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Driving at night and how it's influenced by perceived driver skills

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SUMMARY

Night-time driving is associated with higher crash rates, partly due to reduced visibility of the driving environment. Crash data show that young drivers are over-represented in night-time incidents, world-wide. Self-reported driver skills provide an important indicator of driving abilities, which can also interact with night-time driving performance. This study investigated the relationship between drivers' self-reported driver skills and their perceived night-time driving challenges, comparing responses between young and older drivers. Results found that young drivers with lower self-reported perceptual-motor skills and higher safety skills experienced more difficulties associated with night-time driving.

KEYWORDS

self-reported driver skills, night-time driving, young drivers, older drivers, driving difficulties

Introduction

Night-time driving can be challenging due to limited visibility of the driving environment and problems with glare from other vehicles (e.g., Evans et al., 2020; 2022). Research also shows that inexperienced young drivers are less likely to detect hazards compared to experienced older drivers (Borowsky et al., 2010), and are more likely to be involved in crashes at night in the UK (Regev et al., 2018). When compared to young and less experienced drivers, experienced and relatively older drivers are reported to be more aware of night-driving challenges, for example, those associated with reduced visibility (Evans et al., 2022).

Drivers' performance is influenced by a combination of their behaviour and skills. While behaviour (style) is "*the way individuals choose to drive or driving habits that have become established over a period of years*", driver skills (performance) "*limits to performance on elements of the driving task*" (Elander et al., 1993, p.279). In other words, the former one explains what the driver "does" and the latter concerns what the driver "can do" (Özkan & Lajunen, 2011). According to the "two pathways to a crash" model (Lajunen & Özkan, 2021), behaviours and skills influence crash involvement through driver violations and errors, respectively. More specifically, self-reported driver skills, as an indicator of drivers' abilities and performance, are a crucial predictor of unsafe behaviours and outcomes, including crashes, and are shown to be affected by experience and general cognitive abilities (e.g., Lajunen & Özkan, 2021; Xu et al., 2018).

Whilst few researchers have investigated the risks experienced by young (e.g., Evans et al., 2020; Regev et al., 2018) and older (e.g., Kimlin et al., 2020; Wood, 2019) drivers at night, to the best of our knowledge, it is not known how night-time driving difficulties vary, based on age and perceived level of driver skills. Therefore, the present study collected self-reported driver skills and night-time driving difficulty data from two groups of drivers (young, older), to understand how these accounts are affected by participant age and gender. The following research questions were addressed in this study:

- 1) Are there any age and gender differences in self-reported driver skills and night-time driving difficulties?
- 2) How does the relationship between age and difficulties in night-time driving vary as a function of perceptual-motor skills by safety skills?

Method

Participants

Sixty participants were invited to take part in the study, and 57 participants completed the self-report sections. Three participants were excluded due to technical problems. The cohort included 30 young drivers (15 male, 15 female) between 21 and 25 years old ($M = 22$, $SD = 1$) and 27 older drivers (18 male, 9 female), aged between 59 and 79 years ($M = 66$, $SD = 4$).

Measures

Driver Skills Inventory (DSI): Self-reported driver skills were measured with the 20-item Driver Skills Inventory (Lajunen & Summala, 1995). Self-reported driver skills were conceptualised under two dimensions: perceptual-motor skills and safety skills, and measured with ten items for each. While perceptual-motor skills focus on control aspects of driving, safety skills are related to drivers' safety motivation (Lajunen & Summala, 1995). Drivers were asked to indicate how weak/strong the 20 aspects of driving were on a 5-point Likert from definitely weak (0) to definitely strong (4). The Cronbach's alpha reliabilities of the subscales were .79 for perceptual-motor skills and .86 for safety skills.

Vision and Night Driving Questionnaire (VNDQ): Drivers' self-reported visual difficulties during night-time driving were measured with a 9-item scale, developed by Kimlin et al. (2016). Participants were asked to indicate how difficult it was to complete nine different tasks during night-time driving, using a 5-point Likert scale from no difficulty (0) to extreme difficulty (4). The scale corresponded to a single factor with .88 Cronbach's alpha reliability.

Procedure

The two groups of participants were recruited for a driving simulator study, approved by the ethics committee of the School of Business, Environment and Social Services, University of Leeds (AREA 21-108) as part of the EPSRC-funded HAROLD project (EP/S003576/1). Convenient and snowball sampling methods were used to recruit participants, and social media accounts were also used to advertise the study. Eligible participants (who had a valid UK driving license, were regular drivers, drove at least once a week, and had normal or corrected to normal vision) were invited to take part. The main aim of the study was to investigate how driver behaviour during day and night was affected by a cognitively loading non-visual n-back task (not reported here, see Öztürk et al., 2023). After completing the last drive, participants were asked to complete the two questionnaires reported above, which are reported in this paper.

Analysis

First, Analyses of Variance (ANOVA) were used for the Vision and Night Driving Questionnaire items, to investigate the differences between young and older drivers, for each of the different tasks. In the second step, any difference in age and sex for driver skills and night-time driving difficulties were explored using a 2 (Age: young, older) by 2 (Sex: female, male) Analysis of Covariance (ANCOVA) with 5000 bootstraps, where annual mileage was entered as a control variable. In the third step, the moderated moderation analysis by Hayes (2022) was conducted, to explore the relationship between age and difficulties in night-time driving, and whether these are influenced by drivers' self-reported perceptual-motor skills and safety skills (Figure 1). The analyses were

performed by using the PROCESS macro model 3 for SPSS, with 5000 bootstraps, controlling for sex and annual mileage. Perceptual-motor skills and safety skills were entered into the model as mean-centred variables. The statistical significance value was determined as .10, considering the low statistical power for interaction effects (Morris et al., 1986). Significant interaction effects were shown by using three values of moderators as the mean and one standard deviation above and below the mean.

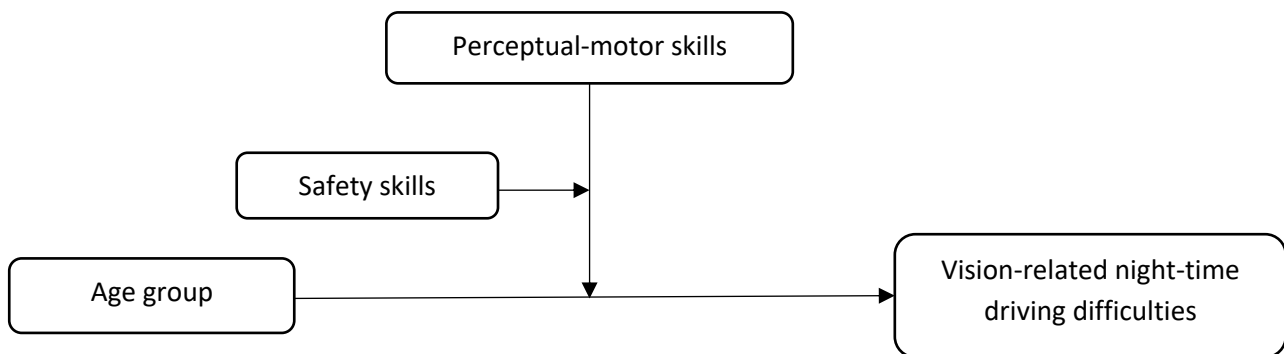


Figure 1. Conceptual diagram of moderated moderation analyses

Results

Night-time driving difficulties

In terms of Vision and Night Driving Questionnaire, when comparing the two groups, young drivers perceived “*Seeing pedestrians or animals on the road side*” as more difficult than older drivers. While the overall level of perceived difficulty for each task was not high, for young drivers the most difficult task was “*Seeing the road in rain or poor weather*”, while “*Seeing because of glare when driving at dusk or dawn*” was reported as most difficult for older drivers. “*Judging the distance between you and other moving cars*” while driving at night was perceived to be the least difficult task for both groups of drivers (Table 1).

Table 1. Descriptive statistics for the different tasks rated for night-time driving

	Young		Older		F	p
	M	SD	M	SD	(1,55)	
Seeing pedestrians or animals on the roadside when driving at night	1.77	.86	1.19	.79	7.06	.010
Seeing the road in rain or poor weather when driving at night	2.00	1.05	1.52	.96	3.19	.079
Seeing the road because of oncoming headlights when driving at night	1.97	1.03	1.70	.78	1.16	.286
Adjusting after passing headlights from oncoming cars when driving at night	1.27	.98	1.41	.93	.31	.582
Seeing because of glare when driving at dusk or dawn	1.97	.93	1.85	.86	.23	.632
Judging the distance between you and other moving cars while driving at night	.90	.76	.81	.83	.16	.688
Judging the distance to your turnoff or exit while driving at night	.90	.71	.96	.71	.11	.739
Seeing dark coloured cars when driving at night	1.30	.53	1.26	.71	.06	.807
Reading street signs when driving at night	.97	.85	.93	.87	.03	.859

Differences in perceptual-motor and safety skills

For perceptual-motor skills (Table 2), the main effect of sex was significant ($F(1, 52) = 16.63, p < .001, \eta^2_p = .24$), with male drivers revealing higher self-reported perceptual-motor skills than female

drivers. There was no significant difference in terms of age ($F(1, 52) = .06, p = .813, \eta^2_p = .00$), or the interaction of age and sex ($F(1, 52) = .72, p = .401, \eta^2_p = .01$).

For safety skills (Table 2), the main effect of age was significant ($F(1, 52) = 7.93, p = .007, \eta^2_p = .13$). Older drivers reported higher safety skills than young drivers. No significant sex difference ($F(1, 52) = 1.79, p = .187, \eta^2_p = .03$) or interaction effect ($F(1, 52) = .02, p = .900, \eta^2_p = .00$) was observed for safety skills.

For night-time driving difficulties (Table 2), no differences were observed for either age ($F(1, 52) = 1.36, p = .249, \eta^2_p = .03$), or sex ($F(1, 52) = .17, p = .685, \eta^2_p = .00$). The interaction of age and sex ($F(1, 52) = .92, p = .341, \eta^2_p = .02$) was also not significant.

Table 2. Descriptive statistics for perceptual-motor skills, safety skills and vision-related difficulties, by age and sex

		Perceptual-motor skills		Safety skills		Night-time driving difficulties	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Young	Male	3.10	.35	2.37	.49	1.39	.63
	Female	2.51	.46	2.54	.54	1.51	.45
	Total	2.80	.50	2.46	.52	1.45	.54
Older	Male	2.97	.45	2.78	.59	1.37	.58
	Female	2.58	.41	3.04	.61	1.10	.88
	Total	2.86	.47	2.85	.60	1.29	.67
Total	Male	3.03	.41	2.60	.58	1.38	.59
	Female	2.54	.44	2.71	.60	1.37	.64
	Total	2.83	.48	2.65	.59	1.37	.61

The effect of age and driver skills on night-time driving difficulties

The moderated moderation model was found to be significant ($F(9, 47) = 2.47, p = .021$), and explained 32% of the variance (Table 3). The three-way interaction between age, perceptual-motor skills, and safety skills contributed to 6% of the additional variance ($F(1, 47) = 4.30, p = .044$).

Table 3. Conditional effects of age group on vision-related night-time driving difficulties by perceptual-motor skills and safety skills

Variable	<i>b</i>	<i>se</i>	<i>t</i>	<i>p</i>	95% CI
Age group (1: Older, 2: Young)	.22	.17	1.30	.202	-.12, .55
Perceptual-motor skills	-.67	.63	-1.05	.297	-1.94, .61
Age by perceptual-motor skills	-.05	.37	-.13	.896	-.79, .69
Safety skills	-.54	.44	-1.22	.228	-1.43, .35
Age by safety skills	.29	.28	1.04	.305	-.27, .85
Perceptual-motor skills by safety skills	2.13	.97	2.19	.034	.17, 4.09*
Age by perceptual-motor skills by safety skills	-1.41	.68	-2.07	.044	-2.78, -.04*
Sex (1: Male, 2: Female)	-.29	.19	-1.56	.126	-.67, .08
Annual mileage	.00	.00	1.88	.067	.00, .00

Note. * Significant effect on night-time driving difficulties

There was a positive interaction between age at the low level of self-reported perceptual-motor skills and high level of safety skills ($b = .81, t(1, 47) = 2.30, p = .026$), with younger drivers reporting more difficulties in night-time driving, compared to older drivers (Figure 2).

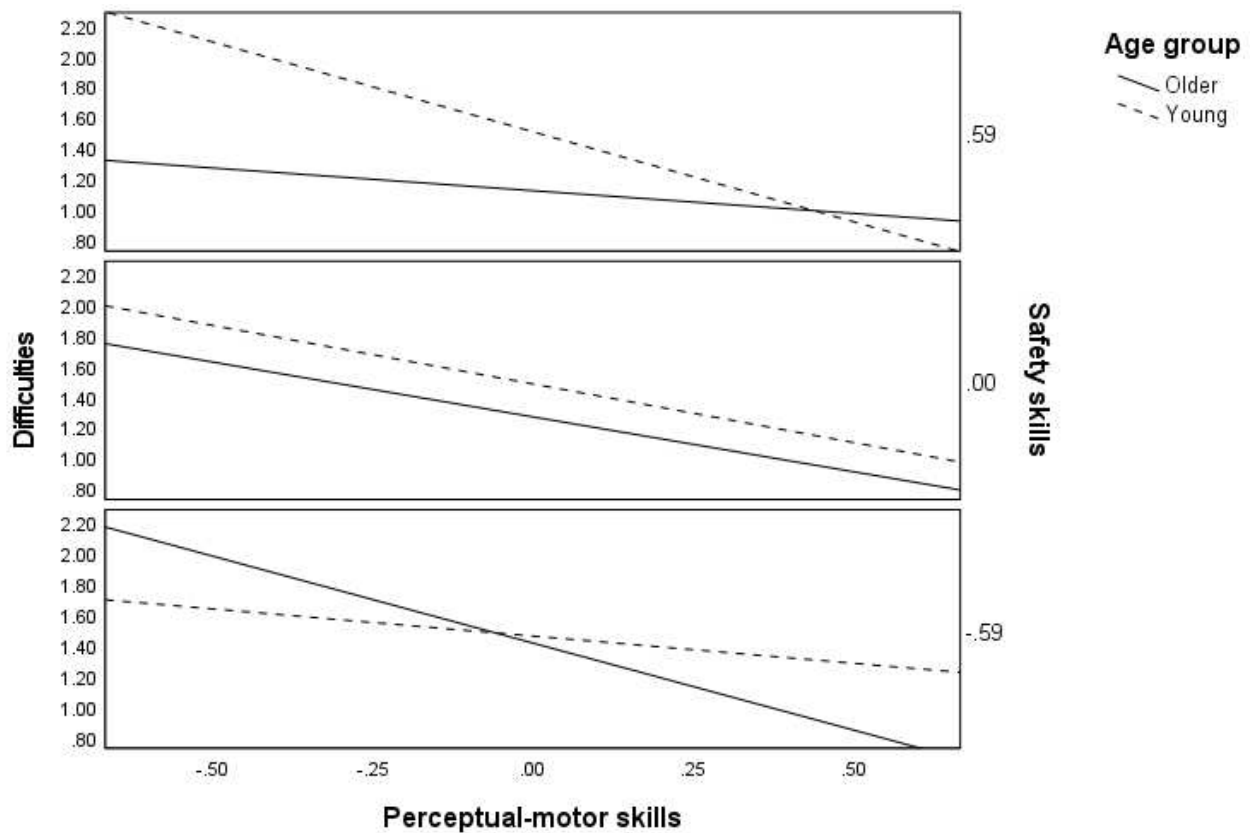


Figure 2: The relationship between age and night-time driving difficulties as a function of perceptual-motor skills by three levels (high, moderate, low) of safety skills

Discussion

The aim of this study was to investigate if there are any differences between young and older, and/or male and female drivers, in terms of their self-reported driving skills, and night-time driving difficulties. The study also sought to investigate whether the difficulties experienced when driving at night differed as a function of the perceived level of perceptual-motor and safety skills. Previous work has shown that drivers reporting higher perceptual-motor skills are also less likely to commit fewer errors and lapses (Xu et al., 2018), while high safety skills are negatively correlated with violations and penalty points (Xu et al., 2018). This work was used to as a basis for investigating the interactions between drivers' self-reported skills, to explain night-time difficulties experienced by young and older drivers.

Regarding the first aim of the study, older drivers declared more safety skills when compared to young drivers, which is in line with previous studies (Martinussen et al., 2014; Ostapczuk et al., 2017, Xu et al., 2018). Male drivers in our study also reported higher perceptual-motor skills than female drivers. However, contrary to previous studies (e.g., Gruber et al., 2013; Kimlin et al., 2020), the perceived level of difficulty across different driving tasks at night was low and was not different for our two groups of drivers. This low level of perceived difficulty in night-time driving may be due to high optimism bias (DeJoy, 1989; White et al., 2011) and an overestimation of the individuals' own driving abilities, or a lack of self-awareness of their driving skills (e.g., Freund et al., 2005; Martinussen et al., 2017; McKenna et al., 1991; Parker et al., 2001). On the other hand, in

agreement with previous work (Evans et al., 2022), our study found that young drivers were less aware of their limited visibility issues during night-time driving, which can account for their overrepresentation in night-time crashes (Regev et al., 2018). Further work in this area is therefore warranted.

Regarding the second aim of this study, the three-way interaction effect showed that, when self-reported perceptual-motor skills were low and safety skills were high, younger drivers reported more difficulties at night-time than older drivers. For this group of young drivers, high safety motives may mean that they are more aware of night-time driving difficulties, which they associate with their lower perceptual-motor and technical skills, likely related to their relatively lower driving experience (De Craen et al., 2011; Martinussen et al., 2014; Ostapczuk et al., 2017). Driver training that focusses on improving the night-time driving experience of this group may, therefore, be of value.

Regarding limitations of the study, although the sample size is sufficient to provide the proposed relationships, a bigger sample size would improve confidence in the results, and our conclusions regarding self-reported difficulties associated with night-time driving. Additionally, although anonymity and confidentiality were ensured in this study, results may have been biased by social desirability (Yılmaz et al., 2022), or participants' own evaluation of their driver skills, including an overestimation of their capabilities (McKenna et al., 1991).

These results have important implications for developing interventions to improve safety among both young and older drivers. These may include training programs focusing on the risks associated with night-time driving to overcome potential effects of optimism bias or overestimation of driving skills, and improving night-time driving skills, especially for young drivers, to reduce the difficulties experienced and the risk of near-misses and crashes. The potential benefits of driver skills may also be beneficial for older drivers, including refresher courses to keep their skills up-to-date (e.g., older drivers and Advanced Driver Assistance Systems, e.g. Davidse, 2006). Development of vehicle-based technologies which help this group of experienced drivers drive for longer may also be of benefit.

Conclusion

In conclusion, the most compelling contribution of this study is the link between drivers' self-reported difficulties in night-time driving, and their perceived driver skills. Young drivers with high safety skills and lower perceptual-motor skills were found to be more likely to experience difficulties while driving at night, when compared to older drivers. Driving at night can be a challenging task requiring certain skill sets. To reduce the risks and difficulties associated with night-time driving, it is important that drivers have the necessary skills and confidence in their driving and are aware of their own limitations. However, further research is needed to confirm the findings and to explore the underlying mechanisms of these difficulties.

Author contribution

İbrahim Öztürk: Methodology, Conceptualisation, Formal analysis, Writing – original draft,
Natasha Merat: Methodology, Conceptualisation, Writing – review & editing, Supervision, Principle Investigator.

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Data access statement

The data that support the findings of this study are available on request from the corresponding author (I.O., i.ozturk@leeds.ac.uk).

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