Sleepy driving and drink driving: attitudes, behaviours, and perceived legitimacy of enforcement of younger and older drivers

Christopher N. Watling[ab] and Hanna A. Watling[a]

[a] Centre for Accident Research and Road Safety – Queensland, Institute of Health and Biomedical Innovation, Queensland University of Technology, Australia; [b] Stress Research Institute, Stockholm University, Sweden

Abstract

Sleepy driving and drink driving are two risky driving behaviours that substantially contribute to road crashes. Several studies demonstrate equivalent levels of impairment from both sleepy and drink driving. Yet, drivers perceive sleepy and drink driving distinctly different, with younger and older drivers engaging in these two risky driving behaviours at different rates. The current study sought to examine the sleepy and drink driving behaviours and perceptions in a sample of 114 younger (17-29 years) and 177 older (30+ years) drivers. Compared to older drivers, younger drivers reported more positive attitudes toward sleepy and drink driving behaviours, as well as more negative views regarding perceived legitimacy of sleepy driving enforcement. Younger drivers were also more likely to report performing sleepy driving behaviours than older drivers. Younger drivers reported greater likelihood to drive while sleepy, lower perceptions of legitimacy for sleepy driving, and more positive attitudes towards sleepy driving when compared to drink driving and the same pattern was found for older drivers as well. Subsequently, the self-reported likelihood of driving while sleepy was greater than drink driving in both age groups. Overall, the results suggest that sleepy driving is not viewed as equally dangerous as drink driving with younger drivers' perceptions being more lenient than older drivers' perceptions. It is likely that change is needed regarding the perceptions of dangerousness of sleepy driving with a particular focus on younger drivers seemingly needed.

Introduction

Sleepy driving and drink driving are two risky driving behaviours that contribute substantially to crash incidents. In Queensland, 20% of the state's fatal crashes were attributed to drink driving (Department Transport and Main Roads [DTMR], 2012). The contribution of sleepy driving (also described as fatigued driving) to the state's fatal crash incidents has been estimated to be 15% (DTMR, 2012), although accurate incidence rates for sleep-related crashes are difficult to ascertain. This is in part due to the absence of an objective test for measuring a driver's sleepiness level, either before or after a crash. The current best estimate of the involvement of sleepiness in crashes comes from a stringent population based case-control study performed in New Zealand, where 19% of all fatal and severe crashes were attributed to sleepiness (Connor et al., 2002). In addition, most crashes are multifactorial in nature and sleepiness might have substantially contributed to crashes primarily attributed to other factors such as alcohol or speeding (Watling, Armstrong, & Smith, 2013). Consequently, the true incidence rates of sleep-related crashes are likely higher than any obtained rates (Åkerstedt, 2000; Cercarelli & Haworth, 2002).

The Impact of Alcohol and Sleepiness on Driving Performance

The performance decrements from alcohol intoxication and from sleepiness are substantial. Laboratory based cognitive and psychomotor studies demonstrate alcohol intoxication produces a dose-related impairment on a number of psychological tasks critical to driving including, attention, working memory, psychomotor performance, motor control/coordination, planning, and tracking (Fogarty & Vogel-Sprott, 2002; Hindmarch, Kerr, & Sherwood, 1991; Peterson, Rothfleisch, Zelazo, & Pihl, 1990). These impairments can also persist during the hangover period which can last up to 12 hours after the alcohol has left the body (McKinney & Coyle, 2004; Prat, Adan, Perez-

Pamies, & Sanchez-Turet, 2008). Similarly, sleepiness produces impairments on attention, working memory, psychomotor performance, and tracking (Dawson & Reid, 1997; Van Dongen, Maislin, Mullington, & Dinges, 2003; Williamson & Feyer, 2000). The impairments from sleepiness are dose-related, such that greater impairments are observed with the longer the duration of wakefulness (Williamson & Feyer, 2000) or the greater the number of nights of partial sleep deprivation (Van Dongen et al., 2003). Cognitive recovery from complete sleep deprivation or disturbed circadian rhythmicity can take between two to five days (Åkerstedt, Kecklund, Gillberg, Lowden, & Axelsson, 2000; Ikegami et al., 2009).

The impairments associated with alcohol intoxication as well as sleepiness have also been demonstrated in simulated driving studies. The association between alcohol intoxication and decrements of lane positioning stability, speed control, and braking times, as well as increased collision frequency has been found (Howland et al., 2011; Ramaekers, Robbe, & O'Hanlon, 2000). Similarly, sleepiness is associated with decrements of simulated driving lane positioning, speed control, and near misses (Arnedt, Wilde, Munt, & MacLean, 2001; Gillberg, Kecklund, & Åkerstedt, 1996). Moreover, alcohol intoxication and sleepiness do not only impact on simulated driving performance, but also on risk acceptability and decision making in relation to driving. Studies have demonstrated that decision making is impaired and the acceptability of risk increases with alcohol intoxication (Lane, Cherek, Pietras, & Tcheremissine, 2004) and sleepiness (Rossa, Smith, Allan, & Sullivan, 2014).

On-road impairment to driving ability has been demonstrated through a robust relationship between blood alcohol content (BAC) levels and actual crash likelihood. The seminal Grand Rapids study (Borkenstein, Crowther, Shumate, Zeil, & Zylman, 1964) and a more recent study by Blomberg, Peck, Moskowitz, Burns, and Fiorentino (2009) have demonstrated that driving impairment occurs at a BAC of approximately 0.04%. Thereafter, crash risk continues to increase as BAC levels increase – such that, relative to a BAC of < 0.05%, BACs of 0.05-0.08% and ≥ 0.08% have been associated with a five and 15 times greater crash propensity (Movig et al., 2004). Regarding the crash risk associated with sleepiness, Åkerstedt, Connor, Gray, and Kecklund (2008) performed an analysis on retrospective crash data with biomathematical modelling of the drivers levels of sleepiness based on the validated Karolinska Sleepiness Scale (KSS: Åkerstedt & Gillberg, 1990) a 9-point Likert scale, with higher scores indicting greater sleepiness. Overall, the odds of having a sleep-related crash rapidly increase in a non-linear, almost exponential curve as subjective sleepiness levels increases. Specifically, relative to a KSS of three (alert), a KSS of six (some signs of sleepiness) and a KSS of eight (sleepy, some effort to stay awake) were associated with a three and seven times greater likelihood of crashing respectively. Considered together, driving while intoxicated and driving while sleepy both result in substantial increases to crash risk.

Comparing the Effect of Alcohol and Sleepiness

Laboratory based comparisons between the impact of alcohol intoxication and sleepiness on performance have demonstrated that moderate levels of extended wakefulness (17 hours) and alcohol intoxication (0.05% BAC) result in approximately equivalent performance decrement on a number of cognitive and psychomotor tasks, including, unstable tracking, vigilance, spatial memory, symbol digit coding (Dawson & Reid, 1997; Williamson & Feyer, 2000). When the duration of wakefulness reaches 20 hours, the performances decrement is equivalent to having a BAC of 0.1% (Dawson & Reid, 1997; Williamson & Feyer, 2000). Similarly, performance decrements have been noted in driving simulator studies, such that 18.5 hours and 21 hours of wakefulness has been equated to driving performance decrements associated with BAC levels of 0.05% and 0.08% respectively (Arnedt et al., 2001). Considered together, the results from these studies suggest that the level of performance decrement associated with 17 hours of extended wakefulness approaches the decrement associated with the legal BAC limit for driving in Australia, New Zealand, and many other countries.

Drink Driving and Sleepy Driving Attitudes

While both sleepy and drink driving are associated with comparable decrements of driving performance and increased crash likelihood, the risk perception of these two driving behaviours is somewhat disparate. For instance, several studies reveal that sleepy driving is typically rated less critical than other risky driving behaviours such as speeding or drink driving by drivers (Pennay, 2008; Radun, Radun, Wahde, Watling, & Kecklund, 2015). In Australia, sustained policing activity and media campaigns rolled out over several decades have changed community attitudes and increased social disapproval of drink driving (Homel, 1988). However, during this time little change in community attitudes towards sleepy driving has occurred (Fletcher, McCulloch, Baulk, & Dawson, 2005). While few studies have directly compared drink and sleepy driving attitudes, perceptions of culpability have been found to be higher for drink drivers who involved in a crash, than those that are involved in a sleep-related crash (Williams, Davies, Thiele, Davidson, & MacLean, 2012). Considering the perceptions of culpability associated with sleepy driving and drink driving it is likely that perceived legitimacy of enforcement for drink driving would be more positive than sleepy driving.

Differences between Younger and Older Drivers

In addition to differences in attitudes toward drink driving and sleepy driving, the literature indicates that pronounced differences exists between age-cohorts. Typically, younger drivers hold lower risk perception of crashing for both drink driving (Jewell, Hupp, & Segrist, 2008) and sleepy driving (Watling, Armstrong, Obst, & Smith, 2014) when compared to older drivers and hold more negative views towards traffic law enforcement in general (Bates, Darvell, & Watson, 2015; Scott-Parker, Watson, King, & Hyde, 2012). Lower risk perception for crashing and negative attitudes toward traffic enforcement and can lead to engagement of risky driving behaviours (Rhodes & Pivik, 2011; Scott-Parker et al., 2012). Indeed, studies have demonstrated that younger drivers are more likely to drive while sleepy (Watling et al., 2014) or intoxicated (World Health Organization, 2013) than older drivers. While younger drivers report lower crash risk perceptions for drink driving as well as driving while sleepy than older drivers, it is not known whether attitudes as well as the perceived legitimacy of enforcement for drink driving and sleepy driving differ between younger and older drivers.

The Current Study

Crashes attributed to drink driving and sleepy driving account for a substantial proportion of road crashes. While equivalent impairment levels associated with drink driving and sleepy driving have been demonstrated, some studies suggest drink driving and sleepy driving could be perceived differently by younger and older drivers. The current study sought to examine the driving behaviour likelihood, perceived legitimacy of traffic law enforcement, and attitudes for drink driving and sleepy driving in a sample of 114 younger (17-29 years) and 177 older (30+ years) drivers.

Method

Participants

To be eligible for participation in this study, individuals were required to drive on Queensland roads and hold an Open driver's licence. In total, 291 participants' (females: 59%, males: 41%) responses were collected in the study. In total, there were 114 younger drivers (17-29 years) and 177 older drivers (30+ years). The characteristics of the younger and older drivers can be seen in Table 1.

Table 1. Demographics and traffic-related information of the younger and older drivers.

Variable	Younger	Older
Age (years)	24.46 (2.77)	48.63 (11.56)
Sex		
Female	66.67%	54.85%
Male	33.33%	45.15%
Education		
Primary	-	0.56%
Secondary	16.67%	18.08%
TAFE or Trade apprenticeship	21.93%	24.29%
University	61.40%	57.07%
Employment		
Employed (full-time)	60.53%	55.93%
Employed (part-time or casual)	19.30%	19.21%
Self-employed	3.51%	13.56%
Student	15.78%	5.08%
Unemployed	0.88%	6.22%
Hours per week driving		
0-10 hours	66.67%	57.95%
11-20 hours	28.95%	35.80%
21+ hours	4.38%	6.25%
Note: Mean value displayed before brackets, standard deviation displayed inside brackets		

Measures

Demographic (age, sex, education, and employment status) and traffic-related information (hours spent driving per week) were obtained from the participants. The self-reported likelihood of sleepy driving and drink driving in the next month was assessed via two items and three items, respectively. The sleepy driving items examined the likelihood of sleepy driving when alone or with passengers. The drink driving items assessed drink driving likelihood in three contexts; when driving in the late/early morning hours, when driving alone, and when driving with passengers. All items were measured on a 5-point Likert scale ranging from 1 (extremely unlikely) to 5 (extremely likely). The items measuring each construct were averaged to create two scale scores.

Enforcement of sleepy driving is typically not preventative, but rather occurs after a crash has taken place; thus, the perceived legitimacy of *reactive* enforcement was assessed. Participants were asked to indicated their agreement with three statements, measured on a 5-point Likert scale scored 1 (strongly disagree) to 5 (strongly agree). One example item was; "It is fair to charge someone if they crash due to sleepiness". Perceived legitimacy of drink driving enforcement was assessed with four items, scored on the same 5-point Likert scale. The items assessed both fairness of random breath testing (e.g., "It is fair to enforce drink driving laws by randomly breath testing drivers") and of mandatory breath testing of drivers involved in crashes and of targeting drivers with erratic driving patterns (e.g., "It is fair to enforce drink driving laws by breath testing all drivers in a crash"). Scale scores were created by averaging items measuring the two driving behaviours.

The definitions components (i.e., attitudes) of Akers, Krohn, Lanza-Kaduce, and Radosevich (1979) social learning theory were utilised to measure the driving behaviour attitudes. Following Aker's lead, two positive, two negative, and two neutral items for each of the driving behaviours were included. Examples of items were: "People who drive when they think they are sleepy are generally more careful on the road" (sleepy driving, positive), "It's okay to drive when you think you might be over the legal alcohol limit, as long as no one gets hurt" (drink driving, neutral), and "there is no excuse for sleepy driving" (sleepy driving, negative). All items were measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). After reverse scoring the negative items, two attitudinal scale scores were created by averaging the six items for each driving behaviour.

Procedure

After the study's protocol received approval from the University's Human Research Ethics Committee as well as health and safety approval, the data collection commenced. Potential participants were invited to take part in the study via the university's email distribution lists, participation webpages, and through social networking sites. Participants were offered the chance to enter a random draw for one of six $50 petrol vouchers as an incentive for their participation. The online survey remained open for approximately one month. It was not possible to complete the survey more than once using the same Internet Protocol (IP) address. The data was cleaned and assumptions of the included statistical tests were checked before the final analysis was performed.

Statistical Analyses

The proportions of females and males was significantly different between the younger and older drivers age groups ($\chi^2(1, 291) = 4.43$, $p = .04$) – this difference has the potential to confound the results as males report greater frequency of drink driving (Pennay, 2008; World Health Organization, 2013) as well as sleepy driving than females (Radun et al., 2015; Watling et al., 2014). Thus, attempting to control for these sex differences, a multivariate analysis of covariance was performed on the dependant variables (i.e., driving behaviour likelihood, perceived legitimacy of enforcement, and attitudes for drink driving and sleepy driving), the independent variable was age group (i.e., younger and older drivers), and sex was the covariate. The second analysis sought to examine the within age group comparisons between drink driving and sleepy driving and thus, a series of paired-samples *t*-tests were performed on driving behaviour likelihood, perceived legitimacy of enforcement, and attitudes variables. Sex was not controlled with these analyses for as the proportions of females and males did not change across the comparisons within the age groups.

Results

Table 2 displays the means, standard deviations and age group comparisons as well within age group comparisons. The covariate, sex, was significantly related to the dependant variables (Wilks' $\Lambda = 0.95$, $F(6, 281) = 2.64$, $p = .02$, partial $\eta^2 = .05$). A significant multivariate analysis of covariance effect of age group was found between younger and older drivers (Wilks' $\Lambda = 0.90$, $F(6, 281) = 4.96$, $p < .001$, partial $\eta^2 = .10$) after controlling for sex. Univariate tests comparing age groups differences and interpreted with the Bonferroni correction, found younger drivers reported greater likelihood to drive while sleepy than older drivers, reported more positive attitudes for sleepy and drink driving behaviours, and more negative views for perceived legitimacy of enforcement for sleepy driving. Comparing the younger drivers drink driving behaviours and perceptions to the sleepy driving, younger drivers reported greater likelihood to drive while sleepy, greater perceptions of legitimacy for drink driving, and more positive attitudes towards sleepy driving. The same pattern was found for the older drivers.

Table 2. Means, standard deviations, and comparisons for the study variables

	Drivers' age group		**Comparisons**		
	Younger	**Older**	**Younger-older**	**Younger: DD-SlpD**	**Older: DD-SlpD**
Variable	***M* (*SD*)**	***M* (*SD*)**	***F*-test**	***t*-test**	***t*-test**
Drink driving behaviour likelihood	1.33 (0.60)	1.26 (0.63)	1.65	-15.19**	-11.76**
Sleepy driving behaviour likelihood	2.84 (1.05)	2.34 (1.19)	14.26**		
Drink driving perceived legitimacy	4.36 (0.53)	4.51 (0.51)	6.02	12.72**	14.82**
Sleepy driving perceived legitimacy	3.22 (0.84)	3.62 (0.82)	16.29**		
Drink driving attitudes	1.77 (0.65)	1.57 (0.49)	10.57**	-12.87**	-13.09**
Sleepy driving attitudes	2.27 (0.72)	2.01 (0.65)	11.49**		

Note: *M*, mean value; *SD*, standard deviation; DD-SlpD, drink driving compared to sleepy driving.
* < .05, ** < .01

Discussion

The current study sought to compare the driving behaviours and perceptions of drink driving and sleepy driving, among younger and older drivers. Although comparable decrements in driving ability and increased crash-risk for these driving behaviours have been demonstrated (Åkerstedt et al., 2008; Blomberg et al., 2009), previous research indicates that attitudes toward sleepy driving are more lenient than those held toward drink driving (Pennay, 2008; Radun et al., 2015). This finding was supported in the current study, with both younger and older drivers reporting more positive attitudes toward sleepy driving. Additionally, both younger and older drivers report a higher likelihood of future sleepy driving and lower levels of perceived legitimacy of reactive enforcement targeting this driving behaviour. These results are of interest as they further highlight important differences between two driving behaviours that are responsible for a considerable proportion of road trauma (Connor et al., 2002; DTMR, 2012).

Several explanations for the differences between drink and sleepy driving behaviours and perceptions can be proposed. Previous literature demonstrates that greater culpability is typically ascribed to crash-involved drivers who were under the influence of alcohol at the time of the crash compared to those who were sleepy (Williams et al., 2012). Together with the findings of the current study (more positive attitudes towards sleepy driving and lower perceived legitimacy of enforcement) results such as those by Williams et al. (2012) indicate that sleepy driving is, overall, seen as less dangerous. Indeed, surveys of drivers demonstrate that sleepy driving is typically rated lower as a critical crash risk factor than drink driving (Radun et al., 2015; Vanlaar, Simpson, Mayhew, & Robertson, 2008). The current results likely reflect efforts of sustained drink driving enforcement and community education campaigns that have changed social norms of the acceptability of drink driving.

The engagement in the two driving behaviours is not only influenced by attitudes and perceptions of legitimacy (e.g., Watling & Leal, 2012), but also by the several other factors (i.e., differences in enforcement and public education) as well the personal choice to drive under these conditions. Largely, drinking alcohol and then choosing to drive while intoxicated is a volitional behaviour. Moreover, alcohol consumption might occur relatively infrequent and in situations when alternative modes of transportation are an available and feasible option. Whereas, experiencing sleepiness is not always a volitional choice; there are a number of factors (e.g., undiagnosed sleep disorder, parenthood, illness, being a shift worker), that are difficult for individuals to control, that can affect the quality and/or quantity of sleep obtained (Åkerstedt, 2000; Alonderis et al., 2008). Moreover, sleepiness, particularly that of a chronic nature, often occurs during ordinary day-to-day driving which makes the use of alternative modes of transport impractical. This difference between intoxication and sleepiness might play a role in the formation of attitudes among drivers.

As stated earlier, choosing to experience sleepiness is not always volitional; choosing to continue to drive while aware of an increasing level of sleepy is, however, a volitional behaviour. Surveys of drivers suggest that continuing to drive while sleepy is a behaviour performed by a substantial proportion of drivers (i.e., 57-73%: Nordbakke & Sagberg, 2007; Vanlaar et al., 2008). Moreover, an increasing body of literature demonstrates that drivers can perceive increasing levels of sleepiness (Reyner & Horne, 1998; Watling, Smith, & Horswill, 2015; Williamson, Friswell, Olivier, & Grzebieta, 2014) and drivers are also cognizant of pre-trip factors that can lead to experiencing sleepiness while driving (Radun et al., 2015). Thus, differences in the volitional control over sleepy and drink driving should not detract from drivers' personal responsibility to ensure that their sleepy driving behaviours do not jeopardise their own safety and that of other road users.

In terms of age-differences, and in line with previous research (e.g., Radun et al., 2015; Watling et al., 2014), it was also found that younger drivers were more likely to drive when sleepy than older

drivers. Moreover, the present study found that young drivers have more favourable attitudes toward sleepy driving and lower perceived legitimacy of enforcement of sleepy driving. Thus, while sleepy driving was overall more acceptable among participants of both age groups, this was most pronounced among the young drivers. These findings could be understood, first, in relation to the lower levels of sleepy driving risk perception that has previously been found among younger drivers (Watling et al., 2014); lower levels of perceived dangerousness likely leads to more accepting attitudes (Lucidi et al., 2006). The obtained findings regarding the younger drivers' perceptions of legitimacy in the current study are also in line with previous research that demonstrates younger drivers, hold more negative views towards traffic law enforcement in general (Bates et al., 2015; Scott-Parker et al., 2012). Last, attitudes and perceptions towards driving are likely shaped during early driving experiences. Younger drivers who drive while sleepy might not yet have experienced any negative outcomes are therefore likely to have more positive views of driving while sleepy (Lucidi et al., 2006). Consequently, as drivers gain more negative experiences with sleepy driving (i.e., sleep-related close calls, sleep-related crashes) they then come to appreciate the dangerous associated with sleepy driving.

It was found that younger drivers held more positive attitudes towards drink driving than older drivers. The lack of significant differences between younger and older drivers for the drink driving likelihood and perceptions of legitimacy of enforcement for drink driving was therefore unexpected and moreover inconsistent with previous research (e.g., World Health Organization, 2013). While younger drivers, overall, hold more negative attitudes toward traffic enforcement (Bates et al., 2015; Scott-Parker et al., 2012), this was not reflected in terms of drink driving in the current study. Perhaps the strong emphasis of sustained drink driving enforcement and media campaigns regarding the dangerousness of drink driving, whereby drinking and driving is perceived contrary to social norms has resulted in a homogenisation across age groups.

When considering the study findings, the limitations of the current study should be kept in mind. One limitation of the study was the sampling methodology. A convenience sample was used which might result in self-selection bias. Moreover, the use of self-report measures for this study leaves it susceptible to self-reporting bias and might not be reflective of participants' actual behavioural likelihood and perceptions of driving while intoxicated or while sleepy. Finally, the cross-sectional design does not allow for inferences of causality to be made from the obtained results. Future research could seek to perform more in-depth analyses of drink driving and sleepy driving behaviours and particularly the attitudes and perceptions of drivers concerning these behaviours. Several suggestions have been given above regarding the reasons behind sleepy driving and drink driving differences. However, in order to design effective intervention campaigns, such assumptions need to be formally tested. For instance, if the pervasive and the somewhat non-volitional nature of sleepiness are indeed linked to the perceived acceptability of sleepy driving, such beliefs could be targeted in intervention efforts. It is important that research in this area continue in light of the serious threat that sleepy driving is posing to drivers and other road users.

In conclusion, the current study sought to compare the driving behaviours and perceptions of drink driving and sleepy driving, among young and older drivers. The main finding was that both younger and older drivers reported a greater likelihood of sleepy driving than drink driving, as well as reporting more positive attitudes toward sleepy driving and lower levels of perceived legitimacy of enforcement for sleepy driving than drink driving. Additionally, younger drivers reported significantly greater likelihood to drive while sleepy than older drivers. Efforts to increase *all drivers'* perceptions of the dangerousness of sleepy driving are seemingly warranted, as well as greater acknowledgement that continuing to drive while sleepy is a volitional behaviour and as such, can be avoided. Such efforts are important to reduce road trauma and provide a safer road environment for all road users.

Acknowledgements

The authors would like to acknowledge the help from Nathan Dovan, Dr Nerida ‘‘Buddy’’ Leal, Janelle Mackenzie, and Gabrielle Stephenson with the study design and data collection. The authors would also like to acknowledge the contribution and support from Dr Kerry Armstrong.

References

Akers, R. L., Krohn, M. D., Lanza-Kaduce, L., & Radosevich, M. (1979). Social learning and deviant behavior: A specific test of a general theory. *American Sociological Review, 44*(4), 636-655.

Åkerstedt, T. (2000). Consensus Statement: Fatigue and accidents in transport operations. *Journal of Sleep Research, 9*(4), 395-395.

Åkerstedt, T., Connor, J., Gray, A., & Kecklund, G. (2008). Predicting road crashes from a mathematical model of alertness regulation--The Sleep/Wake Predictor. *Accident Analysis & Prevention, 40*(4), 1480-1485.

Åkerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. *International Journal of Neuroscience, 52*(1-2), 29-37.

Åkerstedt, T., Kecklund, G., Gillberg, M., Lowden, A., & Axelsson, J. (2000). Sleepiness and days of recovery. *Transportation Research Part F: Traffic Psychology and Behaviour, 3*(4), 251-261.

Alonderis, A., Barbé, F., Bonsignore, M., Calverley, P., De Backer, W., Diefenbach, K., . . . Kostelidou, K. (2008). Medico-legal implications of sleep apnoea syndrome: Driving license regulations in Europe. *Sleep Medicine, 9*(4), 362-375.

Arnedt, J. T., Wilde, G. J. S., Munt, P. W., & MacLean, A. W. (2001). How do prolonged wakefulness and alcohol compare in the decrements they produce on a simulated driving task? *Accident Analysis & Prevention, 33*(3), 337-344.

Bates, L., Darvell, M. J., & Watson, B. (2015). Young and unaffected by road policing strategies: Using deterrence theory to explain provisional drivers’(non) compliance. *Australian & New Zealand Journal of Criminology*.

Blomberg, R. D., Peck, R. C., Moskowitz, H., Burns, M., & Fiorentino, D. (2009). The Long Beach/Fort Lauderdale relative risk study. *Journal of Safety Research, 40*(4), 285-292.

Borkenstein, R. F., Crowther, R. F., Shumate, R. P., Zeil, W. W., & Zylman, R. (1964). The role of the drinking driver in traffic accidents. Bloomington, Indiana: Department of Police Administration, Indiana University.

Cercarelli, L. R., & Haworth, N. L. (2002). The determination of fatigue-related crashes using routinely collected road crash data. Crawley, WA: Injury Research Centre, The University of Western Australia.

Connor, J., Norton, R., Ameratunga, S., Robinson, E., Civil, I., Dunn, R., . . . Jackson, R. (2002). Driver sleepiness and risk of serious injury to car occupants: population based case control study. *British Medical Journal, 324*(7346), 1125.

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature, 388*(6639), 235-235.

Department Transport and Main Roads. (2012). Fatal road traffic crashes in Queensland: A report of the road toll. Brisbane, Australia: Department of Transport and Main Roads.

Fletcher, A., McCulloch, K., Baulk, S. D., & Dawson, D. (2005). Countermeasures to driver fatigue: A review of public awareness campaigns and legal approaches. *Australian and New Zealand Journal of Public Health, 29*, 471-476.

Fogarty, J. N., & Vogel-Sprott, M. (2002). Cognitive processes and motor skills differ in sensitivity to alcohol impairment. *Journal of Studies on Alcohol, 63*(4), 404-411.

Gillberg, M., Kecklund, G., & Åkerstedt, T. (1996). Sleepiness and performance of professional drivers in a truck simulator--comparisons between day and night driving. *Journal of Sleep Research, 5*(1), 12-15.

Hindmarch, I., Kerr, J., & Sherwood, N. (1991). The effects of alcohol and other drugs on psychomotor performance and cognitive function. *Alcohol and Alcoholism, 26*(1), 71-79.

Homel, R. (1988). *Policy and punishing the drinking driver: A study of general and specific deterrence*. New York: Springer-Verlag.

Howland, J., Rohsenow, D. J., Arnedt, J. T., Bliss, C. A., Hunt, S. K., Calise, T. V., . . . Gottlieb, D. J. (2011). The acute effects of caffeinated versus non-caffeinated alcoholic beverage on driving performance and attention/reaction time. *Addiction, 106*(2), 335-341.

Ikegami, K., Ogyu, S., Arakomo, Y., Suzuki, K., Mafune, K., Hiro, H., & Nagata, S. (2009). Recovery of cognitive performance and fatigue after one night of sleep deprivation. *Journal Of Occupational Health, 51*(5), 412-422.

Jewell, J. D., Hupp, S. D. A., & Segrist, D. J. (2008). Assessing DUI risk: Examination of the Behaviors & Attitudes Drinking & Driving Scale (BADDS). *Addictive Behaviors, 33*(7), 853-865.

Lane, S., Cherek, D., Pietras, C., & Tcheremissine, O. (2004). Alcohol effects on human risk taking. *Psychopharmacology, 172*(1), 68-77.

Lucidi, F., Russo, P. M., Mallia, L., Devoto, A., Lauriola, M., & Violani, C. (2006). Sleep-related car crashes: Risk perception and decision-making processes in young drivers. *Accident Analysis & Prevention, 38*(2), 302-309.

McKinney, A., & Coyle, K. (2004). Next day effects of a normal night's drinking on memory and psychomotor performance. *Alcohol and Alcoholism, 39*(6), 509-513.

Movig, K. L. L., Mathijssen, M. P. M., Nagel, P. H. A., Van Egmond, T., De Gier, J. J., Leufkens, H. G. M., & Egberts, A. C. G. (2004). Psychoactive substance use and the risk of motor vehicle accidents. *Accident Analysis & Prevention, 36*(4), 631-636.

Nordbakke, S., & Sagberg, F. (2007). Sleepy at the wheel: Knowledge, symptoms and behaviour among car drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 10*(1), 1-10.

Pennay, D. (2008). Community Attitudes to Road Safety: 2008 survey report. Canberra, Australia: Australian Government Department of Infrastructure, Transport, Regional Development and Local Government.

Peterson, J. B., Rothfleisch, J., Zelazo, P. D., & Pihl, R. (1990). Acute alcohol intoxication and cognitive functioning. *Journal of Studies on Alcohol, 51*(2), 114-122.

Prat, G., Adan, A., Perez-Pamies, M., & Sanchez-Turet, M. (2008). Neurocognitive effects of alcohol hangover. *Addictive Behaviors, 33*(1), 15-23.

Radun, I., Radun, J. E., Wahde, M., Watling, C. N., & Kecklund, G. (2015). Self-reported circumstances and consequences of driving while sleepy. *Transportation Research Part F: Traffic Psychology and Behaviour, 32*, 91-100.

Ramaekers, J. G., Robbe, H. W. J., & O'Hanlon, J. F. (2000). Marijuana, alcohol and actual driving performance. *Human Psychopharmacology Clinical and Experimental, 15*(7), 551-558.

Reyner, L. A., & Horne, J. A. (1998). Falling asleep whilst driving: Are drivers aware of prior sleepiness? *International Journal of Legal Medicine, 111*(3), 120-123.

Rhodes, N., & Pivik, K. (2011). Age and gender differences in risky driving: the roles of positive affect and risk perception. *Accident Analysis & Prevention, 43*(3), 923-931.

Rossa, K. R., Smith, S. S., Allan, A. C., & Sullivan, K. A. (2014). The effects of sleep restriction on executive inhibitory control and affect in young adults. *Journal of Adolescent Health, 55*(2), 287-292.

Scott-Parker, B., Watson, B., King, M. J., & Hyde, M. K. (2012). "They're lunatics on the road": Exploring the normative influences of parents, friends, and police on young novices' risky driving decisions. *Safety science, 50*(9), 1917-1928.

Van Dongen, H. P., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 26*(2), 117-126.

Vanlaar, W., Simpson, H., Mayhew, D., & Robertson, R. (2008). Fatigued and drowsy driving: A survey of attitudes, opinions and behaviors. *Journal of Safety Research, 39*, 303-309.

Watling, C. N., Armstrong, K. A., Obst, P. L., & Smith, S. S. (2014). Continuing to drive while sleepy: The influence of sleepiness countermeasures, motivation for driving sleepy, and risk perception. *Accident Analysis & Prevention, 73*, 262-268.

Watling, C. N., Armstrong, K. A., & Smith, S. S. (2013). *Sleepiness : how a biological drive can influence other risky road user behaviours*. Paper presented at the 2013 Australasian College of Road Safety (ACRS) National Conference, Adelaide, Australia.

Watling, C. N., & Leal, N. L. (2012). *Exploring perceived legitimacy of traffic law enforcement*. Paper presented at the 2012 Australasian College of Road Safety (ACRS) National Conference, Sydney, Australia.

Watling, C. N., Smith, S. S., & Horswill, M. S. (2015). Psychophysiological changes associated with self-regulation of sleepiness and cessation from a hazard perception task. *Journal of Psychophysiology,* (in press).

Williams, L. R., Davies, D. R., Thiele, K., Davidson, J. R., & MacLean, A. W. (2012). Young drivers' perceptions of culpability of sleep-deprived versus drinking drivers. *Journal of Safety Research, 43*(2), 115-122.

Williamson, A. M., & Feyer, A.-M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational and Environmental Medicine, 57*(10), 649-655.

Williamson, A. M., Friswell, R., Olivier, J., & Grzebieta, R. (2014). Are drivers aware of sleepiness and increasing crash risk while driving? *Accident Analysis & Prevention, 70*, 225-234.

World Health Organization. (2013). *WHO global status report on road safety 2013: supporting a decade of action*: World Health Organization.