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Comparing Safety Climate Factors as Predictors of Work-Related Driving Behavior

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Abstract

Introduction: Research suggests safety climate (SC) is a strong predictor of safety-related outcomes in organizations. This study explores the relationship between six SC dimensions and four aspects of work-related driving. *Method:* The SC factors measured were 'communication and procedures', 'work pressures', 'relationships', 'safety rules', 'driver training', and 'management commitment'. The aspects of self-reported occupational driving measured were traffic violations, driver error, driving while distracted, and pre-trip vehicle maintenance. *Results:* Hierarchical regression analyses revealed the SC factors accounted for significant amounts of variance in all four aspects of work-related driving, over and above the control factors of age, sex, and work-related driving exposure. However, further investigation indicated certain SC factors (particularly safety rules, communication, and management commitment) were more strongly related to specific aspects of work-related driving behavior than others. Together, the SC factors were best able to predict self-reported distraction from the road than the other aspects of driving behavior measured. Implications for occupational safety, particularly for the management of work-related drivers are discussed.

Keywords: Safety climate; safety culture; work-related driving; organizational influences; occupational safety

1. Introduction

Work-related traffic crashes are the largest single cause of occupational fatalities in Australia (Haworth, 2002). These crashes account for approximately 25% of all occupational fatalities each year (Harrison, Mandryk, & Frommer, 1993; National Occupational Health and Safety Commission [NOHSC], 1998), and are twice as likely to result in death or permanent disablement as any other occupational incidents (Wheatley, 1997).

The scope of the problem of work-related crashes has also been recognized as a major public health and safety issue in many other countries including the United States, the United Kingdom, New Zealand, and Sweden (e.g., Bibbings, 1997; Bylund, Björnstig, & Larsson, 1997; Driscoll et al., 2005; Gregersen, Brehmer, & Moren, 1996). In recent years, work-related driving has received increased focus and recognition as an issue with occupational health and safety implications (Haworth, Tingvall, & Kowadlo, 2000; Murray, Newnam, Watson, Davey, & Schonfeld, 2002).

1.1 Safety Climate

Over the past two decades, research and discussion in occupational safety sciences has focused on the importance of management practices and their impact on employees' occupational safety behaviors and other organizational safety outcomes such as injuries, fatalities, and other incidents. A key aspect of this has been the increasing interest in the concept of organizational safety climate (SC). While thus far, researchers have not provided one definitive description, there appears to be increasing consensus about the nature of the concept.

This literature suggests SC represents employees' perceptions about organizational support, and particularly, management's commitment to safety in the organization. The most problematic inconsistency in the literature concerns the theoretical distinction between safety climate and safety culture, an issue which has, at times, also been evident in the literature on organizational culture and climate more generally (Denison, 1996). While a comprehensive discussion of this problem is beyond the intent of this paper, it is important to note distinctions are often recognized, both in terms of the underlying theory and methodology used.

As the terms are used throughout this study, 'safety climate' (SC) refers to workers' perceptions – a psychological concept (as described above), while the broader and more complex notion of 'safety culture' refers to a phenomenon which manifests at various levels including behaviorally, psychologically and socially, through channels such as values, attitudes, beliefs, and normative behaviors (Glendon & Stanton, 2000; International Atomic Energy Agency [IAEA], 1991; Schein, 1990; Waring & Glendon, 1998).

Investigation into SC has primarily focused on the relationship between workers' perceptions of organizational and management practices, and various organizational safety outcomes, including: company incident rates (Diaz & Cabrera, 1997; Varonen & Mattila, 2000); self-reported occupational incident involvement frequency (Mearns, Flin, Gordon, & Fleming, 1998; Mearns, Whitaker, & Flin, 2003); self-reported occupational injury frequency and severity (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002; Vredenburgh, 2002); safety performance and behavior (Griffin & Neal, 2000; Wills, Watson, & Biggs, 2004); and the frequency of worker's compensation claims (O'Toole, 2002).

Gillen et al. (2002) also found SC differed between union and non-union construction workers, reflecting the different worksite safety requirements of these affiliations. Additionally, O'Toole (2002) demonstrated employees' SC scores changed with the implementation of organizational safety interventions. Recent research on SC has also started to investigate group-level climate influences on occupational safety (e.g., Cheyne, Tomás, Cox, & Oliver, 2003; Zohar, 2000; Zohar & Luria, 2005) as well as the determinants of SC (DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004).

Factor analytic studies have demonstrated SC measures typically contain underlying factor structures of comparable nature. For example, Flin, Mearns, O'Connor, and Bryden (2000) reviewed the dimensions underlying 18 SC survey measures and found several recurrent factors, including: management behaviors and attitudes; safety management systems such as policies and procedures; risks; work pressures; and competency. Evidence also suggests that perceptions concerning management commitment to safety may be another stable element of SC (Cox & Flin, 1998; Oliver, Cheyne, Tomás , & Cox, 2002; O'Toole, 2002; Zohar, 1980).

While some studies have shown inconsistent factor structures when measures are re-examined with samples from different organizations and industries (e.g., Brown & Holmes, 1986; Niskanen, 1994; Zohar, 1980), others have shown relatively consistent factor structure patterns (e.g., Glendon & Litherland, 2001; Glendon, Stanton, & Harrison, 1994; Wills, Biggs, & Watson, 2005). The literature has provided much discussion (and recommendations) about which aspects of organizational safety management and practice should be included in SC measures.

1.2 Study Aims

Paradoxically, although research appears to confirm the multi-dimensionality of SC in organizations, many studies have treated the concept as a global indicator of the overall shared climate held by employees within a particular organization or group. To date, there is limited evidence regarding the relative influence, and hence importance, of the various SC dimensions and their relationship to occupational safety behaviors. This study will begin to address this limitation by comparing the relative relationship between SC factors and various safety-related occupational behaviors. Therefore, self-reported work-related driving behaviors were the dependent variables of interest to this study, and SC factors represented the independent variables.

2. Method

2.1 Participants

A total of 1000 workers were approached to participate in the study across three organizations based in the State of Queensland, Australia. The organizations were a local government council, a state government transport agency, and a private industrial resource provider. A total of 329 workers agreed to participate in the study – representing an overall response rate of 32.9%. Six participants were removed from the sample prior to data analysis due to incomplete data. The final sample consisted of 323 employees. To be eligible to participate in the study, the respondents needed to drive a motor vehicle at least once during the course of their average working week. The sample consisted of 93.5% male workers and 6.5% females. Although there were few female participants, this gender distribution reflected the nature of the industries and organizations involved. The majority of participants were aged between 40 - 49 years (43%), 50 - 59 years (23%), or 30 -39 years (22%).

2.2 Procedure

Workers were contacted through the internal mail systems of their respective organizations and asked to participate in a voluntary research study. They received an information sheet detailing: the anonymous nature of the study and a letter confirming management support for their participation; instructions for completing and returning the survey; and the survey. Two weeks following distribution of surveys each organization was requested to send reminders about participation in the study via email or other internal communications processes. To maintain participant anonymity and confidentiality and to maximize the response rate, surveys were returned directly to the researchers in prepaid envelopes.

2.3 Measures

2.3.1 Safety climate. A modified version of Glendon and Litherland's (2001) Safety Climate Questionnaire (SCQ) was used. A description of this questionnaire (Safety Climate Questionnaire – Modified for Drivers [SCQ-MD]) including development, factor structure, and reliability statistics is fully described in Wills et al. (2005). The SCQ-MD contained items from the original SCQ which were modified to increase applicability to the context of work-related vehicle driving, and included 35 items (five-point Likert scale ranging from 'Never / Not at all' to 'Always') representing six SC factors, relating to 'communication', 'work pressures', 'relationships', 'driver training', 'management commitment', and 'safety rules'. All factors were calculated such that higher scores indicated safer perceptions. Regarding the 'work pressures' factor, it is important to note that a high score on this factor is indicative of a safer perception, indicating that the participant perceived a high level of support from the organization and thus less pressure.

2.3.2 Driver behavior. A modified version of the Driver Behavior Questionnaire (DBQ) (Lawton, Parker, Manstead, & Stradling, 1997) was used to measure driver behavior. The modifications were designed such that there was an increased focus on work-related driving; that is, driving during the course of work. Additional behavior items included were: two items pertaining to reversing behavior while driving for work, five items relating to on-road distraction while driving for work, and two items relating to pre-trip maintenance behaviors. The inclusion of these items was based on previous research on work-related driving (Newnam, Watson, & Murray, 2002; Salminen & Lahdeniemi, 2002), as well as discussions with staff involved in the day-to-day management of fleets. Items were measured using a six-point Likert scale ranging from 'Never' to 'Nearly all the time'. New items included in the current study are denoted in Table 1. Appropriate calculations were performed such that higher scores on any item indicated safer behavior. The factor structure of the modified DBQ applied in this study is shown in the following results section.

3. Results

3.1 Factor Analysis of the Modified DBQ

Exploratory factor analyses were performed on the data collected from all 323 cases on the 29 behavior items included in the modified DBQ. The case-to-variable ratio (10:1) exceeded that recommended by Hair, Anderson, Tatham, and Black (1998). A Principal Axis Factor Analysis with varimax rotation revealed eight factors exceeding Kaiser's criterion of eigenvalues > 1. Cattell's scree test strongly supported a four-factor extraction, accounting for 35.6% of the total variance. However, as examination of the factor transformation matrix indicated several factors were strongly correlated (> .5), a second Principal Axis Factor Analysis with an oblimin rotation was performed and the same criteria for factor extraction followed. Four factors were extracted, explaining 35.5% of the total variance. The resulting factor loadings of greater than .30 are shown in bold-type in Table 1. As shown in Table 1, reliability coefficients for each of the factors was above the acceptable cut-off level of .70 (De Vaus, 2002). It is important to note that items 11, 12, 19, and 29 were excluded from further analyses due to unsatisfactory factor loadings (< .30).

[Insert Table 1 here]

3.2 Correlations and Hierarchical Regressions

Pearson correlation coefficients were calculated for the SC factors, the four aspects of driver behavior, overall driver behavior, and key socio-demographic variables and are shown in Table 2. The correlations between the SC factors ranged from moderate to strong (r = .19 to .70). A hierarchical regression was conducted to examine the combined capacity of the SC factors to predict overall work-related driver behavior (each of the four aspects combined). Subsequently, four follow-up hierarchical regression analyses were conducted to examine the combined capacity of the SC factors to predict each of the aspects of work-related driving. In each of these five analyses, employee age and sex were entered as demographic control variables at step 1, along with the average hours driven each week for work as a measure of driving exposure. The SC factors were entered as step 2 of the hierarchical regression analyses to examine their ability to predict work-related driving behavior over and above the control factors.

[Insert Table 2 here]

3.2.1 Overall work-related driver behavior (combined). All of the SC factors were significantly correlated with overall work-related driving behavior (as shown in Table 2). 'Safety rules' had the strongest correlation, followed by 'communication and procedures', 'management commitment', and 'work pressures' ($r \geq .30$).

Hierarchical regression analysis revealed that together the model accounted for 25% of the variance in overall work-related driver behavior, F (9, 306) = 11.30, $p <$ .001. The six SC factors accounted for 19% of the variance in driver distraction, over and above the control factors, ΔF = (6, 306) = 13.12, $p < .001$. Inspection of the Beta (β) coefficients (see Table 3) showed that 'safety rules' made a significant contribution to the overall regression model, uniquely accounting for 4% of the variance in overall work-related driver behavior.

[Insert Table 3 here]

3.2.2 Driver distraction. All SC factors were significantly correlated with driver distraction. There was a moderate correlation between 'work pressures' and driver distraction. 'Safety rules' and 'management commitment' were moderately correlated with driver distraction, while ‘relationships’ and ‘communication and procedures’ displayed correlations of $r < .30$ with driver distraction (see Table 2).

Hierarchical regression analysis revealed that together the model accounted for 24% of the variance in self-reported driver distraction, F (9, 306) = 10.67, $p < .001$. The six SC factors accounted for 20% of the variance in driver distraction, over and above the control factors, ΔF = (6, 306) = 13.12, $p < .001$. Inspection of the Beta (β) coefficients (see Table 4) showed that ‘work pressures’ contributed significantly to the overall regression model, uniquely accounting for 6% of the variance. ‘Safety rules’ and ‘management commitment’ were also significant, uniquely accounting for 2% and 1% of the variance in self-reported driver distraction respectively.

3.2.3 Traffic violations. All SC factors were significantly correlated with self-reported traffic violations. As shown in Table 2, the ‘safety rules’ factor was moderately correlated with reported traffic violations, while ‘communications and procedures’, ‘management commitment’, ‘work pressures’, and ‘relationships’ correlated with traffic violations at $r < .30$.

A third hierarchical regression revealed the overall model accounted for 20% of the variance in traffic violations, F (9, 306) = 8.38, $p < .001$. The six SC factors accounted for 13% of the variance in driver distraction, over and above the control factors, ΔF = (6, 306) = 8.15, $p < .001$. Inspection of the Beta (β) coefficients (see Table 5) showed that ‘safety rules’ contributed significantly to the overall regression model, uniquely accounting for 4% of the variance in reported traffic violations.

3.2.4 Driver error. All SC factors correlated significantly with driver error, although only ‘management commitment’ and ‘safety rules’ displayed weak-moderate correlations, while ‘communication and procedures’ was correlated at $r = .20$ (see Table 2).

Hierarchical regression revealed the overall model accounted for 11% of the variance in reported driver error, F (9, 306) = 4.24, $p < .001$ (see Table 5). The six SC factors accounted for 10% of the variance in driver distraction, over and above the control factors, ΔF = (6, 306) = 5.91, $p < .001$. Inspection of the Beta (β) coefficients (see Table 6) showed that ‘management commitment’ and ‘safety rules’ each made a significant contribution to the overall regression model, uniquely accounting for 3% and 2% of the variance in driver error, respectively.

3.2.5 Pre-trip vehicle maintenance. Finally, all SC factors correlated significantly with drivers’ pre-trip maintenance behaviors. However, only ‘communication and procedures’ displayed a correlation of $r > .20$ (see Table 2).

The final hierarchical regression revealed the overall model accounted for 16% of the variance in driver error, F (9, 306) = 6.28, $p < .001$. The six SC factors accounted for 6% of the variance in driver distraction, over and above the control factors, ΔF = (6, 306) = 3.35, $p < .001$. Inspection of the Beta (β) coefficients (see Table 7) showed that ‘communication and procedures’ was the only SC factor to make a significant contribution to the overall regression model, uniquely accounting for 3% of the variance in driver error. Interestingly, driving exposure (average hours per week spent driving) also significantly contributed to the overall model uniquely accounting for 7% of the variance in pre-trip vehicle maintenance.

[Insert Table 4 here]
[Insert Table 5 here]
[Insert Table 6 here]
[Insert Table 7 here]

3.3 Summary of Results

To investigate the proposed relationship between SC and occupational driver safety, correlations between the six SC factors and the four aspects of work-related driving were examined using combined data from all three organizations and further investigated with hierarchical regression analyses. Hierarchical regression revealed that together the SC factors were significant predictors of overall work-related driving behavior (over and above the control factors age, sex, and work-related driving exposure). In summary, these data also suggest that the following climate perceptions are important predictors of occupational safety for work-related drivers: the importance and practicality of the organization's safety rules; how issues relating to fleet and driver safety are communicated within and across the organization; and management's commitment to fleet and driver safety (see Table 8 for a summary of significant SC factors). Additionally, together the SC factors were best able to predict self-reported distraction from the road while driving (which included behaviors such as driving while tired or feeling time pressured) than the other aspects of work-related driving behavior included.

[Insert Table 8 here]

4. Discussion

Safety climate has been treated as a construct which can be used as a quantitative measure of employees' global perceptions about how safety is managed and treated within their employing organization. Researchers have linked SC perceptions to a number of occupational safety behaviors and outcomes. While there may well be sufficient evidence to support treating SC as such a global or 'molar' construct, research has also provided evidence for its multi-dimensional nature (we have suggested elsewhere that further confirmatory and hierarchical factor analyses on SC measures are needed [see Wills et al., 2005]).

The results of this study suggest (in the case of organizational fleets and work-related driving) some dimensions of SC may be more strongly related to certain driving behaviors than others. That is, regression analyses revealed certain aspects of SC (such as work pressures) were more salient predictors of certain behaviors (such as being distracted from the road) than others. On the whole however, 'safety rules' was the only significant predictor of overall self-reported driver behavior (and traffic violations including such on-road behaviors as speeding and aggressive driving). It is worth noting that while not all of the relationships presented in the results are statistically 'strong', they are not insignificant. These results also suggest future SC research need also consider additional organizational and non-organizational influences on driver behavior.

Nonetheless, the results indicate particular aspects of SC are more strongly related to certain aspects of work-related driver behavior than others. Therefore, organizations and researchers should explore which particular organizational and management practices should become the focus of change and development programs, with the aim of having an impact upon the broader organizational safety culture and the workers' safety behaviors. For example, the results indicated if an intervention strategy were implemented to decrease distraction amongst drivers, work pressures may be an important factor to consider.

The results also suggest the impact of safety policies and rules, and management commitment should be considered. In this case, a multi-pronged approach may be beneficial, aiming to reduce those pressures which lead to stress and distraction from the road as well as introducing programs to enhance management commitment to ensuring driver safety receives an appropriate level of attention.

A further example can be drawn from the results relating to drivers' pre-trip maintenance behavior. In this case, it may be useful to focus on the 'communication' dimension, as the results suggested organizational communication was the only factor that had a significant relationship with drivers' self-reported vehicle maintenance behaviors (compared to the other SC factors studied). Enhancing the lines and flow of formal and informal communication regarding the rules and expectations relating to vehicle maintenance should be beneficial. Following the identification of such relationships, the literature and research on developing such programs should then be consulted for potential strategies.

We suggest the results from an SC survey be used to activate further investigation. Glendon and Stanton (2000) outlined the potential benefits of complementing SC survey research with other techniques such as qualitative interviews and observations. Before designing intervention strategies we recommend drivers, supervisors, and other organizational stakeholders be interviewed so the researchers understand the applicable contextual issues more comprehensively. Such extensive data collection processes will enhance the quality of the information collected about problematic behaviors and organizational practices.

While the results of this study provide support for the use of a SC measure as a safety diagnosis tool for organizations and researchers, the investigation of such data should be the first stage in organizational safety diagnosis. Subsequently, it is important to complement such investigation with more in-depth data collection techniques. Such further data collection and exploration should also help to guide researchers and managers in identifying other (organizational and non-organizational) factors which impact work-related driver safety.

As SC is often conceptualized as a psychological manifestation of behavioral and cultural artifacts within an organization, these findings have strong practical applicability for the management of work-related driver safety and the prediction of work-related road safety, including related employee health outcomes in fleet settings. In terms of practical implications, it remains important that day-to-day operations be managed in a way that reduces psychological pressures and strains upon drivers. This should be achieved through the proper implementation of relevant safety policies and procedures.

These findings suggest an essential part of implementing such strategies may be to ensure rules and procedures are perceived as practical and important by employees, and they do not conflict with the requirements of other work tasks. The safety rules items used in this study have a particular focus on the perceived practicality and importance of those rules (see Wills et al., [2005] for a description of the items included in each SC factor). Findings relating to the importance of management commitment to driver safety support and extend this point. To assist the transfer of policy implementation to safer employee driving behavior, organizations should openly demonstrate they are committed to the issue, thus taking steps towards convincing employees that safe driving is an accepted and expected part of their role within the organization.

5. Limitations

The data analyzed in this study were collected using self-report methods, and are subject to the limitations inherent through using that methodology such as memory and denial biases and related influences on recall. While some efforts were made to limit the potential for socially desirable responses (such as emphasizing the confidential and voluntary nature of the research), such potentially confounding factors were not statistically controlled. Similarly, it is important to consider the possible impact of consistency and self-selection principles on the results. For example, it is possible some participants made a link between factors such as work pressure and driver distraction when responding on the questionnaire measures. Future research should explore more extensive methodologies to counter such potentially confounding effects.

The sample was predominantly male. Although this did reflect the organizations and the general nature of the industries involved (three industrial organizations operating in the state of Queensland, Australia), care needs to be taken when generalizing the results and findings to other organizations and cultural contexts. Further research needs to confirm the present findings with larger and more diverse samples of work-related drivers.

One limitation regarding the driver safety training dimension (as it was operationalized in this study) is that the items focused on the perceived quality and relevance of any driver training received. Thus, a low score on this dimension may indicate employees had simply not received any driver training at all. Anecdotal evidence from an open-ended section of the questionnaire provided some support for this interpretation. As this is a difficult issue to control in multiple-organization research, future studies could address this by: 1) devising items that are organization/contextually specific; or 2) for the purpose of comparing organizations, remove the training dimension and simply determine whether or not training had been offered to employees at all.

To maintain the ecological validity of the questionnaire used, a number of items were modified to enhance their applicability to the context and behaviors of interest – work-related driving/road-user safety. Efforts were made to limit such changes to only necessary items (such as items pertaining to policies). Although this is an inherent problem in research involving multiple organizations, it is important to consider this limitation when extending these findings and recommendations to other industrial and behavioral contexts and settings.

6. Conclusions and Future Directions

This study is an initial exploratory step in a program of research which aims to examine the nature and antecedents of work-related driver safety. In terms of managing employees' on-road behavior and the related outcomes, overall the findings suggest policies relating to driver and vehicle safety may play an important role in influencing the four behaviors examined. However, this study also found the SC factors included had a stronger relationship with driver distraction than violations, errors, or vehicle maintenance behaviors. This suggests there may be other work-related or personrelated factors (not included in this study) which may be more strongly linked to these other behaviors.

It is also important to consider some of the methodological limitations inherent to self-report data collection which may have influenced the results. Future SC research should explore counter methodologies, such as incorporating more sophisticated triangulated data collection techniques. Further research is therefore needed to compare the relationship between SC and work-related driver safety, with consideration for, and relative to other influencing factors.

In conclusion, these findings support the expected benefits of adopting a multi-dimensional approach to driver safety management in organizations, and occupational health and safety management more broadly. Future research may enhance the depth and richness of knowledge regarding the interaction between organizational SC factors, behavior and other safety outcomes, by placing the constructs within a more comprehensive conceptual and theory-based model.

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Table 1
Pattern matrix for modified DBQ with additional behavior items

Label and items	1	2	3	4
Factor 1 – Driver error				
1. Fail to notice that pedestrians are crossing when turning into a side street from a main road	**.67**			
2. Miss 'Stop' or 'Give Way' signs and narrowly avoid colliding with traffic having right of way	**.60**			
3. Hit something while reversing [1]	**.58**			
4. Underestimate the speed of an oncoming vehicle when overtaking	**.57**			
5. Queuing to turn left onto a main road, you pay such close attention to the mainstream of traffic that you nearly hit the car in front	**.51**			
6. Come close to hitting something while reversing [1]	**.50**			
7. Brake too quickly on a slippery road, or steer the wrong way in a skid	**.47**			
8. Attempt to overtake someone that you hadn't noticed to be signalling a right turn	**.47**			
9. Fail to check your rear-view mirror before pulling out, changing lanes, etc	**.42**			
10. On turning left nearly hit a cyclist who has come up on your inside	**.37**			
11. Pull out of a junction so far that the driver with right of way has to stop and let you out	.26			
12. Become angered by another driver and give chase with the intention of giving him/her a piece of your mind	.26			
Factor 2 – Pre-trip vehicle maintenance behaviors [2]				
13. Check the tyre pressure of your work vehicle		**.97**		
14. Check the oil and water levels of your work vehicle		**.79**		
Factor 3 – Driver distraction [3]				
15. Drive while tired			**-.68**	
16. Drive while under time pressure			**-.63**	
17. Find yourself being distracted from the road by other thoughts	.23		**-.62**	
18. Lose concentration	.47		**-.57**	
19. Drive even though you suspect you may be over the legal blood-alcohol limit				
Factor 4 - Violations				
20. Disregard the speed limit on a highway/freeway			-.22	**.63**
21. Drive especially close to the car in front as a signal to its driver to go faster or get out of the way				**.62**
22. Race away from the traffic lights with the intention of beating the driver next to you				**.51**
23. Become impatient with a slow driver in an outer lane and overtake on the inside				**.48**
24. Become angered by a certain type of driver and indicate your hostility by whatever means you can	.21			**.46**
25. Disregard the speed limit on a residential road			-.27	**.43**
26. Sound your horn to indicate your annoyance to another driver				**.41**
27. Stay in a lane that you know will be closed ahead until the last minute before forcing your way into another lane				**.37**
28. Cross a junction knowing that the traffic lights have already turned against you	.27			**.30**
29. Drive while using a hand held mobile phone [3]			-.22	.26
Percentage of variance explained (%)	22.1	5.6	4.6	3.3
Alpha reliability coefficient	.81	.87	.71	.77

Note. Items with factors loadings shown in bold were included in analyses
[1] Additional study items relating to errors while reversing
[2] Additional study items relating to pre-trip vehicle maintenance behaviors
[3] Additional study items relating to distraction

Table 2
Correlations among main variables

	Driver behavior (combined)	Driver distraction	Traffic violations	Driver error	Pre-trip maintenance	1.	2.	3.	4.	5.	6.	7.	8.	9.
1.Age	.17*	.18*	.23**	-.05	.13*	-	-.22**	.08	-.01	.02	-.07	-.09	.02	.02
2.Sex [1]	-.12*	-.12*	-.09	-.04	-.12*		-	-.02	-.08	-.10	-.09	.04	-.08	-.01
3.Hours driven per week	.15*	-.03	.15*	.06	.29**			-	.06	-.18*	-.04	.18*	-.02	.03
4.Communication & procedures	.35**	.26**	.29**	.20**	.25**				-	.60**	.61**	.42**	.70**	.57**
5.Work pressures	.32**	.41**	.23**	.19**	.09*					-	.55**	.19**	.49**	.53**
6.Relationships	.28**	.27**	.23**	.19**	.11*						-	.38**	.49**	.42**
7.Driver training	.21**	.15*	.16*	.17*	.11*							-	.39**	.21**
8.Management commitment	.35**	.30**	.25**	.28**	.15*								-	.48**
9.Safety rules	.39**	.33**	.34**	.25**	.16*									-

*$p < .05$ **$p < .001$
[1] 1 = Male, 2 = Female

Table 3
Hierarchical regression analysis for overall work-related driver behavior (combined)

Variable	*B*	Std. error	β	sr^2 (unique)	R^2	*Adj* R^2	ΔR^2
Step 1							
Age	.06*	.02	.15	.03			
Sex	-.10	.09	-.06				
Average hours driven (per week)	.04*	.01	.15	.03			
					.06	.05	
Step 2							
Communication	-.01	.05	-.02				
Work pressures	.07	.04	.12				
Relationships	.03	.03	.06				
Driver training	.02	.02	.06				
Management commitment	.07	.04	.14				
Safety rules	.15**	.04	.22	.04			
					.25	.23	.19

*$p < .05$ **$p < .01$

Table 4
Hierarchical regression analysis for driver distraction

Variable	*B*	Std. error	β	sr^2 (unique)	R^2	*Adj* R^2	ΔR^2
Step 1							
Age	.12	.04	.17				
Sex	-.16	.15	-.06				
Average hours driven (per week)	.00	.02	.01				
					.04	.03	
Step 2							
Communication	-.20	.09	-.18				
Work pressures	.30**	.07	.32	.06			
Relationships	.05	.06	.06				
Driver training	.04	.03	.08				
Management commitment	.11*	.06	.13	.01			
Safety rules	.19*	.07	.16	.02			
					.24	.22	.20

*$p < .05$ **$p < .001$

Table 5
Hierarchical regression analysis for traffic violations

Variable	*B*	Std. error	β	sr^2 (unique)	R^2	*Adj* R^2	ΔR^2
Step 1							
Age	.11**	.03	.21	.05			
Sex	-.05	.12	-.02				
Average hours driven (per week)	.04	.02	.13				
					.07	.06	
Step 2							
Communication	.03	.07	.03				
Work pressures	.03	.05	.04				
Relationships	.05	.05	.07				
Driver training	.02	.03	.04				
Management commitment	.03	.05	.05				
Safety rules	.20*	.06	.23	.04			
					.20	.17	.13

*p < .05 **p < .001

Table 6
Hierarchical regression analysis for driver error

Variable	*B*	Std. error	β	sr^2 (unique)	R^2	*Adj* R^2	ΔR^2
Step 1							
Age	-.02	.02	-.06				
Sex	-.05	.09	-.03				
Average hours driven (per week)	.02	.01	.07				
					.01	-.00	
Step 2							
Communication	-.08	.06	-.14				
Work pressures	.02	.04	.05				
Relationships	.02	.04	.04				
Driver training	.02	.02	.06				
Management commitment	.11*	.04	.23	.03			
Safety rules	.10*	.05	.16	.02			
					.11	.09	.10

*$p < .05$

Table 7
Hierarchical regression analysis for pre-trip vehicle maintenance

Variable	*B*	Std. error	β	sr^2 (unique)	R^2	*Adj* R^2	ΔR^2
Step 1							
Age	.12	.17	.09				
Sex	-.40	.30	-.07				
Average hours driven (per week)	.21**	.05	.26	.07			
					.10	.09	
Step 2							
Communication	.51*	.18	.26	.03			
Work pressures	-.03	.13	-.02				
Relationships	-.04	.12	-.03				
Driver training	-.02	.06	-.02				
Management commitment	-.04	.12	-.02				
Safety rules	.08	.14	.04				
					.16	.13	.06

*$p < .05$ **$p < .001$

Table 8
Summary of significant safety climate factor predictors

SC Factor	Overall driver behavior (combined)	Driver distraction	Traffic violations	Driver error	Pre-trip maintenance
Communication		x		x	**X**
Work pressures		**X**			
Relationships					
Driver training		x			
Management commitment		x		**X**	
Safety rules	**X**	x	**X**	x	

Note. The strongest individual predictors are shown in bold uppercase.