

# The influence of safety ownership on occupational road safety outcomes

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## Abstract

Questionnaires and interviews were conducted with employees and senior managers from three Australian organisations to explore the relationship between perceived managerial ownership of safety responsibilities and occupational road safety. It was found that the perceived authority of the person primarily responsible for managing road risks and perceived shared ownership of safety tasks were both significant independent predictors of safer driving behaviours. It was identified that the position of the person accepting primary risk management responsibilities was typically a member of the occupational health and safety (OHS) team and typically in a management position. The extent that ownership was shared across members within the researched organisations varied, with personnel from OHS and fleet management typically accepting partial ownership of managing occupational road risks. Based on the findings, several recommendations are made to assist practitioners in managing occupational road risks.

## Keywords

Occupational road safety, Work-related road safety, Safety ownership, Driver behaviour questionnaire

## Introduction

The success of organisational change initiatives appears to be influenced by the owners of the change initiative. Workplace Health and Safety Acts generally advocate a duty of care to all parties. For example, in accordance with the Queensland Workplace Health and Safety Act 1995, duties of care to workers and third parties are shared by everyone [1]. Therefore ownership of occupational road safety must be embraced by all members of an organisation.

Whilst general safety responsibilities are often readily adopted by industry, it currently appears that ownership of occupational road safety is often only adopted by employees operating in specific positions such as Workplace Health and Safety Manager or Fleet Manager. This paper explores safety ownership with respect to the position of the primary change owner and the extent to which ownership is shared across members of an organisation.

In relation to primary ownership of managing occupational road risks, it is suggested that the organisational position of the employee may be related to the effectiveness of the safety

initiative. A recent case study revealed that changes in management level and the department of the person primarily in charge of safety were associated with changes in the safety behaviours of employees [2]. Barrett et al. noted that employees initially reported only minimal adherence to safe working practices as they believed that the Health and Safety Manager did not carry the necessary authority or respect to achieve compliance with safety procedures and rules. Upon the Health and Safety Manager's resignation, the Production Director assumed primary ownership of safety. With his authority to fire employees immediately for non-compliance to rules or procedures, health and safety compliance increased within the organisation.

The importance of position authority has also been recognised in earlier research. For example, De Michiei et al. [3] observed that responsibility for safety procedures in high incident-rate mines was often delegated to safety personnel who lacked the authority to enforce safe work procedures. Findings from these studies suggest that management department and level of authority may be related to achieving effective implementation of safety initiatives.

More specifically, the job description and authority of the primary change owner may restrict their ability to execute or influence others to execute key safety management practices. For example, it is suggested that within an organisation, the position of Fleet Asset Manager may require different priorities, competencies, authority levels and circles of influence to the position of Occupational Health and Safety (OHS) Manager. The appropriateness of a safety owner's position may also vary in relation to the safety initiative. For example a risk management strategy comprising the selection of safe vehicles may be better suited to leadership from within a fleet department rather than a health and safety department.

Currently the influences of safety ownership have not been researched with respect to occupational road safety. To address this gap, this paper explores whether the position of the person primarily responsible for managing road safety is related to road safety outcomes.

In addition to the position of the primary owner of managing occupational road risks, it is suggested that the extent to which ownership is shared across members of an organisation may also be related to the success of a safety initiative. It has long been recognised in the safety literature that managers at different hierarchical levels within an organisation have different roles in the overall management of OHS [4]. Senior managers

are typically responsible for organisational strategies such as managing organisational structure and developing policy. Middle-level managers are typically responsible for interpreting and implementing policies and programs. Lower-level managers, including supervisors and team leaders, are typically responsible for operational matters such as coordinating and facilitating work tasks [5].

As managers operating within different positions and levels within an organisation typically have different responsibilities, each manager may be able to provide a unique and valuable role in managing safety. Furthermore, research conducted across a range of Westernised countries, including New Zealand, Canada and America, supports the utility of a decentralised risk management approach to enhance occupational safety [6-8]. For example, research has found that the reorganisation of a coal mine work section into an autonomous work group resulted in increased employee knowledge of safe practices and procedures, beneficial communication and increased employee responsibility for safety [8].

To manage OHS performance effectively, it is suggested that ownership of safety management tasks should be shared by employees in all safety-critical positions. Safety-critical positions may vary between organisations but will typically include Managing Director/Chief Executive Officer, Senior Manager, Operations Manager, Project Manager, Site Manager, National OHS Manager, State OHS Manager, Regional OHS Manager, Site OHS Advisor and employees [9]. The sharing of safety responsibilities may allow an organisation to draw upon the expertise of employees whose competencies and position responsibilities are best aligned with each safety management task.

Recent research findings pertaining to manufacturing companies support the formalisation of safety management responsibilities. More specifically, research investigating the characteristics of over 400 manufacturing companies found that organisations with low rates of lost time injuries typically defined health and safety responsibilities in all managers' job descriptions and included health and safety topics in performance appraisals [10].

As previously noted, the influences of safety ownership have not been researched with respect to occupational road safety. To further address this gap, the current research explores whether the level of shared ownership of safety management tasks by employees in safety-critical positions is related to road safety outcomes.

## Method

To comprehensively explore the relationships between safety ownership and occupational road safety outcomes, a combination of qualitative and quantitative techniques was used. Firstly, a brief questionnaire was utilised to gain exploratory data from a large sample of employees. Interviews were then conducted with a smaller sample of employees and

managers to gain more in-depth data. This provided a robust methodology that allowed the researchers to clarify and validate the data obtained through questionnaires with the data obtained through interviews.

## Questionnaire

An online questionnaire was administered to 444 employees sourced from three Australian organisations. These organisations included a cross-section of private and public organisations, profit and not-for-profit organisations, and medium and large vehicle fleet organisations. More specifically, these organisations were responsible for a combined workforce of approximately 42,000 and a combined fleet of approximately 19,000.

Participating organisations operated fleets that comprised a mixture of vehicle models and required their employees to operate vehicles in both rural and urban environments.

Given the real-world context of this study, the selection of participants was a convenience sample with a minimum of 100 participants being sampled from each of the organisations. All employees with access to the internet within the participating organisations were sent an email invitation to participate in the questionnaire. As participation was voluntary, a self-selection bias may be present in this sample. A majority of the participants were male (69 per cent). Participants ranged in age from 20 to 65 years ( $M = 44$ ,  $SD = 10$ ). All participants reported regularly driving a vehicle for occupational purposes.

The questionnaire collected demographic, safety ownership and safety outcome data. Time restrictions were imposed by the participating organisations for their employees to complete the questionnaire. Therefore, to achieve a brief questionnaire, two items were utilised to explore differences in safety ownership. These items were developed to further investigate previous research findings that suggest that the department and level of authority of the person taking primary ownership of safety tasks [2, 11] and the extent to which ownership of safety tasks is shared [9, 12] may be related to organisational safety outcomes.

Participants were asked to indicate their level of agreement with the following two statements. The first statement, 'The people predominantly responsible for road safety in my organisation carry the necessary authority and respect to achieve compliance', was developed to assess employees' perceptions in regard to the person primarily responsible for managing road risks in their organisation. The second statement, 'Responsibility for achieving work-related road safety is shared across members in my organisation, was developed to assess employees' perceptions of the extent to which safety was shared across members of the organisation. Items were measured using a five-point Likert scale, ranging from 1 representing 'strongly disagree' to 5 representing 'strongly agree'.

Consistent with previous occupational road safety research, the modified Manchester Driver Behaviour Questionnaire (DBQ) [13] and self-reported involvement in driving incidents [13-14] were collected for use in the current study as safety outcome

## Special Feature

variables. Participants were presented with a list of 34 items and were required to indicate how often they had committed each of the driving behaviours over the past six months on a seven-point Likert scale. Response options ranged from 1 representing 'never' to 7 representing 'always'. Incident involvement was measured via the frequency of crash involvement (any incident involving a motor vehicle that resulted in damage to a vehicle or other property, or injury regardless of who was considered to be 'at fault') experienced during the past 12 months while driving for work.

To ensure participant anonymity, all completed questionnaires were sent directly to the researcher. Questionnaire data was analysed using the Statistical Package for the Social Sciences version 15. Before commencing analyses, the data was screened for accuracy. An examination of histograms confirmed the absence of outliers and an examination of residuals scatterplots confirmed that the assumptions of normality, linearity and homoscedasticity were not violated.

The sample size was considered sufficient as the cases-to-IV ratio exceed the level of 40 to 1 as recommended by Tabachnick and Fidell [15] for conducting statistical regression analyses. When conducting post hoc comparisons, a Bonferroni adjustment was applied to the significance level. As only a small number of planned comparisons were being made, an alpha value of .025 was selected to reduce the probability of making a type I error. In applying this more stringent level of significance, the authors recognise that the associated loss of power may result in true differences in the treatment population not being identified.

### Interview

Interviews were conducted with 18 participants sourced from the same three organisations that participated in the questionnaire. Participants from within each organisation comprised four front-line employees and two senior managers. The selection of participants was a convenience sample with care taken to ensure that the participants selected were representative of each organisation's driving workforce and that they had not previously participated in the questionnaire. Participants ranged in age from 24 to 58 years. As the majority of the drivers within the researched organisations were male, 83 per cent of the employees selected for interviewing were male. All participants reported regularly driving a vehicle for occupational purposes.

Several structured questions were asked to all participants to explore employees' perceptions in relation to safety ownership. Participants were asked to identify the position of the person primarily responsible for managing occupational road safety in their organisation. To identify the extent to which safety was shared across members within an organisation, participants were presented with a list of seven task categories and asked to indicate the positions of anyone in their organisation who were accepting responsibility for actioning the safety tasks with respect to each category. The task categories were selected based on previous

research findings in the construction industry that identified links between the categories and workplace safety [12].

The task categories enquired about in the interviews comprised proactively identifying, assessing and determining appropriate controls for OHS hazards and risks; communicating and consulting with stakeholders regarding OHS risks; monitoring, reporting and evaluating safety program effectiveness; engaging with subcontractors in OHS performance management; identifying and implementing relevant components of the OHS and workers compensation management systems; understanding and applying workers compensation and case management principles; and providing leadership and management to staff and subcontractors in OHS performance.

After piloting the interview with two managers and two employees from another organisation to ensure the content was understood and interpretation of the categories was consistent, face-to-face interviews were conducted in private offices on the premises of each organisation. Participation was voluntary and written consent was obtained from all participants. Participants were interviewed individually to minimise any contamination of data arising from potential group bias. Upon completion of the interviews, a thematic analysis was conducted. A coding manual was developed and key points and significant statements were identified through reviewing the notes taken by the researcher in combination with the verbatim transcripts. Finally, conclusions were drawn after interpretations of the data were verified against the questionnaire results and the existing literature.

### Results

This section presents the findings from the questionnaire data followed by the interview data. Mean and standard deviation scores are presented for each of the safety ownership items. Bivariate correlation scores between each of the safety ownership items and the road safety outcome measures are then presented. To examine the utility of the safety ownership items for predicting road safety outcomes, regression analyses were conducted in relation to driver behaviours and crash involvement.

Driver behaviours were measured using the 34-item modified driver behaviour questionnaire. A factor analysis of this scale extracted the following four factors: errors, fatigue and distractions, violations and unsafe driving preparations. Factor four failed to achieve an acceptable reliability coefficient cut-off level of .70 [16] and was therefore excluded from further analyses. Crash involvement was a dichotomous variable with employees grouped according to whether they reported being involved in no vehicle incidents, or being involved in one or more vehicle incidents, while driving for work during the past 12 months.

#### Mean and standard deviation scores

Mean and standard deviation scores were calculated for both safety ownership items. Potential responses ranged from 1 to 5,

with higher scores indicating safer perceptions. Participants indicated moderate agreement with the first item, 'The people predominantly responsible for road safety in my organisation carry the necessary authority and respect to achieve compliance' ( $M = 3.18$ ,  $SD = .98$ ). Participants indicated slightly higher agreement with the second item, 'Responsibility for achieving work-related road safety is shared across members in my organisation' ( $M = 3.38$ ,  $SD = .99$ ). Before examining safety ownership perceptions in regard to safety outcomes, analyses of variances were conducted to determine if perceptions varied between the three organisations. It was identified that the mean scores did not differ significantly among the organisations in regard to perceived authority ( $p = .07$ ) or perceived shared ownership ( $p = .85$ ).

### Correlations and regressions

Bivariate correlation scores were calculated for the two ownership variables and the road safety outcome variables. It was found that the two safety ownership variables were significantly correlated ( $r = .54$ ,  $p < .01$ ). Table 1 presents the correlation statistics between the ownership variables and the road safety outcome variables.

**Table 1. Bivariate correlations between safety ownership variables and road safety outcome variables**

	Overall driver behaviour	Errors	Fatigue and distractions	Violations	Vehicle crashes <sup>a</sup>
Authority	-.13 <sup>b</sup>	-.07	-.19 <sup>b</sup>	-.03	.04
Shared	-.09	-.05	-.11 <sup>c</sup>	-.04	.02

<sup>a</sup>1 = No crashes, 2 = One or more crashes; ; <sup>b</sup> $p < .001$ ; <sup>c</sup> $p < .05$

As can be seen in Table 1, it was found that individuals' perceptions of authority were negatively associated with both overall driver behaviours and the second driver behaviour factor (fatigue and distractions). Furthermore, individuals' perceptions of shared ownership were negatively associated with fatigue and distractions. While these correlations are significant, it is important to note that they are relatively weak. Details pertaining to these correlation analyses and the follow-up regression analyses are provided below. No significant relationships were observed among employees' safety ownership perceptions and self-reported driving errors, driving violations or vehicle crashes.

#### Authority

Correlation results reveal that perceived authority was negatively related to overall driver behaviours ( $r = -.13$ ,  $p < .001$ ). This finding indicates that participants who perceived that road risks were managed by personnel with authority and respect reported engaging in overall safer driving behaviours. A hierarchical regression was conducted to investigate the capacity of perceived authority to predict overall driving behaviours.

In predicting overall driving behaviours, age, gender and average hours driven each week for work were entered into the

equation as control variables at step 1. To examine the influence of perceived authority on driving behaviours beyond these variables, this variable was entered separately at step 2. The overall model (including all predictors) was significant ( $F(4, 459) = 14.42$ ,  $p < .001$ ). The first step accounted for 6% of the variance in overall driving behaviours ( $F(3, 460) = 18.24$ ,  $p < .001$ ). Inspection of the Beta ( $\beta$ ) coefficients revealed that age ( $p < .001$ ) and hours per week ( $p < .001$ ) made a significant contribution to the overall regression model. Older participants and participants that reported lower volumes of driving for work reported engaging in overall safer driving behaviours. Perceived authority did not predict overall driving behaviours, over and above the control factors ( $R^2_{Cha} = .01$ ,  $F(1, 459) = 2.72$ ,  $p = .10$ ).

Correlation results reveal that perceived authority was negatively related to driving behaviours pertaining to fatigue and distractions ( $r = -.19$ ,  $p < .001$ ). This finding indicates that employees who perceived that road risks were managed by personnel with authority reported lower tendencies to engage in driving while fatigued and lower multitasking while driving. A hierarchical regression was conducted to investigate the capacity of perceived authority to predict driving behaviours pertaining to fatigue and distraction.

In predicting driving behaviours pertaining to fatigue and distraction, the control variables were entered into the equation at step 1. To examine the influence of perceived authority on driving behaviours pertaining to fatigue and distraction beyond these variables, this variable was entered separately at step 2. The overall model (including all predictors) was significant ( $F(4, 473) = 17.23$ ,  $p < .001$ ). The first step accounted for 19% of the variance in driving behaviours pertaining to fatigue and distraction ( $F(3, 474) = 18.99$ ,  $p < .001$ ). The second step accounted for a significant additional amount of variance in driving behaviours pertaining to fatigue and distraction ( $R^2_{Cha} = .02$ ,  $F(1, 473) = 10.76$ ,  $p < .01$ ).

Inspection of the Beta ( $\beta$ ) coefficients revealed that age ( $p < .001$ ) and hours driven per week ( $p < .001$ ) made a unique significant contribution to the overall regression model. Older participants and participants that reported lower volumes of driving for work reported lower tendencies to engage in driving while fatigued and lower multitasking while driving. Perceived authority also emerged as a significant independent predictor of driving behaviours pertaining to fatigue and distractions ( $r = .36$ ,  $p < .01$ ). Although significant, perceived authority only explained an additional 2 per cent of the variance. Table 2 provides a summary of this analysis.

**Table 2. Summary table of hierarchical regressions for perceived authority as a predictor of driving behaviours pertaining to fatigue and distractions**

	$R^2$	Adj $R^2$	$\Delta R^2$
Block 1 - Control variables	.11 <sup>a</sup>	.10	
Block 2 - Perceived authority	.13 <sup>a</sup>	.12	.02 <sup>a</sup>

<sup>a</sup> $p < .01$

### Shared ownership

Secondly, in regards to shared ownership, correlation results reveal that perceived shared ownership was negatively related to driving behaviours pertaining to fatigue and distractions ( $r = -.11, p < .05$ ). This finding indicates that participants who perceived that responsibility for managing road risks was shared across several organisational personnel reported lower tendencies to engage in driving while fatigued and lower multitasking while driving. A hierarchical regression was conducted to investigate the capacity of perceived shared ownership to predict driving behaviours pertaining to fatigue and distraction.

In predicting driving behaviours pertaining to fatigue and distraction, the control variables were entered into the equation at step 1. To examine the influence of perceived shared ownership on driving behaviours pertaining to fatigue and distraction beyond these variables, this variable was entered separately at step 2. The overall model (including all predictors) was significant ( $F(4, 474) = 15.70, p < .001$ ). The first step accounted for 19% of the variance in driving behaviours pertaining to fatigue and distraction ( $F(3, 475) = 18.92, p < .001$ ). The second step accounted for a significant additional amount of variance in driving behaviours pertaining to fatigue and distraction ( $R^2_{\text{Cha}} = .01, F(1, 474) = 5.48, p < .05$ ).

Inspection of the Beta ( $\beta$ ) coefficients revealed that age ( $p < .001$ ) and hours driven per week ( $p < .001$ ) made a unique significant contribution to the overall regression model. Older participants and participants that reported lower volumes of driving for work reported lower tendencies to engage in driving while fatigued and lower multitasking while driving. Perceived shared ownership also emerged as a significant independent predictor of driving behaviours pertaining to fatigue and distractions ( $r = .34, p < .01$ ). Although significant, perceived shared ownership only explained an additional 1 per cent of the variance. Table 3 provides a summary of this analysis.

**Table 3. Summary table of hierarchical regressions for perceived shared ownership as a predictor of driving behaviours pertaining to fatigue and distractions**

	$R^2$	$Adj R^2$	$\Delta R^2$
<b>Block 1 - Control variables</b>	.11 <sup>a</sup>	.10	
<b>Block 2 - Perceived shared ownership</b>	.12 <sup>b</sup>	.11	.01 <sup>b</sup>

Notes: <sup>a</sup> $p < .01$ , <sup>b</sup> $p < .05$

### Perceived influence of safety ownership

To further explore the influence of safety ownership on road safety outcomes, interviews were conducted. The purpose of the interviews was to: identify which organisational positions were primarily responsible for managing occupational road safety and to explore the extent to which safety responsibilities were shared across members within organisations.

### Position accepting primary ownership of managing occupational road risks

Road safety responsibilities were not formally stated in job descriptions in any of the researched organisations. An analysis of the interview transcripts revealed that the position of the person accepting primary ownership of managing occupational road risks varied among organisations. In two of the organisations (organisation A and organisation B), a member of the OHS team was identified as the person primarily responsible for managing occupational road safety. More specifically, in organisation A the person primarily responsible was a manager. In comparison, in organisation B the person was a senior employee who did not have as much authority within the organisation as a manager. In the third organisation (organisation C), the person primarily responsible for managing road safety was the Strategic Procurement Manager.

The authors, when reviewing the interview transcripts in relation to primary ownership, made two interesting observations. Firstly, it was observed that some employees preferred primary ownership of occupational road risks to come from within the OHS department. These employees believed that management of road risks was more of an OHS issue than a fleet issue. For example, one employee from organisation A commented that management from within the fleet team could 'be seen as too far removed'.

Secondly, it was observed that organisational practices and processes varied with regard to the position of the person primarily responsible for managing occupational road safety. For example, in organisation C, where the Strategic Procurement Manager was the primary safety owner, the organisation's road safety practices and processes were most developed in the areas of vehicle selection and monitoring vehicle incident data. This finding makes sense, as these types of safety tasks align with the competencies and responsibilities required for a procurement manager. In comparison, in organisation A, road safety practices and processes were most developed in the area of safety policy. Again, this makes sense as the competencies and responsibilities required for OHS managers are well suited to tasks including the development of safety policies.

### Shared ownership of managing occupational road risks

Across the organisations, employees from a range of positions were accepting partial ownership of managing occupational road risks. These positions included General Manager, OHS Manager, OHS Senior Advisor, OHS Coordinator, Insurance Compensation Manager, Business Unit Manager, Strategic Procurement Manager, Risk Management Officer, Fleet Manager, Fleet Technical Officer, Supervisor and Driver.

The extent that ownership was shared across members within an organisation varied. For example, participants from organisation B reported cooperative sharing of safety responsibilities among several positions within the organisation.

Employees in the positions of General Manager, OHS Manager, OHS Coordinator, Business Unit Manager, Fleet Technical Officer, Supervisor and Driver accepted partial ownership of safety management tasks. In comparison, participants from organisation C reported limited sharing of safety responsibilities. Employees in the positions of Fleet Manager, Risk Management Officer, Supervisor and Driver accepted partial ownership of safety management tasks.

The authors made two interesting observations when reviewing the interview transcripts in relation to shared ownership. Firstly, it was observed that the sharing of ownership for managing occupational road risks may cause some role ambiguity within the workforce in regard to who is responsible for specific aspects of risk management. For example, one employee from organisation B commented, 'It's all pass the buck. When they say something's wrong with the vehicle, oh, go and talk to so and so.' The authors also identified that in some organisations, this ambiguity appeared to be used strategically by some personnel to defer responsibility to other departments.

Secondly, it was observed that a shared approach was perceived as necessary to comprehensively manage occupational road risks. For example, one manager from organisation C commented that although the manager currently accepting primary risk management responsibility was 'passionate about improving work-related road safety, the amount of work needing to be done in this area would be too large for him to manage and more support would be needed from other members of the organisation.'

## Discussion

This study pioneered research into a new area of occupational road safety by exploring whether differences in safety ownership related to self-reported occupational road safety outcomes. Participants who perceived that road risks were managed by personnel with authority reported engaging in overall safer driving behaviours and less driving while fatigued or multitasking. Similarly, participants who perceived that responsibility for managing road risks was shared across several organisational personnel reported engaging in overall safer driving behaviours and less driving while fatigued or multitasking.

Although only accounting for a small amount of unique variance, perceived authority and perceived shared ownership were both significant independent predictors of safer driving behaviours in regard to fatigue and distractions. The finding that perceived safety ownership is associated with self-reported road safety outcomes is consistent with previous research that has linked safety ownership to safety outcomes [2].

Examination of the interview results provides insights into how occupational road risks are being managed in Australian organisations. It was observed that the position of the person accepting primary risk management responsibilities was typically a member of the OHS team and typically in a

management position. The extent that ownership was shared across members within an organisation varied.

In the researched organisations, managers and/or employees from OHS and fleet management were accepting partial ownership of managing occupational road risks. The authors suggest that the potential integration of safety knowledge, skills and abilities from a range of employees gained through shared ownership of safety responsibilities may facilitate the development of superior safety practices and procedures.

In conclusion, the findings from the current study suggest that organisations may have more influence over employees' driving behaviours pertaining to fatigue and distractions, rather than driving behaviours pertaining to errors and violations. This is an important finding, as it indicates that organisations can have a real protective influence. In the work setting, employees may be exposed to occupational pressures that encourage drivers to engage in unsafe behaviours such as driving while tired or multitasking to complete work in a productive timeframe. Organisations have the ability to manage work demands to ensure that employees can safely drive without being exposed to fatigue or occupational distractions. Furthermore, the current study found that organisations may be able to reduce the likelihood of employees engaging in unsafe driving as a result of fatigue or distractions through increasing ownership of safety management tasks.

Based on these findings, the authors propose that organisations should aim to foster cooperative sharing of occupational road risk management tasks among organisational personnel. To formally facilitate shared ownership, the authors recommend that employees and managers should be educated about their OHS responsibilities. To minimise potential role ambiguity associated with shared ownership, the authors recommend that responsibility for occupational road safety management tasks should be explicitly stated in job descriptions across all safety critical positions.

Given that the findings from this research have important applications for enhancing road safety outcomes, it is recommended that future studies expand upon this exploratory research in three key ways. Firstly, investigating what characteristics of shared ownership facilitate safer driving behaviours pertaining to fatigue and distractions could, for example, lead to better management of work demands or more comprehensive safety policies and procedures. Secondly, future research may expand upon this study through the development of a scale to more comprehensively measure perceived authority and perceived shared ownership. Finally, by applying the same methodology with a more diverse sample, future researchers should explore other possible variables that could be accounting for additional variance in traffic-related outcome measures.

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# Forecasting negative effects of monotony and sensation seeking on performance during a vigilance task

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## Abstract

The driving task requires sustained attention during prolonged periods and can be performed in highly predictable or repetitive environments. Such conditions could create hypovigilance and impair performance towards critical events. Identifying such impairment in monotonous conditions has been a major subject of research, but no research to date has attempted to predict it in real-time. This pilot study aims to show that performance decrements due to monotonous tasks can be predicted through mathematical modelling, taking into account sensation-seeking levels.

A short vigilance task sensitive to short periods of lapses of vigilance, called Sustained Attention to Response Task, is used to assess participants' performance. The framework for prediction developed on this task could be extended to a monotonous driving task. A Hidden Markov Model (HMM) is proposed to predict participants' lapses in alertness. A driver's vigilance evolution is modelled as a hidden state and is correlated to a surrogate measure: the participant's reaction time.

This experiment shows that the monotony of the task can lead to an important decline in performance in less than five

minutes. This impairment can be predicted four minutes in advance with an 86% accuracy using HMMs. This experiment showed that mathematical models such as HMM can efficiently predict hypovigilance through surrogate measures. The presented model could result in the development of an in-vehicle device that detects driver hypovigilance in advance and warns the driver accordingly, thus offering the potential to enhance road safety and prevent road crashes.

## Keywords

Monotony, Fatigue, Vigilance, Hidden Markov Models, Sensation seeking

## Introduction

Drowsiness at the wheel has been identified globally as a major cause of road crashes. Inattention and fatigue are reported as contributing factors in 6% and 5% of fatal crashes, respectively, in Australia between 1992 and 2006 [1]. It is difficult to reliably measure the influence of such contributing factors so that such estimates are likely to be underestimated. This is