

**Sleepy Driving and Pulling Over for a Rest: Investigating Individual Factors that
Contribute to these Driving Behaviours**

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Abstract

Driver sleepiness is a substantial crash risk factor and as such, is a major contributor to crash statistics. A number of individual factors (i.e., psychological factors) have been suggested to influence driving while sleepy. However, few studies have examined the influence of these individual factors for sleepy driving in combination. The current study sought to examine how various demographic factors, attitudes, perceived legitimacy, personality constructs, and risk taking variables were associated with self-reported likelihood of driving sleepy and pulling over and resting when sleepy. The results show that being a younger driver, having positive attitudes towards driving sleepy, and high levels of emotional stability were related to self-reported likelihood of driving sleepy. Whereas, being an older driver and having negative attitudes towards driving sleepy were associated with self-reported likelihood of pulling over and resting when sleepy. Overall, the obtained results suggest that the age and attitudes of the driver have greater influence than personality traits or risk taking factors. Campaigns focused on changing attitudes to reflect the dangerousness of sleepy driving could be important for road safety outcomes.

Key works: driver sleepiness; individual factors, Australian drivers; attitudes; perceived legitimacy; personality; risk taking

1. Introduction

The role of sleepiness as a major contributing factor for fatal and non-fatal crashes is widely recognised (Connor et al., 2002; Kecklund, Anund, Wahlström, & Åkerstedt, 2012). The incidence rates for sleep-related crashes is estimated to be approximately 20% (Connor et al., 2002; Kecklund et al., 2012) with the incidence rates for less severe crashes likely to be as great or even greater. Incident rate data suggests that driver sleepiness is a major problem for road safety. Yet, a substantial proportion of individuals will drive when feeling sleepy. For example, 58.6% of drivers admit driving occasionally while feeling sleepy (Vanlaar, Simpson, Mayhew, & Robertson, 2008). Furthermore, 73-77% of drivers report continuing to driving even though they believe they are too sleepy to drive safely (Armstrong, Obst, Banks, & Smith, 2010; Nordbakke & Sagberg, 2007). These reports suggest that many drivers are willing to risk the dangerousness of sleepy driving.

The potential reasons for driving when sleepy are numerous and complicated. Factors influencing sleepy driving include lower risk perceptions, inadequate awareness of sleepiness levels, trip demands, amongst others. Being a younger driver and being male have both been associated with greater sleepy driving (Philip et al., 1996; Phillips & Sagberg, 2013) and are important demographic variables. These facilitators have been examined in a number of studies as well as the use of sleepiness countermeasures. Most studies concerned with sleepy driving typically examine external factors (e.g., destination arrival, duration of driving) or individual issues of sleepiness (e.g., sleep habits, daytime sleepiness, having a sleep disorder). However, very little is known about the individual factors (i.e., psychological factors) that may contribute to sleepy driving. Therefore, the current study sought to examine how a number of individual factors are associated with self-reported likelihood of sleepy driving and pulling over and resting when sleepy.

1.1 Attitudes

Attitudes may potentially have a substantial effect for influencing driving while sleepy. Drivers typically cite driver sleepiness after risky driving behaviours such as speeding, drink driving, and driver distraction as major crash risk factors (Vanlaar et al., 2008). This suggests that driving while sleepy is not perceived as a particularly risky behaviour. A lack of appreciation of the dangerousness of sleepy driving could be reflected in prevalence rates of driving during high sleepiness times (Nordbakke & Sagberg, 2007) as well as poor sleep habits the night before long distance driving (Philip et al., 1996). Moreover, ambivalent views towards driver culpability associated with sleepy driving exists (Jones, Rajaratnam, Dorrian, & Dawson, 2010) and likely contributes to tolerant attitudes towards sleepy driving. Considered together, the attitudes among drivers regarding the dangerousness of sleepy driving might be modest. Examining the attitudes surrounding sleepy driving may be beneficial for road safety as modifications of attitudes may be an important avenue for behaviour change.

1.2 Perceived Legitimacy

Another individual factor that could potentially have an effect on driver behaviour is perceptions of legitimacy of enforcement (e.g., McKenna, 2007; Watling & Leal, 2012). An individual who believes sleepy driving is not a dangerous behaviour may not think it is legitimate to enforce sleepy driving laws. The legal sanctions for sleepy driving are not well known and very rarely are legal sanctions applied to drivers suspected of being responsible for a sleep-related crash (Rajaratnam, 2001). Previous work suggests that increasing the perceptions of legitimacy of speeding enforcement leads to reductions of the likelihood of performing the behaviour (e.g., McKenna, 2007). Nonetheless, little is known about the perceptions of legitimacy of sleepy driving enforcement and how this affects the likelihood of sleepy driving.

1.3 Personality

Another individual factor that has been examined for its involvement in risky driving behaviours is the personality of the driver. A number of personality constructs have been linked to driver sleepiness. For instance, higher levels of extraversion and neuroticism have been associated with higher levels of risky simulated driving (Matthews & Desmond, 1998; Verwey & Zaidel, 2000). Higher levels of extraversion and neuroticism have also been related to poorer cognitive performance during sleep deprivation (Mastin, Peszka, Poling, Phillips, & Duke, 2005; Taylor & McFatter, 2003) as well as performing risky driving behaviours (Sarma, Carey, Kervick, & Bimpeh, 2013). A meta-analysis of studies examining personality constructs and vehicle crashes, found that low levels of conscientiousness and agreeableness were positively associated with vehicle crashes (Clarke & Robertson, 2005). Considered together, personality constructs appear to have some utility regarding drivers' decisions to drive when sleepy.

1.4 Risk Taking

A related construct of personality which may be useful to consider when investigating sleepy driving is risk taking. Previous work suggests that some drivers tend to be more accepting of the risks associated with driving at high levels of sleepiness (Corfitsen, 1999). Other findings suggest that sensation seeking is associated with self-reported likelihood of sleepy driving (Fernandes, Hatfield, & Job, 2010). Higher levels of risk taking are also associated with retrospective on-road driving crashes (Patil, Shope, Raghunathan, & Bingham, 2006).

1.5 Current study

The reviewed studies suggest that a number of individual factors are related to sleepy driving. However, the exact nature of how these factors are related to sleepy driving and taking a rest break is uncertain when considered together at the multivariate level. Hence, the

first aim of this study was to examine the associations between demographic factors, attitudes, perceptions of legitimacy, personality constructs, and risk taking factors and how they relate to self-reported likelihood of sleepy driving. An important aspect of reducing driver sleepiness is pulling over and resting when sleepy. Therefore, the second aim of this study was to examine the associations between the individual factors and self-reported likelihood of pulling over and resting when sleepy. It was hypothesised that several of the individual factors would be associated with self-reported likelihood of sleepy driving and pulling over to rest when sleepy.

2. Method

2.1 Participants

Eligibility criteria included holding an Open/unrestricted drivers licence and to be a current driver on the road network. These criteria were included to ensure participants had adequate on-road driving experiences. In total, 293 participants completed the survey. The average age of the participants was 39.20 years ($SD = 15.10$; range = 20-84 years) with the majority of the sample being female (59.1%). Participants were offered the opportunity to enter a random draw for one of six petrol vouchers valued at 50 Australian Dollars for their involvement.

2.2 Measures

2.2.1 Dependent variable

The dependent variable, self-reported likelihood of sleepy driving in the next month (i.e., a risky behaviour) was measured via two items on a 5-point Likert scale ranging from 1 (highly unlikely) to 5 (highly likely). The items examined the likelihood of sleepy driving when alone or with passengers. The two items were averaged to create a scale score. The second dependent variable was self-reported likelihood of pulling over and resting when

sleepy. This item was measured with the same 5-Likert scale with higher scores indicating greater likelihood of performing the behaviour (i.e., a safety behaviour).

2.2.2 Demographic information

The demographic information included participant age, gender, and level of education. Traffic-related demographic data, such as the duration of licensure and a measure of driving exposure (i.e., number of hours driven per week), were also collected.

2.2.3 Attitudes

Attitudes towards sleepy driving were measured using the definitions component of Akers' social learning theory (Akers, Krohn, Lanza-Kaduce, & Radosevich, 1979) which assesses personal attitudes relating to driving when sleepy. Participants indicated their agreement with six items (two positive, two negative, and two neutral items) on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Examples included: "people who drive when they think they are sleepy are generally more careful on the road" (positive), "there is no excuse for sleepy driving" (negative), and "It's okay to drive when you feel sleepy, as long as you don't do it too much" (neutral). The wording of these items is consistent with recommendations from Akers (1990). An attitudes scale score was created by averaging all six items after reverse scoring the negative items.

2.2.4 Perceived legitimacy of enforcement of sleepy driving

The enforcement of sleepy driving generally occurs after a sleep-related crash has occurred and this was the focus of the perceived legitimacy items. The perceived legitimacy of enforcement of sleepy driving was assessed via three items, which asked participants to indicate their agreement with statements on a 5-point Likert scale scored 1 (strongly disagree) to 5 (strongly agree). For example: "It is fair to charge someone if they crash due to sleepiness" and "It is fair to enforce dangerous driving due to sleepiness" A scale score was created by averaging the score from these three items.

2.2.5 Personality constructs

Personality constructs were assessed via the International Personality Item Pool (IPIP: Goldberg, 1999). The IPIP utilises a five factor model of personality, thus including the following personality constructs: extraversion, conscientiousness, agreeableness, emotional stability, and intellect/imagination. Participants responded to 50 items and rated how well the items described themselves. The items used a 5-point Likert scale scored from 1 (very inaccurate) to 5 (very accurate). Examples of the items include: (I) “feel comfortable around people” (extraversion), “pay attention to details” (conscientiousness), “feel little concern for others” (agreeableness: reversed scored), “am relaxed most of the time” (emotional stability), and “have difficulty understanding abstract ideas” (intellect/imagination: reversed scored). The five personality constructs were each comprised by 10 items; which were summated to create each construct.

2.2.6 Risk taking

Risk taking was assessed using Donovan’s (1993) risk taking driving scale. This scale utilises eight items to measure risk taking with responses ranging from 1 (never) to 4 (very often). Examples items are: (I) “out-manoeuvre other drivers for the thrill of it?” and “drive dangerously because you enjoy it?” An overall risk taking scale score was calculated by averaging all the items together.

2.3 Procedure

After obtaining ethical and health and safety approvals, invitations to potential participants were distributed online in the university virtual environment (e.g., research participation webpage, university mailing lists). The questionnaire was an online survey which took approximately 10-15 minutes to complete. The link to the survey was active for one month and participants using the same Internet Protocol address could not complete the survey more than once.

2.4 Statistical analyses

The internal consistency of the scale scores were evaluated with Cronbach's alpha coefficient. Pearson's product moment correlation for continuous variables and point biserial correlations for dichotomous and continuous variables were used to examine the bivariate associations between study variables. Multiple regression analyses were performed to examine the strength of the predictor variables with the dependent variable while controlling for the relationships between the predictor variables. The minimum sample size (using Green's (1991) formula) was met. The assumptions required for multiple regression analyses were met.

3. Results

3.1 Demographic Characteristics

Approximately half of the participants (58.7%) were university educated (undergraduate 31.4%, postgraduate 27.3) the remaining participants had a secondary school level of education. On average, the participants reported having been licensed for 22.71 years ($SD = 20.44$). The majority (61.4%) of participants drove between 1-10 hours/week, while 33.1% drove 10-20 hours and the remainder of the participants (5.5%) reported driving greater than 20 hours/week.

3.2 Descriptive Statistics

The means, standard deviations, and Cronbach's alphas of the participant's scores are displayed in Table 1. The self-reported likelihood of driving when sleepy was evenly distributed in the sample, with a moderate amount of variance. Generally, the attitudes towards sleepy driving were not overly favourable which is reflected in the perceived legitimacy scores. Scores on the personality factors were slightly over the mid-point of possible scores. The risk taking propensity for the sample was quite low and the data was skewed to enable the inclusion of this scale in the regression analysis it was re-coded to a

dichotomous variable. Participants were divided into those that indicated no risk taking propensity (a score of 1 “never” on all risk taking items, 52.90%) and those reporting some risk taking propensity (a score > 1 on at least one of the risk taking items, 47.10%).

Table 1.

Means, Standard Deviations, and Cronbach’s alpha of the study variables

Scale	<i>M</i>	<i>SD</i>	Cronbach’s α	No. of items	Range
Likelihood of sleepy driving	2.55	1.15	.85 ^a	2	1-5
Pulling over and resting when sleepy	3.11	1.42	-	1	1-5
Attitudes	2.09	0.68	.81	6	1-5
Perceived legitimacy	3.53	0.86	.77	3	1-5
Extraversion	32.47	7.32	.88	10	10-50
Conscientiousness	33.68	5.29	.79	9 ^b	9-45 ^b
Agreeableness	40.27	5.30	.79	10	10-50
Emotional stability	33.81	7.25	.87	10	10-50
Intellect/imagination	37.74	5.23	.76	10	10-50
Risk taking	1.20	0.35	.90	8	1-4

^a Pearson’s correlation coefficient; ^b Due to a technical error, the data from one item on this scale was not recorded in the database. Brief forms of the IPIP have psychometric properties that are similar to the full length questionnaire (Donnellan, Oswald, Baird, & Lucas, 2006).

3.3 Bivariate analysis

Table 2 displays the bivariate correlations between the study variables. Several predictor variables were correlated with the two dependent variables. Small correlations were found with both dependent variables. Larger correlations were found between the dependent variables and attitudes and the perceived legitimacy variables.

Table 2.

Bivariate correlations of the individual factors and their relationship with sleepy driving and pulling over and resting when sleepy

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Sleepy driving	-											
2. Pulling over and resting	-.16**	-										
3. Age	-.25**	.30**	-									
4. Gender (male) ^a	.09	.04	.19**	-								
5. Attitudes	.34**	-.29**	-.12*	.14*	-							
6. Perceived legitimacy	-.24**	.20**	.13*	.01	-.45**	-						
7. Extraversion	.04	-.12*	-.29*	-.15*	-.03	-.04	-					
8. Conscientiousness	-.12*	.04	.16**	-.03	-.27**	.10	.09	-				
9. Agreeableness	-.09	-.01	-.09	-.39**	-.15*	.05	.41**	.19**	-			
10. Emotional stability	-.20**	.04	.22**	.13*	-.06	-.04	.12*	.34**	.07	-		
11. Intellect/imagination	-.01	-.11	-.23**	-.04	-.03	-.01	.38**	.16**	.27**	.04	-	
12. Risk taking (some) ^a	.19**	-.18**	-.18**	.16**	.28**	-.15	.07	-.16**	-.09	-.05	.06	-

** $p < .01$, * $p < .05$; ^a Point bi-serial correlation

3.4 Multivariate analyses

3.4.1 Likelihood of sleepy driving

A linear regression analysis was performed to examine which variables were predictive of self-reported likelihood of sleepy driving (see Table 3). The overall model was a significant predictor of sleepy driving ($F(8, 280) = 7.246, p < .001$) and accounted for 18% of the variance. In this model, being younger, having more favourable attitudes towards sleepy driving, and having higher levels of emotional stability were all significant predictors of the likelihood of sleepy driving.

Table 3.

Linear regression of the individual factors and their relationship with sleepy driving

Variable	<i>B</i>	SE <i>B</i>	β	<i>r</i> _{ab.c}	<i>r</i> _{a(bc)}
Age	-.02**	.01	-.19	-.18	-.17
Gender (male)	-.26	.14	-.11	-.11	-.10
Attitudes	.42**	.11	.25	.23	.21
Perceived legitimacy	-.14	.08	-.10	-.10	-.10
Extraversion	.01	.01	.04	.04	.04
Conscientiousness	.02	.01	.07	.07	.06
Agreeableness	-.01	.01	-.02	-.02	-.01
Emotional stability	-.03**	.01	-.18	-.18	-.16
Intellect/imagination	-.01	.01	-.06	-.06	-.06
Risk taking (some)	.12	.13	.05	.05	.05
Constant	3.50**	.88			

Adjusted $R^2 = .18$; $F(8, 280) = 7.24$ **

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

3.4.2 Likelihood of pulling over and resting when sleepy

A second linear regression analysis was performed to examine which variables were predictive of self-reported likelihood of pulling over and resting when sleepy (see Table 4). The model was a significant predictor of pulling over and resting when sleepy ($F(10, 280) = 10.16, p < .001$) and accounted for 14% of the variance. In this model being an older driver and having negative attitudes towards sleepy driving were significant predictors of the likelihood of pulling over and resting when sleepy.

Table 4.

Linear regression of the individual factors and their relationship with pulling over and resting when sleepy

Variable	<i>B</i>	SE <i>B</i>	β	$r_{ab,c}$	$r_{a(bc)}$
Age	.02**	.01	.26	.24	.22
Gender (male)	.11	.18	.04	.04	.03
Attitudes	-.50**	.14	-.24	-.21	-.20
Perceived legitimacy	.08	.10	.05	.05	.04
Extraversion	-.01	.01	-.02	-.02	-.02
Conscientiousness	-.02	.02	-.07	-.07	-.06
Agreeableness	.01	.02	.01	.01	.01
Emotional stability	-.01	.01	-.01	-.01	-.01
Intellect/imagination	-.01	.02	-.03	-.03	-.03
Risk taking (some)	-.21	.17	-.08	-.07	-.07
Constant	3.94**	1.10			
Adjusted $R^2 = .14$; $F(10, 280) = 10.16^{**}$					

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

4. Discussion

The first aim of the current study was to examine the relationship between self-reported likelihood of sleepy driving and a number of individual factors that have previously been found to be related to sleepy driving. The multivariate analysis revealed that being a younger driver, having more favourable attitudes towards sleepy driving, and having higher levels of emotional stability were all significant predictors of greater likelihood of sleepy driving. The second aim was to examine the same individual factors for their association with self-reported likelihood of pulling over and resting when sleepy. The predictors of pulling over and resting when sleepy were being an older driver and have negative attitudes towards driving sleepy.

4.1 Factors associated with the likelihood of driving sleepy

The strongest predictor of driving while sleepy was the attitudes towards sleepy driving variable which was positively associated with the dependent variable. These findings support the notion that attitudes are important for influencing risky driving as a link between positive attitudes and risky driving behaviour has been found for the behaviours of speeding (e.g., Brown & Cotton, 2003) and drink driving (e.g., Baum, 2000), amongst others. The current findings provide an avenue for educational campaigns to modify driver's attitudes regarding sleepy driving. Educational campaigns could target knowledge levels about the effects of sleep loss and the sleep-wake cycle – educational campaigns have been tested in secondary schools and evidence for their efficacy exists (e.g., Cortesi, Giannotti, Sebastiani, Bruni, & Ottaviano, 2004). Driver educational campaigns that are more specific with their information could be more successful at modifying attitudes.

Being a younger driver and having higher levels of emotional stability were associated with a lower likelihood of sleepy driving. Emotional stability is characterised by low levels of anxiousness, hostility, and importantly, impulsiveness (Eysenck, 1970).

Individuals with high levels of impulsiveness do not fully consider the ramifications of their behaviours (Wright, Caspi, Moffitt, & Paternoster, 2004) and tend to perform more risky behaviours (Sarma et al., 2013). Moreover, low levels of emotional stability is related to poor sleep quality (Gray & Watson, 2002; Soehner, Kennedy, & Monk, 2007) – poor sleep quality is an important component of sleep-related crashes (Philip et al., 1996) and highlights the need for educational campaigns that address sleep health.

Overall, the strength of the significant predictors were small in magnitude as indexed by the beta weights and as such, the model only accounted for a small amount of variance. Consequently other factors could have explained the remaining variance. Previous work suggests that destination arrival is an important reason drivers cite for continuing to driving even when sleepy (Nordbakke & Sagberg, 2007). The lack of perceived dangerousness of driving while sleepy could also have been an influencing factor with the obtained results. If drivers do not perceive sleepy driving as a risky behaviour, it then follows that they would be more likely drive when sleepy. Moreover, the perceived benefits of driving while sleepy may outweigh any dangerousness perceived by the driver (Fernandes et al., 2010) and would likely reinforce positive attitudes towards sleepy driving.

4.2 Factors associated with pulling over and resting when sleepy

The individual factors were examined for their predictive utility of self-reported likelihood of pulling over and resting when sleepy. Age was the strongest predictor; being an older driver and having negative attitudes towards driving while sleepy were predictive of pulling over. Previous studies have shown that older drivers are more likely to utilise driver sleepiness countermeasures possible owing to greater on-road experiences with sleepiness (Anund, Kecklund, Peters, & Åkerstedt, 2008). Whereas, younger drivers due to their inexperience have limited understanding of signs of sleepiness (Anund et al., 2008).

Consequently younger drivers' perceptions of dangerousness of sleepy driving could be low and thus make them unlikely to pull over and rest when sleepy.

An unexpected finding was the lack of multivariate association between any of the personality constructs and self-reported likelihood of pulling over and resting when sleepy. Previous work has shown that several personality constructs (e.g., low extraversion, high conscientiousness, low neuroticism) have been associated with performing safety and health promoting behaviours (Raynor & Levine, 2009; Vollrath & Torgersen, 2002) and it was expected that the safety behaviour of pulling over and resting would also show some associations with the personality constructs. A possible explanation can be found with the indirect that personality constructs can have on driving behaviours via a mediating effect that personality constructs can have on attitudes. Previous work has shown that personality constructs have an indirect effect on risky driving via influencing individuals attitudes (Ulleberg & Rundmo, 2003). It is possible that this indirect effect may have been present in the data.

4.3 Limitation and Future Research

The obtained results need to be interpreted with consideration given the studies limitation. One limitation of the current study is the sampling methodology. A convenience sample was used and has the potential to result in self-selection bias. The use of a self-report measure for the outcome variables is another limitation. Self-report data can be influenced by the effects of social desirability and may not be reflective of actual behaviours on the road.

Future research could specifically focus on younger drivers and seek other individual factors that might be more influential factors. Perceptions of the dangerousness of sleepy driving may prove valuable in understanding why individuals drive when sleepy. Last, future research could examine how best to apply current educational campaigns (e.g., Cortesi et al., 2004) to promote attitudinal change for drivers.

4.4 Conclusion

Driver sleepiness is a substantial crash risk factor and as such, is a major contributor to crash statistics. A number of individual factors have been suggested to influence individuals driving when sleepy. The results showed that being a younger driver, having positive attitudes towards driving sleepy, and higher emotional stability were related to self-reported likelihood of driving sleepy. Whereas, being an older driver and having negative attitudes towards driving sleepy were associated with self-reported likelihood of pulling over and resting when sleepy. These results could inform educational campaigns aimed at reducing the prevalence rates of driver sleepiness and therefore reduce road trauma.

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