

Managing driver fatigue: education or motivation?

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Abstract

Fatigue has been recognised as the primary contributing factor in approximately 15% of all fatal road crashes in Australia. To develop effective countermeasures for managing fatigue, this study investigates why drivers continue to drive when sleepy, and driver perceptions and behaviours in regards to countermeasures. Based on responses from 305 Australian drivers, it was identified that the major reasons why these participants continued to drive when sleepy were: wanting to get to their destination; being close to home; and time factors. Participants' perceptions and use of 18 fatigue countermeasures were investigated. It was found that participants perceived the safest strategies, including stopping and sleeping, swapping drivers and stopping for a quick nap, to be the most effective countermeasures. However, it appeared that their knowledge of safe countermeasures did not translate into their use of these strategies. For example, although the drivers perceived stopping for a quick nap to be an effective countermeasure, they reported more frequent use of less safe methods such as stopping to eat or drink and winding down the window. This finding suggests that, while practitioners should continue educating drivers, they may need a greater focus on motivating drivers to implement safe fatigue countermeasures.

Refereed Paper

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INTRODUCTION

Previous research has identified that most incidents of falling asleep while driving are preceded by subjective symptoms of sleepiness (Reyner and Horne 1998a). Although many Australian drivers appear to be aware of strategies for managing fatigue (Pennay 2006), fatigue continues to present a substantial risk and has been recognised as the primary contributing factor in approximately 15% of all fatal road crashes in Australia (Parliamentary Travelsafe Committee 2005). To develop effective countermeasures for managing fatigue in Australia, an understanding is needed of the reasons drivers continue to drive when sleepy and their perceptions of a range of available countermeasures.

Why drivers operate vehicles when feeling sleepy

Fletcher et al. (2005) proposed several potential explanations as to why drivers may choose to continue operating a vehicle when they are feeling sleepy. They suggested that drivers may have:

- a poor understanding of either fatigue-related crash risk or the transition between sleepiness and sleep;
- no experience of fatigue-related incidents;
- an acceptance of risk in choosing to ignore symptoms of sleepiness;
- pressure to arrive at their destination; or
- no perceived risk of penalty.

Although a majority of drivers do acknowledge fatigue as a source of crash risk (Obst et al. 2009), questions have been raised regarding the abilities of drivers to monitor and estimate their level of impairment during the transition between sleepiness and sleep (Powell et al. 2001; Reyner and Horne 1998a). It appears that drivers are choosing to ignore symptoms of sleepiness, as studies conducted in America, Norway and Australia have found that many drivers have operated vehicles when feeling sleepy (National Sleep Foundation 2008; Nordbakke and Sagberg 2007; Smith, Carrington and Trinder 2005). When asked why they continue to drive when sleepy, a Norwegian sample of drivers most frequently reported their reasons as being on a short trip, going to an appointment, and a desire to arrive at a reasonable time (Nordbakke and Sagberg 2007). The current study will investigate whether the reasons cited by the Norwegian sample of drivers apply internationally or whether Australian drivers have different motivations for continuing to drive when sleepy.

Perceived effectiveness and use of countermeasures

The only guaranteed methods of reducing fatigue-related incidents are to avoid driving when one has not had ample restorative sleep and to avoid driving during periods of prolonged wakefulness (Fletcher et al. 2005). Research has also identified several other countermeasures that have demonstrated some effectiveness in temporarily suppressing sleepiness. For example, a short nap of less than 30 minutes has been linked to reduced subjective sleepiness, improved task performance and suppressed slow eye movements (Phillip et al. 2006; Hayashi and Abe 2008; Horne and Reyner 1996). Caffeine has also been linked to reduced subjective sleepiness and reduced lane drift (Biggs et al. 2007; Phillip et al. 2006; Horne and Reyner 1996). Other countermeasures that have been researched but have only demonstrated non-significant and transient effects in reducing subjective sleepiness and lane drift include cold air to the face from the vehicle air conditioning vents and listening to the radio while operating the vehicle (Reyner and Horne 1998b). To develop appropriate countermeasures, it is important to understand whether drivers' perceptions of the effectiveness of these countermeasures match the above empirical findings.

Two recent studies have explored drivers' perceptions of the effectiveness of countermeasures. When asked what drivers should do if they experience fatigue when driving, 97% of respondents in an Australia study mentioned pulling over or stopping driving. Other strategies cited by the respondents included winding down the window, eating or drinking, turning on the radio, conversing with others and splashing cold water on their face (Pennay 2006). These perceptions are similar to those expressed by a Norwegian sample of drivers. When asked to rate the effectiveness of a range of fatigue countermeasures, more than 90% of respondents in the Norwegian sample believed that swapping drivers would be very effective. Other strategies that were believed to be very effective by more than 30% of the respondents comprised stopping and getting out of the car, stopping to take a nap, stopping to eat, opening the window and conversing with a passenger (Nordbakke and Sagberg 2007).

It is encouraging to note that the majority of drivers accurately perceived strategies that involved stopping the car to be more effective than methods that involved continuing to drive, such as listening to music. Interestingly, however, when the same sample of Norwegian drivers were asked to identify the precautions that they had adopted on their last driving occasion when they either fell asleep or feared falling

asleep, only 50% of the drivers reported stopping and getting out of the car. In comparison, 52% of the drivers reported opening the window, even though they perceived this to be a less effective countermeasure. Other countermeasures that were not perceived to be very effective but were still frequently used include listening to music (reported by 36%) and talking to oneself or singing (24%). Only 10% of the respondents reported stopping and taking a nap, even though this was perceived by many respondents to be a very effective countermeasure. Similar findings have been obtained in a study conducted in Sweden. Swedish drivers most frequently reported the use of the following countermeasures: stopping to take a walk (54%), turning on the radio (52%), opening a window (47%), drinking coffee (45%) and conversing with a passenger (35%) (Anund et al. 2008).

The current study will investigate whether the countermeasures adopted by the Norwegian and Swedish samples of drivers apply internationally or whether Australian drivers differ in their perceptions of effectiveness and preferred use of fatigue countermeasures. Furthermore, previous research has identified that the likelihood of a driver stopping the car for a nap increases with age. Similarly, the likelihood of a driver attempting to prevent sleep by engaging in activities in the car, such as putting on loud music, decreases with age (Nordbakke and Sagberg 2007). As it is possible that drivers' employment responsibilities are contributing to the observed patterns of age-related use of countermeasures, the current study will expand on the research of Nordbakke and Sagberg by investigating whether the use of countermeasures differs between employment groups such as shift workers and retirees.

METHOD

To achieve a random sample, 1000 Royal Automobile Club of Queensland (RACQ) members were randomly selected from the Australian RACQ membership database. These members were sent a paper survey from the RACQ accompanied by a letter inviting them to participate in this study, a reply paid envelope to return the survey directly to the researchers, and a complimentary tea bag in appreciation of their research participation. The sample is a self-selected sample with 305 members returning surveys, representing a 31% response rate. There were 191 females (63%) and 114 males (37%). Ages ranged from 17 to 78 years with a mean age of 44.67 years (SD = 17.64). In response to a forced choice response format of yes or no, 77% of participants reported that they had driven while feeling sleepy at some time in the past.

The survey developed by the researchers comprised both a short-response format and a rating-scale format. First, to identify the motivations of Australian drivers for driving while sleepy, participants were asked to describe the major reason why they continued to drive when sleepy. A short-response format was used for this exploratory question, to allow participants maximum response freedom without being influenced by the researchers' hypothesised motivators.

Second, the perceptions and use of fatigue countermeasures by participants were investigated in regards to 18 fatigue risk management strategies that had previously been identified in a pilot study. These strategies ranged from interventions designed to remove the fatigue risk, such as stopping the vehicle and sleeping, to interventions designed to manage the fatigue risk such as taking an alertness medication. Participants were asked to use a Likert scale to rate the perceived effectiveness and actual use of each strategy. More specifically, to rate the effectiveness of each strategy in reducing a driver's risk of falling asleep while driving, participants used a scale ranging from 1, representing not at all effective, to 10, representing extremely effective. To estimate how often they have used each strategy in the past, participants used a scale ranging from 1, representing never, to 10, representing very often. Finally, to identify any additional countermeasures, participants were provided with an opportunity to specify any other fatigue risk management strategies they have used.

RESULTS

When asked to describe the major reason why they continued to drive when sleepy, six reasons were cited by this sample of Australian drivers. Forty per cent of drivers identified the primary reason they engaged in driving when sleepy as 'wanted to get to their destination'; 23% of drivers identified 'being close to home' as their major reason, and 20% of drivers identified 'time factors' as their major reason. Less frequently cited reasons for driving when sleepy comprised 'needing to get home after shift work', 'being the only available driver' and 'being in an emergency situation'.

Of the 18 fatigue risk management strategies investigated, participants believed that stopping and sleeping somewhere and continuing the next day would be the most effective countermeasure. Other strategies that were perceived to be effective included swapping drivers, stopping and having a quick nap, stopping to eat or drink, and stopping to get out of the car to stretch. Overall the reported

use of countermeasures was moderate to low. The most frequently used countermeasures comprised swapping drivers and stopping to eat or drink. When provided with the opportunity to specify any other fatigue risk management strategies they have used, several respondents listed conversing with a passenger. Respondents mean self-reported perceptions and use of fatigue countermeasures are presented in *Table 1*.

The type of countermeasure used by a driver appeared to be related to their employment status. In this sample, 60% of respondents were daytime workers, 18% were shift workers, and 22% were non-workers. A majority of the respondents who were not working classified themselves as retired. Mean use scores for daytime workers, shift workers and non-workers were compared for each of the 18 countermeasures. Analyses of variances (ANOVAs) revealed that use patterns differed significantly between the groups for six of the countermeasures. These comprised taking caffeine pills ($F(2, 225) = 7.04, p < 0.01$); stopping and sleeping somewhere and continuing the next day

($F(2, 241) = 10.30, p < 0.01$); stopping and having a quick nap ($F(2, 238) = 3.88, p < 0.05$); stopping to eat or drink ($F(2, 245) = 7.92, p < 0.01$); stopping to get out of the car ($F(2, 252) = 5.89, p < 0.01$); drinking an energy drink ($F(2, 232) = 3.40, p < 0.05$); and putting on loud music ($F(2, 242) = 12.04, p < 0.01$).

Post hoc tests with a Bonferroni adjustment of 0.025 were conducted to examine the mean differences. Significant differences are presented below in *Table 2*. As can be seen in *Table 2*, shift workers reported a higher use of activities designed to increase alertness including taking caffeine pills, than daytime workers and non-workers. In comparison, non-workers reported a higher use of strategies that involved stopping the car. These included stopping and sleeping somewhere and continuing the next day, stopping and having a quick nap, stopping to eat or drink, and stopping to get out of the car. Similarly, non-workers reported lower use of listening to loud music as a countermeasure than shift workers and daytime workers.

Table 1
Self-reported perceptions and use of fatigue countermeasures

Countermeasure	Mean effectiveness (SD)	Mean use (SD)
Stop and sleep somewhere	9.47 (1.60)	5.78 (3.74)
Swap drivers	9.16 (1.80)	6.82 (3.45)
Stop and have a quick nap	8.18 (2.63)	4.04 (3.58)
Stop to eat and drink	7.84 (2.24)	6.73 (3.00)
Stop and get out of car	7.50 (2.55)	5.30 (3.49)
Have a caffeinated drink	5.74 (4.02)	4.16 (3.19)
Wind down window	5.12 (2.85)	4.68 (3.19)
Turn on fan or AC	4.73 (2.98)	4.53 (3.30)
Splash water on face	4.62 (2.85)	3.32 (2.97)
Drink water	4.56 (2.79)	4.56 (3.17)
Put on loud music	4.30 (2.76)	3.90 (3.23)
Drink an energy drink	3.79 (2.64)	2.53 (2.59)
Eat sweets or mints	3.75 (2.60)	3.28 (2.79)
Drive slower	3.29 (2.81)	2.75 (2.65)
Take a caffeine medication	3.25 (2.79)	1.29 (1.33)
Take an alertness medication	3.09 (2.71)	1.78 (1.03)
Drive faster	1.73 (1.54)	1.57 (1.64)
Increase the heat	1.34 (0.97)	1.20 (0.88)

Table 2
Mean and standard deviation scores for countermeasures where self-reported use differed significantly between the employment groups

Countermeasure	Non-workers	Shift workers	Daytime workers
Stop and sleep somewhere	7.65 (3.38) ^{a**}	4.30 (3.57) ^{a**b**}	5.81 (3.65) ^{b**}
Stop and have a quick nap	5.48 (3.92) ^{a*}	3.84 (3.68)	3.86 (3.44) ^{a*}
Stop to eat and drink	8.17 (2.88) ^{a**}	5.95 (3.01) ^{a**b**}	6.66 (2.85) ^{b**}
Stop and get out of car	6.76 (3.64) ^{a*}	4.46 (3.46) ^{a*}	5.32 (3.38)
Put on loud music	2.08 (1.86) ^{a*}	4.58 (3.12) ^{a**b**}	4.46 (3.40) ^{b**}
Drink an energy drink	2.23 (2.34)	3.55 (3.01)	2.47 (2.58)
Take a caffeine pill	1.19 (0.92) ^{a*}	1.88 (2.43) ^{a* b**}	1.09 (0.51) ^{b**}

^a and ^b indicate relationships, * $p < 0.01$, ** $p < 0.025$

DISCUSSION

Why drivers operate vehicles when feeling sleepy

The primary reasons cited for driving when sleepy were 'wanted to get to their destination' and 'being close to home'. Norwegian drivers reported similar reasons for operating vehicles when sleepy, such as a desire to arrive at a reasonable time and only having a short distance to travel (Nordbakke and Sagberg 2007). These findings are of concern, as fatigue-related crashes commonly occur close to the destination (Armstrong and Haworth 2009). Furthermore, drivers may be less inclined to engage in fatigue countermeasures, such as stopping, if they are focusing on arriving at their destination as soon as possible and if their destination is close.

'Time factors' were also frequently cited in this study as a reason why drivers operate vehicles when sleepy. Again this finding is consistent with previous research which identified that Norwegian drivers operate vehicles when sleepy to arrive in time for appointments. It is understandable that if drivers only have a short distance to travel or if they feel time-related pressure they may be less willing to engage in effective countermeasures such as stopping the car and having a nap. To assist drivers in these circumstances to manage their risk, it may be best to promote the efficacy of countermeasures such as swapping drivers or obtaining sufficient restorative sleep prior to driving, while reinforcing the need to stop driving if experiencing sleepiness.

Perceived effectiveness and use of countermeasures

Consistent with previous research, it was found that a majority of drivers accurately perceived strategies that

involved stopping the car or swapping drivers to be very effective. However, drivers appeared to be less accurate in their perceptions of countermeasures that were moderately effective. More specifically, drivers perceived that consuming a caffeinated drink would be only slightly more effective than winding down a window. Research has linked the use of caffeine to reduced subjective sleepiness and reduced lane drift, but currently there is no empirical support for the use of winding down a window as a fatigue countermeasure. Other countermeasures that were also perceived by drivers to be moderately effective were using the air conditioner and listening to loud music. Contrary to drivers' perceptions, research has found that use of these strategies has only demonstrated non-significant and transient effects in reducing subjective sleepiness and lane drift (Reyner and Horne 1998b).

Similar to the findings obtained for a sample of Norwegian drivers, the current study identified a discrepancy between perceived effectiveness and use of countermeasures. For example, although the Australian drivers believed that stopping and sleeping somewhere and continuing the next day would be the most effective countermeasure, they only reported a moderate use of this strategy. Overall, the reported use of all countermeasures was moderate to low. The most frequently used countermeasures comprised swapping drivers and stopping to eat or drink. It is interesting to note that although drivers accurately perceived stopping and having a nap to be an effective countermeasure their reported use of this strategy was lower than their reported use of strategies that they perceived to be less effective such as using the vehicle's air conditioning.

Finally, the findings from the current study suggest that drivers' employment responsibilities may have

partially contributed to the patterns of age-related use of countermeasure identified by Nordbakke and Sagberg (2007). For example, Nordbakke and Sagberg concluded that the likelihood of a driver stopping the car for a nap increases with age. In the current study it was found that non-workers (a majority of whom were retirees) reported a higher use than workers of strategies that involved stopping the car. It is possible that older drivers who are retired feel less time pressure and may believe that countermeasures that involve stopping driving are appropriate to their lifestyle. In comparison, some shift workers in this study cited 'needing to get home after shift work' as a reason for driving when sleepy. It is possible that these drivers attempted to prevent sleep by engaging in activities in the car, such as putting on loud music, as they did not believe other strategies such as stopping and getting out of the car were appropriate in their circumstances.

In conclusion, this study found that the major reasons why Australian drivers engage in driving when sleepy were wanting to get to their destination, being close to home and time factors. Although these drivers demonstrated an accurate knowledge of countermeasures that are very effective including swapping drivers and stopping and sleeping, they did not appear to be aware of the effectiveness of other valuable strategies such as consuming caffeine. Given the observed discrepancy between perceived effectiveness and use of some countermeasures, further education may be useful to assist road users in managing their fatigue risk. Perhaps more importantly, though, is the need to motivate drivers to use the fatigue countermeasures that they know are effective, such as stopping the car for a quick nap. To encourage drivers to adopt effective countermeasures, it is important to recognise the reasons why they drive when sleepy and attempt to offer suggestions that may be appropriate to their lifestyle. For example shift workers are unlikely to stop the car for a quick nap on their way home; however, they may consider caffeine consumption to be a viable risk management strategy. To assist drivers in selecting effective and viable countermeasures, future research is needed to determine the effectiveness of a range of fatigue countermeasures by examining their efficacy individually.

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