less likely to have accidents within the workplace. This study's findings were consistent with this research. However, past research has established that an employees motivation is strongly influenced by their perceptions of safety (e.g., Griffin & Neal, 2000), and the findings of this study were not consistent with this proposition. Rather, motivation was determined through drivers' self efficacy and their attitudes towards traffic safety. This finding suggests that drivers' individual attributes are better predictors of motivation, than their perceptions of safety within the organisation. No previous research has distinguished self efficacy and attitudes as antecedents of safety performance, or found support for their relationship with safety motivation and knowledge. A possible explanation of why perceptions of safety did not predict safety motivation was that this study did not include a subdimension of managerial safety values in the safety climate construct. This study was interested in examining drivers' perceptions of the agencies' instituted safety policies and procedures, rather than drivers' perceptions of the supervisory practices undertaken by managers.

This study also did not find support for the relationship between safety knowledge and self-reported crashes. This is not surprising as past research has found inconsistent links between safety knowledge and safety outcomes (eg. Griffin & Neal, 2000; Probst & Brubaker, 2000). However, drivers' perceptions of safety climate, self efficacy and attitudes were found to be significant predictors of safety knowledge. This finding suggests that although there appears to be sufficient support for safety knowledge as a determinant of performance, knowledge per se does not prevent driving accidents, indicating that the safety messages may not be effectively translated into safer driving behaviour.

*Practical applications*

This study has applied a framework for systematically assessing drivers' perceptions of safety and their individual attributes, to the prediction of crashes in a work vehicle. The results of the current study provide support for a range of individual level interventions designed to reduce work-related road safety outcomes. The findings suggested that individual level interventions focused on enhancing drivers' beliefs in their ability to drive safely and their attitudes towards traffic safety could be effective in increasing levels of motivation, which in turn reduce work-related road crashes. Specifically, through the adoption of a behaviour management framework (eg., Prue & Fairbank, 1981), a potential application could focus on providing a combination of modelling good driving behaviours, feedback from work-group supervisors, and in particular, strategies aimed at involving employees in workplace safety programs (i.e., Gist & Mitchell, 2002). This could be applied through worker participation programs, such as safety committees, or regular discussion based forums.

As individual motivation was found to be a significant predictor of work-related crashes, this finding suggests an avenue to directly influence crash involvement. This study assessed the intrinsic value of safety, rather than extrinsic motivators such as rewards and punishment (eg., Probst & Brubaker, 2001). As such, a possible intervention could focus on providing feedback to drivers' on their safety performance in a work vehicle. This type of intervention would aim to enhance drivers' belief in the intrinsic value associated with safety, through a system of positive reinforcement (e.g., Prue & Fairbank, 1981).

*Limitations*

There are some limitations associated with this study. This study relied on self report data, which are open to socially desirable responding. Although this is normally a serious limitation, it is less likely to be an issue in this particular study, for two reasons. First, crashes represent infrequent and salient events, so unlike other forms of behaviour (e.g., absenteeism), they are not likely to be affected by poor recall. Second, it has been shown that self report driving questionnaires are associated with minimal social desirability bias (Lajuen & Summala, 2003).

A second issue reflects the fact that the study measures were collected from the same survey and set of respondents, which means that the observed relationships may have been inflated by common method variance (e.g., Podsakoff & Organ, 2003). However, previous studies have demonstrated the link between the determinants of performance and safety behaviours (e.g., Griffin & Neal, 2000; Neal & Griffin, in press). Additionally, the zero-order correlations did not indicate consistently high coefficients (>.60), which would be expected if there were effects due to common method variance (i.e., Tabachnick & Fidell, 2001).

A final limitation relates to the representativeness of the sample. Due to issues relating to confidentiality, it was not possible to distribute the surveys directly to drivers. As such, it was not possible to obtain a response rate to the surveys, or gain an understanding of the representativeness of the sample. As such, it would be desirable to replicate this study with a larger random sample.

*Conclusion*

In summary, this paper has applied a framework for systematically assessing drivers' perceptions of safety and their individual attributes, to the prediction of crashes in a work vehicle. This study found that safety motivation mediated the relationship between individual attributes and crashes in a work vehicle. Safety climate was not found to be a significant predictor of safety motivation. The results of this study could be used to design specifically targeted fleet safety interventions to reduce work-related crash involvement.

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