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Influence of commercial drivers' risky behavior on accident involvement: moderating effect of positive driving behavior



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Abstract

The influence of risky driving behavior on road traffic accidents (RTAs) is a relationship that requires draconian measures to curtail the rising surge of road traffic accidents among commercial drivers. Any attempt to ignore this will result in continuous loss of lives and properties, thus weakening the global economy, especially in developing countries. The risky driving behaviors of commercial drivers (truck and taxi drivers) in Nigeria require a panacea due to their contribution to RTAs. The study examines the moderating effect of positive driving behavior on commercial truck and taxi drivers' risky driving behavior and accident involvement relationship. A total of 1823 commercial vehicle drivers (943 taxi drivers and 880 truck drivers) completed the driver behavior guestionnaire (DBQ), while the structural equation modeling (SEM) method was used for the analysis. The results indicated a significant moderating effect of positive driving behavior on the risky driving behavior and accident involvement relationship for both commercial truck and taxi drivers in Nigeria. Specifically, the truck drivers had a positive moderating effect, resulting in a decrease in RTAs with an increase in positive driving behavior. In contrast, the taxi drivers had a negative moderating effect. The results suggest that increasing positive driving behavior among truck drivers will enhance their safety, while taxi drivers will need more assessment to identify other risky behaviors that could expose them to more RTAs despite the positive driving behavior. This study will aid decision makers, transport trainers, and driver employers in knowing the importance of enforcing and promoting positive driving behaviors among drivers and include it in driving policy and driver training curricula towards RTA reduction.

Keywords: Road traffic accidents, Positive driving behavior, Commercial drivers, Driver behavior questionnaire

Introduction

Overview of road traffic accidents

The global prevalence of road traffic accidents (RTAs) is disturbing and leading to massive loss of properties and precious lives that are indispensable for the economy and nation-building. The occurrence of this problem has driven researchers to become increasingly interested in figuring out what can be done about it. The financial loss



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attributed to RTAs has been estimated to cost most countries 3% of their gross domestic product (GDP), especially in developing nations [58]. Annually, Road Traffic crashes claim over 1.2 million lives, with over 90% occurring in third-world countries [59]. In Nigeria, RTA happens daily, affecting the country's socioeconomic well-being [51], thus negatively impacting the quality of living. Over a thousand five hundred people died out of 3345 road traffic accidents in the first quarter of 2022 [34]. Although RTAs have been reported to be due to environmental, mechanical, and human factors, human factors are ranked the highest [22] due to vehicle drivers' risky driving behavior comprising driving violations and errors.

Even though the significant role commercial drivers play in every nation's economic growth cannot be underestimated as the movement of persons, freight, and services thrive on effective and efficient transport operations, the road safety menace attributed to them is enormous. This may be because they primarily drive long distances and long hours, resulting in risky driving behaviors due to stress and fatigue. Specifically, commercial truck drivers contribute to RTAs in no small way [42, 65] due to their size and role in freight transport, which usually demands long-distance travel [20]. According to Dayyabu et al. [9], truck accidents in Nigeria are usually severe. Also, Useche et al. [54] found that speeding elevates the probability of crashes among truck drivers. Despite the facts, it is also interesting to note that in the study by Mehdizadeh et al. [32], taxi drivers exhibited more violations and errors than truck drivers.

Commercial taxi drivers have also been reported to be involved in RTAs due to their long hours driving in scouting for passengers and to make more income, which often results in stress culminating in RTAs [64]. Ba et al. [2] also asserted that taxi drivers often indulge in driving violations due to speeding to save time in the quest for more passengers. Similar results were found in the study by Y. W. Huang et al. [24] among taxi drivers in China. Consequently, Wang et al. [57] reported that road traffic accidents among taxi drivers are a function of socioeconomic pressures. This indicates the adverse effects of the taxi industry's income per distance system of operation. Furthermore, violations and errors were found in taxi drivers with high chances of RTA involvement based on the study of Rejali et al. [41]. The high frequency of driving and violations also increased the propensity for RTA in taxi drivers [55]. These require critical investigation, especially on risky driving behaviors and the role of positive driving behavior. One of the methods of collecting driving behavior data is through the use of the Driver behavior Questionnaire (DBQ).

Driver behavior questionnaire

The DBQ is an in-depth model and tool for measuring daily driving behavior [10, 25], the rate of the exhibition, and how they trigger traffic collisions [8]. The DBQ has undergone several modifications, revisions, and improvements, resulting in its heterogeneity (concerning versions) from different researchers [8, 37] culminating in published DBQ researched articles with variations in results [19]. DBQ has been used for over 30 years with different versions and still stands as a crucial instrument for risky behavioral analysis [53]. In other words, it stands out with a superimposing advantage of creating the borderline between intentional and unintentional aberrant practices [21, 52]. Significant effort has been made to studying driver behavior using the Driver Behavior

Questionnaire with Reason et al. [40] for several years, initiating the DBQ theory. The DBQ classified driver behavior as violation and error, which are differentiated based on intention. Driving violations are considered deliberate disregard for driving rules, while errors are not intentional.

According to Han and Zhao [19], the different results from researched DBQ studies stem from the population/cultural differences and variations in DBQ versions. Sullman et al. [49], also found that most times, due to different versions of the DBQ, results from studies appear to diverge. While the DBQ has been used in different languages after translation [6], many DBQ studies have been done in different countries, especially high-income countries (developed). Some of the developed countries with DBQ studies include India [15], North America [3, 8], Turkey [37], Denmark [28], Malaysia [1], New Zealand [49], East Europe [48], Serbia [30], Australia [47], Czech [48], China [19, 60], Finland [31] while documented peer-reviewed studies from developing countries in African include Nigeria [35], Ghana [12], South Africa [44]. Based on the authors' search, DBQ studies from Nigeria are sparse, indicating a need for more research on risky driving behaviors due to its advantage in collecting data from different and large categories of drivers. Also, most DBQ studies have used the factor structures involving violations and errors for driver assessment, with few including positive driving behavior.

Literature review

Positive driving behaviors are driving practices exhibited by drivers that can aid in ensuring a safe and smooth driving environment for other road users [29, 37]. They include, not driving too closely to a vehicle ahead, being careful and not splashing water on other road users, ensuring smooth traffic by not blocking other vehicles, and avoiding indiscriminate use of horns while driving. On the other hand, risky driving behaviors are behaviors (both deliberate and unintentional disregard of traffic rules) that have the likelihood of causing RTAs, for instance, I keep driving ahead even when the traffic light has turned red, I become angry at another driver and chase them with the intention of showing them how angry I am, I do force my way into the traffic, and I take alcohol immediately before or during driving. Not until the introduction of positive driving behavior in studies relating to driver behavior, did most studies focus on risky driving behavior and road traffic accidents, broadly examining driving violations and errors. Notably, there are sparse studies on positive driving behavior [14, 19]. However, among the existing studies reviewed, Özkan et al. [37] and Guého et al. [14] have found a correlation between positive and risky driving behaviors. Also, studies on positive driving behaviors have adopted correlation tests for the relationship between positive driving behaviors and other driving factors like aggressive violation, errors, and inattention [6, 29, 30, 36]. Specifically, RTAs among professional drivers decrease as positive driving behavior increases in the study by Maslać et al. [29]. Similarly, bus drivers were found to have an appreciable decrease in RTAs as their positive driving behavior increased [19, 56]. Beyond correlation, the current study will contribute to the scanty literature on positive driving behaviors [19] and examine the moderating role of positive driving behavior on the relationship between risky behavior and accident involvement for commercial drivers in Nigeria.

Many studies have assessed the behavioral factors causing RTA among the general driving population, but detailed studies on specific drivers like commercial trucks and taxi drivers are scanty [11, 61]. Additionally, there are sparse studies on positive driving behavior [14, 45], while research on the moderating effect of positive driving behavior is scarce based on a literature search (Table 1). Furthermore, available studies (Table 1) on positive driving behavior have adopted correlation tests for the relationship between positive driving behavior and other driving factors [29, 30, 37]. The justification for using positive driving behavior as a moderator is hinged on the fact that potential moderating variables can be antecedent or independent variables from previous studies [33]. As shown in Table 1, positive driving behavior has been used as an independent variable in past studies. Moreover, based on a literature search, no study was found on moderating roles of positive driving behaviors specifically for truck and commercial taxi drivers in Africa, where Nigeria is situated. Hence, studying the moderating effect of positive driving behavior is expedient in Nigeria with larger sample sizes. This will aid in a detailed understanding of the variations between taxi and truck drivers in Nigeria based on their positive and risky driving behaviors.

Therefore, this study aims to assess the moderating effect of positive driving behavior on risky behavior and traffic crash involvement among Nigerian truck and taxi drivers. It is imperative to examine their moderating role as this will reveal the complexity of commercial driver behavior patterns, give an understanding of their significance in curtailing RTAs among commercial drivers, and the need to encourage them to exhibit more

Authors	Sample	Country	Method of assessment	Findings on positive driving behavior	Category of drivers
Singh and Kathuria [45]	135	India	Correlation	Positive driving behavior predicts accidents among bus drivers	Bus rapid transport drivers
Luo et al. [26]	_	China	Correlation	Positive driving behavior was associated with agreeableness, conscientiousness, and openness.	Not specified
Han and Zhao [19]	220	China	Correlation	Driver errors, violations, and inattention errors negatively correlate with positive driving behavior.	Bus
Maslać et al. [29]	1422	Serbia	Correlation	Professional drivers were associated with positive driving behavior	Professional and non- professional drivers
Maslać et al. [30]	354	Serbia	Correlation	Age and years of driving experience are positively associated with positive driving behavior.	Professional drivers
Guého et al. [14]	525	France	Correlation	Age was a predictor of positive driving behavior	General driving popu- lation
Özkan et al. [37]	312	Turkey	Correlation	A negative association was found between positive driving behavior and hostile aggression and revenge.	Not specified

Table 1 Previous studies on positive driving behaviors

positive driving behaviors. Therefore, the following hypotheses are postulated for this study:

H1: A significant relationship exists between taxi drivers' risky driving behaviors and accident involvement.

H2: There is a significant relationship between truck drivers' risky driving behaviors and accident involvement.

H3: The relationship between risky driving behaviors and their involvement in RTA will increase when positive driving behavior decreases among taxi drivers.

H4: The relationship between risky driving behaviors and their involvement in RTA will increase when positive driving behavior decreases among truck drivers.

In sum, the driving behaviors of taxi and truck drivers in Nigeria might be affected by cultural aspects unique to the country. These cultural factors can include norms, attitudes toward traffic regulations, and customary driving practices, which can differ significantly across various regions. By re-examining these hypotheses within Nigeria, it ensures that cultural intricacies are taken into account when comprehending the correlation between driving behavior and road traffic accidents.

Methodology

Participants and data collection

In this study, 1823 registered commercial drivers (943 taxi and 880 truck drivers) from the 5 economic states (Abuja, Kano, Kogi, Lagos, and Rivers) in Nigeria filled out the questionnaires in person. Ethical clearance was sought and approved by the Nigerian Institute of Transport Technology Zaria before data collection. At the same time, participation in the study was voluntary and based on the willful verbal consent from the commercial drivers. The participants completed a questionnaire consisting of demographic data, accident history, and the Driver Behavior Questionnaire (DBQ). G* Power software was used to ascertain the sample effectiveness level to ensure that the sample size is sufficient based on the requirement of SEM sample size [18, 53]. According to Hair et al. [18], the most recommended settings for G power are 0.15 (medium effect) for effect size, a minimum of 0.80 for power level, and 0.05 for confidence level. Therefore, considering the recommended G power settings, the minimum sample size was 77, which was at least doubled for each state for more statistical power. The data were screened for missing data and questionnaire misconduct, while the linear interpolation method handled 9 and 7 missing truck and taxi samples.

Instruments

The Driver Behavior Questionnaire (DBQ) [40] is a self-report questionnaire that measures the different risky behaviors of drivers while driving. In this study, the DBQ used was a modified version of the study of Han and Zhao [19], Mehdizadeh et al. [32], and Useche et al. [53], which were validated on Nigerian drivers through a pilot test. The questionnaire comprised three sections namely, driver sociodemographic factors, accident involvement, and driving behaviors (i.e., driving violation, driving error, inattention errors, and positive driving behavior). The driving behavior

consisted of 30 items with a 5-point Likert type (1 = never, 2 = rarely, 3 = occasionally, 4 = very frequently, and 5 = always). The formulation of the DBQ is centered on Reason's taxonomy [40], which explains the difference in the drivers' behavior based on intention. A driving violation was defined as deliberate disregard for stipulated road traffic rules, while errors are misbehaviors that are not intentional but due to a mistake of intention. Inattention errors or lapses are a type of error that occurs as a result of memory loss or deficient attention. Özkan et al. [37] introduced positive driving behavior as a new inclusion in the DBQ. They are behaviors that aid a smooth driving environment for both drivers and other road users.

Data analysis

The data were coded, and the descriptive characteristics of the drivers, experience, and gender were analyzed using SPSS27. SmartPLS4 was used for the moderation analysis in which the moderators' significant level and effect sizes were examined. First, the variance inflation factor (VIF) values were examined to ensure no multicol-linearity issues due to common method variance (CMV), as the same self-reported questionnaire was used to collect responses for the predictor, dependent, and moderator variables from the same respondents. Testing the threats for multicollinearity is essential to ensure the constructs (driving violation, driving errors, inattention errors, positive driving behavior, and accident involvement) are valid and have no bias in the study [50]. Thereafter, the factor loadings (> 0.6 is considered acceptable) and the reliability of the scales were assessed using composite reliability (> 0.7), while convergent (> 0.5) and discriminant validity (< 0.9) were used to determine the validity. The convergent validity measured through the average variance extracted (AVE) shows how the driving behavior items converge to explain each construct distinctively. Also, the discriminant validity indicates the constructs in the DBQ are not related but distinct.

Furthermore, the path and moderation analyses were used to examine the influence of positive driving behavior on the drivers' risky driving behaviors and their involvement in traffic crashes. The standard level of p < 0.05 was chosen as the statistical significance criterion, and the effect sizes of the moderators were identified to determine the range of their effects. Guidelines used to assess f^2 values were 0.02, 0.15, and 0.35 as small, medium, and large effects, respectively [7]. The moderating effect aids in examining the relationship between an independent and dependent variable is influenced by another variable known as the moderator [33].

Results

Participants characteristics

The sample characteristics comprising driving experience, gender, and accident history of the taxi and truck drivers are presented in Fig. 1. As shown, there are more commercial male drivers than female drivers. Also, commercial truck drivers were more involved in road accidents than commercial taxi drivers, while driving experience was reportedly higher for truck drivers than taxi drivers.



Fig. 1 Commercial drivers' characteristics

Table 2 VIF

Driver category	Accident involvement	Driving violation	Driving error	Inattention error	Positive driving behavior
Taxi drivers	1.095	2.230	1.586	1.638	1.325
Truck drivers	1.164	1.566	1.405	1.525	1.204
Taxi drivers Truck drivers	1.095 1.164	2.230 1.566	1.586 1.405	1.638 1.525	1.325 1.204

Exclusion criteria: > 3

Common Method Variance (CMV)

This is associated with measurement methods due to the variance attributed to them. The variance inflation factor (VIF) was examined to avoid potential bias due to the multiple variables measured using the same measurement method. Hence, the full collinearity test was performed to assess if any driving behavior construct indicates the VIF values equal to or greater than 3.3 [27]. As shown in Table 2, the results indicate that VIF for the constructs range from 1.095 to 2.230, confirming that the multicollinearity (CMV) issue was not a threat to this study.

Factor loadings

The factor loadings are coefficients representing the strength and direction of a relationship between indicators (items) and their respective constructs. They are loadings that quantify the degree of variability in the indicators accounted for by the constructs. Tables 3 and 4 summarize the factor loadings for the DBQ items for commercial drivers. Each item is associated with a factor loading for their respective constructs. The factor loadings greater than 0.6, which indicate variance explained by the items on a latent variable (factors) were retained in the model [16].

Reliability and validity

The composite reliability for the driving violation, driving errors, inattention, positive driving behaviors, and accident involvement of the drivers were greater than 0.6, while

ltem	Taxi driving behaviors	Driving violations	Inattention errors	Positive driving behavior	Driving errors
1.	I keep driving ahead even when the traffic light has turned red	0.644			
2.	I become angry at other drivers and chase them to show them my anger	0.729			
3.	I force my way into the traffic	0.723			
4.	l take alcohol immediately before or while driving	0.753			
5.	l overload my vehicle with passengers and goods	0.718			
6.	I drive with an expired driving license	0.739			
7.	I deliberately disregard the speed limits at night or early in the morning	0.684			
8.	l disregard the speed limit on a residential road	0.714			
9.	I drive from the main road to the other street roads without paying attention to pedestrians, bicycles, or vehicles		0.751		
10.	l do forget to turn on the indicator or signal light when turning		0.758		
11.	I realize that I have no clear memory of the road I have been traveling on		0.688		
12.	I do hit something when reversing that I had not previously seen		0.750		
13.	l like to pay attention and avoid splashing water at pedestrians when driving			0.770	
14.	l do keep the lane clear and do not hinder vehicles behind			0.864	
15.	I try to avoid the indiscriminate use of horns while driving			0.822	
16.	l ensure that I do not obstruct other road users while parking by the road			0.852	
17.	l do keep a safe following distance while driving			0.854	
18.	l do not look at the rear-view mirror when changing lanes or merging				0.697
19.	I follow so close to the vehicle ahead that applying the brake in an emergency is hard				0.805
20.	I suddenly break on a wet road or a road with bad conditions				0.711
21.	I do not carry out maintenance on my vehicle at the right time				0.724

Table 3 Factor loadings for commercial taxi drivers

The exclusion criteria: < 0.60

the convergent validity was greater than 0.5 (Table 5) [17] to satisfy that the scale is reliable. Composite reliability indicates the consistency and reliability of the measurement model, while Convergent validity shows driving behavior items reflect their assigned constructs.

The extent to which constructs are distinct from each other and not overlapping with other constructs in a model is discriminant validity. It ensures items measuring constructs are not highly correlated, which could affect the interpretation of results. The discriminant validity measured using the Heterotriat Monotrait (HTMT) values for the

ltem	Truck driving behaviors'	Driving violations	Inattention errors	Positive driving behavior	Driving errors
1.	I force my way into the traffic	0.742			
2.	l deliberately disregard the speed limits at night or early in the morning	0.715			
3.	l disregard the speed limit on a residential road	0.764			
4.	l disregard the speed limit on a freeway or rural highway	0.772			
	l do forget to turn on the indicator or signal light when turning		0.747		
5.	I brake too quickly on a slippery road or when it's raining		0.635		
6.	I do switch on one thing, such as the head- lights, when I meant to switch on something else, such as the wipers		0.768		
7.	I do hit something when reversing that I had not previously seen		0.734		
8.	I like to pay attention and avoid splashing the water at pedestrians when driving			0.741	
9.	l do keep the lane clear and do not hinder vehicles behind			0.805	
10.	I try to avoid the indiscriminate use of horns while driving			0.810	
11.	l ensure that I do not obstruct other road users while parking by the road			0.859	
12.	l do keep a safe following distance while driving			0.799	
13.	l do not look at the rear-view mirror when changing lanes or merging				0.740
14.	I underestimate the speed of overtaking or oncoming vehicles when overtaking or swerving left				0.803
15.	I suddenly brake on a wet road or a road with bad conditions				0.756
16.	I do not carry out maintenance on my vehicle at the right time				0.688

 Table 4
 Factor loadings for the DBQ items for commercial truck drivers' sample

The exclusion criteria: < 0.60

Table 5 Composite reliability and convergent validity for taxi and truck driving behavior	rs
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Variables	Composite re	liability (CR)	Convergent validity (CV)	
	Tx _{drivers}	Tr _{drivers}	Tx _{drivers}	Tr _{drivers}
Driving violation	0.892	0.836	0.509	0.560
Driving errors	0.825	0.835	0.541	0.559
Inattention errors	0.802	0.813	0.505	0.522
Positive driving behaviors	0.919	0.901	0.694	0.646
Accident involvement	0.931	0.936	0.818	0.830

 $\label{eq:constraint} Exclusion\ criteria\ for\ CV:<0.5\ (Tx_{drivers}\ Taxi\ Drivers,\ Tr_{drivers}\ Truck\ Drivers$

Accident involvement	Driving error	Driving violation	Inattention error
0.194			
0.220	0.762		
0.139	0.852	0.870	
0.175	0.290	0.449	0.389
	Accident involvement 0.194 0.220 0.139 0.175	Accident involvement Driving error 0.194 0.220 0.762 0.139 0.852 0.175 0.290	Accident involvement Driving error Driving violation 0.194

Table 6 Discriminant validity (HTMT values) for taxi driving behaviors

Table 7 Discriminant validity (HTMT values) for truck driving behaviors

	Accident involvement	Driving error	Driving violation	Inattention error
Driving errors	0.186			
Driving violations	0.334	0.524		
Inattention errors	0.279	0.477	0.741	
Positive driving behavior	0.247	0.270	0.251	0.156

Exclusion criteria for HTMT: > 0.9

Tabl	e8 Path	n relations	ships of	f taxi anc	l truck	k drivers' k	pehavior ar	id accio	dent invo	lvement
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Variable relationships	Original sample	Standard deviation	T statistics	P value sig
TARDB –>TAAI	0.170	0.035	4.792	0.00
PDBTAD -> TAAI	- 0.153	0.037	4.123	0.00
TKRDB -> TKDAI	0.260	0.034	7.694	0.00
PDTKD ->TKDAI	-0.133	0.033	4.060	0.00

TARDB taxi drivers' risky behavior, TAAI taxi drivers' accident involvement, TKRDB truck drivers risky behavior, TKDAI truck drivers' accident involvement, PDBTAD taxi drivers' positive driving behavior, PDTKD truck drivers' positive driving behavior

taxi and truck driving behavior constructs were less than 0.9 (Tables 6 and 7) [17]. This indicates that the constructs in the scale are valid and distinct in measuring their respective items.

Path analysis

Table 8 shows the results of the path coefficient (direct effect) of the taxi and truck risky behaviors and their involvement in road traffic crashes, indicating a significant (p < 0.05) influence of their risky behavior. Also, the relationship between their positive driving behavior and involvement in road traffic accidents indicates a significant relationship (p < 0.05).

Moderating effect

Moderation analysis was performed (after examining the direct effect) to assess positive driving behavior moderating effects on the relationship between risky driving behavior and RTA involvement among commercial truck and taxi drivers in Nigeria (Figs. 2 and 3). The results (Table 9) show a significant moderating role of positive driving behaviors for commercial taxi drivers (β =0.209, *t*=5.895, *p*=0.000) and commercial truck drivers (β =0.082, *t*=2.040, *p*=0.041). The results indicate that positive driving behaviors



Fig. 2 Moderating model of taxi drivers



Fig. 3 Moderating model of truck drivers

Tahla 9	Moderating	effects of	nositive drivina	hehaviors
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Moderating relationship	Original sample	T statistics	P value sig
PDBTAD × TARDB—> TAAI	0.209	5.895	0.000
PDTKD × TKRDB—> TKDAI	-0.082	2.040	0.041

PDBTAD taxi drivers' positive driving behavior, PDTKD truck drivers' positive driving behavior, TARDB taxi drivers' risky driving behavior, TAAI taxi drivers' accident involvement, TKDAI truck drivers accident involvement

moderate the risky behavior of drivers and their involvement with RTAs. However, the direction of the moderating effect varies among the drivers (taxi and truck) considering the β values, as shown in Figs. 4 and 5.

Effect size

The effect size of the moderators indicates the strength of their moderating effects on the relationship between the independent and dependent variables. The results of the effect sizes show small effects (< 0.02) of the positive driving behaviors for the taxi and truck drivers. However, the effect is stronger for the taxi drivers (Table 10).

The slope analysis of the moderating effect of positive driving behavior on the relationship between commercial taxi drivers' risky behavior and RTA involvement (Fig. 4) reveals that the slope of high positive driving behavior is steeper than that of low positive behavior. This implies an increase in the relationship between the taxi driver's risky behavior and RTA



Fig. 4 Graph of moderating effect of positive driving behavior on commercial taxi drivers' risky behavior-accident involvement





 Table 10
 Effect sizes of the moderators

Variable	Effects sizes
Taxi positive driving behavior $ imes$ accident involvement	0.030
Truck positive driving behavior $ imes$ accident involvement	0.005

despite their highly positive driving behavior. In contrast, as their positive driving behavior increases, commercial truck drivers' risky driving behavior and RTA involvement decrease (Fig. 5). In other words, as their positive driving behavior decreases, it appears as though risky driving behavior increases with increasing RTA. The results suggest that risky driving behavior increases with increasing RTA at low positive driving behavior for truck drivers.

Discussion

The moderating role of positive driving behavior on the risky behavior and RTA involvement of commercial (taxi and truck) drivers in Nigeria was examined and found to moderate the risky driving behavior and their involvement in RTA. Also, a significant relationship was found between risky driving behavior and accident involvement among the drivers.

Taxi drivers' risky behavior significantly influenced RTA, supporting hypothesis 1. The influence of their risky behavior on RTA involvement may be connected to long hours of driving and scouting for passengers. The potential connection between their risky behavior and their involvement in road traffic accidents (RTAs) may be attributed to the extensive time spent driving and scouting for passengers, thereby establishing a potential reciprocal relationship. On one hand, prolonged periods of driving which could be due to the continuous pursuit of passengers can result in fatigue [39], consequently augmenting the probability of engaging in risky driving practices. Conversely, engaging in risky driving practices, particularly while fatigued, may heighten the risk of being involved in accidents [43]. Consequently, this connection implies a multifaceted interplay in which the extensive hours of driving and the active search for passengers may contribute to the manifestation of risky driving practices and the likelihood of being involved in RTAs. Furthermore, taxi drivers make their daily income through the number of passengers they can transport, which could influence them to walk behind the clock to make more money by getting more passengers. Consequently, this may raise the likelihood of their involvement in RTA as fatigue and tiredness could set in. Overspeeding may also be a factor that makes taxi drivers involved in RTA. In an attempt to complete a trip and make more, the chances of overspeeding may not be ruled out, which can cause RTA Thus, the involvement of taxi drivers in RTA due to overspeeding as a fall-out of the quest for more trips could be a factor to note. This aligns with the findings of Zahid et al. [63], who suggested that speeding violations among taxi drivers are prevalent. This could increase the chances of RTA involvement [62]. Also, Vahedi et al. [55] and Peng et al. [38] found a high number of trips made by taxi drivers and financial burdens as RTA influence. Although most of the previous studies were done in developed countries, there is an alignment in the results on the taxi drivers in Nigeria which is a developing country. The consistency in our findings with previous studies could be because taxi drivers were specifically examined in the studies, which suggests taxi drivers' behaviors are similar irrespective of location.

Risky driving behavior of truck drivers influences accident involvement, confirming hypothesis 2. Truck drivers' behavior had a stronger influence than taxi drivers due to its higher path coefficient. The potential for truck drivers' behavior to influence more of the RTA could be due to their vehicle's size, weight, complexity in maneuvering, braking effect time, and fatigue. Considering the size and weight of trucks, which outweighs other categories of vehicles, more devasting effects from injuries, death, and property damage are expected when RTA involves trucks. Also, the technicalities in maneuvering a truck are complex and require expertise, which, if not properly done, can result in RTA. This is related to the braking effect time in which truck vehicle brakes rarely take effect immediately after application. It may require some distance for the truck to completely halt, increasing the chances of RTA compared to taxi drivers. Although all categories of drivers may experience driving fatigue, the chances could be high among truck drivers, especially long-haul drivers who usually travel longer distances and may not comply with the daily driving limit, resulting in fatigue that may cause RTA. This is in agreement with the findings of Song and Choi [46] that commercial truck drivers' behavior

contributes significantly to high RTAs. Similarly, truck drivers were also reported to have more propensity to RTA due to negligence and lapses [20], substance abuse, poor working conditions, and driving styles [4], fatigue, long hours driving, and insufficient sleep [13] which are risky driving behaviors. Their contribution to accidents could be a function of long-distance driving and inconsistent schedules peculiar to professional truck drivers. Despite the different methods of analysis like the logistic regression and fuzzy logic adopted in the previous studies in contrast to structural equation modelling used in our studies, which offers less measurement error, our findings still align in terms of truck drivers behavior influencing RTA.

The relationship between the taxi drivers' risky behavior and RTA involvement increases when positive driving behavior increases, even though the significant moderating effect did not support hypothesis 3. The negative moderating role of positive driving behavior on commercial taxi drivers' risky behavior and accident involvement suggests positive driving behavior had a negative effect on risky driving behaviors and accident involvement for commercial taxi drivers. Positive driving behavior should curtail some careless driving behavior, but the reverse is true for taxi drivers based on our findings. The risky driving behavior increases with accident involvement, even with highly positive driving behavior. The potential justification for this could be that commercial taxi drivers may be perceptive that road traffic crashes involving them are not as fatal as commercial truck drivers, as confirmed by the study by Chen et al. [5]. Also, positive driving behavior may not consistently serve as a reliable moderator because of disparities in driving circumstances. Variances in road conditions, traffic scenarios, and geographic locations in Nigeria may impact the efficacy of positive driving habits in attenuating the consequences of hazardous behaviors. Additionally, individual differences among taxi drivers may have an impact. For instance, some taxi drivers may possess a greater capacity for accepting risk, thereby reducing the effectiveness of positive driving behavior as a mitigating factor. Moreso, personal attributes such as experience, personality traits, and coping mechanisms may differ, affecting the capability of positive behavior to moderate hazardous actions. If the frequency and severity of risky behaviors among taxi drivers are consistently high, the moderating effect of positive driving behavior may be limited. Specifically, the quest to make more trips for more money could result in driving violations and limit their positive driving behaviors. This is consistent with the findings of Ba et al. [2] and Y. Huang et al. [23] that taxi drivers indulge in driving violations to save time in the quest for more passengers. Also, the results align with the findings of Zhao et al. [64] that commercial taxi drivers spend long hours scouting for passengers to make more income, which often results in stress culminating in RTAs. In such cases, positive actions might struggle to offset the cumulative impact of frequent or severe risky behaviors. Additionally, the potential impact of positive driving behavior as a moderator may be subject to the influence of taxi drivers' skill level and training. In the event that drivers possess insufficient skills or have not undergone appropriate training in positive driving techniques, the mitigating impact may be diminished.

The relationship between risky driving behaviors and involvement in RTA increases when positive driving behavior decreases among truck drivers; thus, hypothesis 4 is supported. At low positive driving behavior exhibited by truck drivers, risky driving behavior strongly impacts the accident. In other words, risky driving behavior increases with accident involvement when commercial truck drivers exhibit less positive driving behavior. This could result from the truck drivers' consciousness that they are driving large vehicles and are aware that any form of risky driving behavior can result in fatal crashes. Truck accidents are usually detrimental and colossal compared to other vehicle categories. Thus, the more positive driving behavior among the truck drivers, the fewer RTAs due to risky driving behavior as a good driving safety environment is created. This notion is confirmed by the findings of Han and Zhao [19] that positive driving reduces risky driving behavior among professional drivers. It is also in tandem with the findings in the study of Han et al. [20] and Maslać et al. [29], in which there was a decline in risky driving behaviors due to an increase in positive driving behaviors. Positive driving behavior creates and ensures a good and safe driving environment. In cases where less of it is practiced by drivers, the chances of more risky driving practices and RTA are expected. The consistency of the findings with previous studies may be due to the peculiarity of professional drivers' styles, which is common among them, notwithstanding their countries.

The findings that accidents increase for taxi drivers despite the moderating effect of positive driving behavior suggest that the moderating effect may not be as effective in mitigating the impact of risky behaviors for taxi drivers. This finding opens avenues for further research to explore why positive behavior might have varying effects across different driver populations. In addition, interventions and training initiatives targeted towards taxi drivers may require focused attention towards addressing particular obstacles associated with risky driving behavior, while taking into account the restricted effectiveness of positive driving behavior as a mitigating variable. Furthermore, for truck drivers, finding that accidents reduce truck drivers with the moderating effect of positive behaviors that are effective in reducing accidents among truck drivers. Practically, identifying and promoting positive driving behaviors among truck drivers may prove to be an effective strategy for enhancing road safety. This insight can inform targeted training programs and interventions.

Generally, these results imply that positive driving behaviors among commercial taxi and truck drivers in Nigeria are a vital factor that can enhance road safety. However, suppose positive driving behaviors are not exhibited by drivers, possibly due to cultural influence, pressure to compete with other drivers, ignorance, or personality influence driving. In that case, it may not create a conducive driving environment that should promote road traffic safety through drivers. This further strengthens the importance of positive driving behavior as it produces an atmosphere that curtails risky driving among drivers, especially for commercial drivers who drive long hours with irregular work schedules. Therefore, promoting positive driving behaviors and deliberately exhibiting them should be prioritized for safety.

This study has some limitations. The drivers' participation was based on registered commercial taxis and truck drivers. Therefore, the results cannot be generalized for all categories of commercial drivers. The data were collected through self-reports, and measuring the variables was limited to the participants' perceptions. The possibility of self-report bias may be a concern, even though anonymity was ensured during data collection and VIF results were within acceptable limits. Also, the moderating effect of

drivers' sociodemographics was not within the scope of this study, which can be an avenue for future studies.

Conclusion

The study investigated the moderating role of positive driving behavior on risky driving behavior and accident involvement among commercial truck and taxi drivers in Nigeria to promote and encourage positive driving behaviors for commercial drivers. Positive driving behavior positively moderated truck drivers' risky behavior, while taxi drivers' behavior was negatively moderated. This study significantly advances the knowledge of the moderating effect of positive driving behavior on the relationship between risky driving behavior and accident involvement among commercial taxi and truck drivers in Nigeria. The findings contribute to the existing literature on driver behavior and give practical insights for transport programs among stakeholders like driver trainers, driver employees, transport policymakers, and government agencies. Also, the duality inherent in the moderating effects highlights the necessity for customized methods when tackling road safety concerns among distinct driver demographics.

Therefore, there is a need to ensure positive driving behavior is included in the driver's training and policy formulation to create a safe driving environment for road users. This study contributes to the existing literature by including positive driving behavior as a moderating variable and understanding that only positive driving behavior among drivers may not reduce road traffic accidents but through enforcement, monitoring, and evaluation. Future studies may consider the moderating effect on the relationship between driving anger, fatigue, and accident involvement. This will further give insights into the moderating effect of positive driving behavior.

Abbreviations

RTA	Road traffic accidents
DBQ	Driver Behavior Questionnaire
SEM	Structural equation modeling
VIF	Variance inflation factor
CMV	Common method variance
AVE	Average variance extracted
PDB	Positive driving behaviors
CR	Composite reliability
CV	Convergent validity
HTMT	Heterotrait monotrait

Acknowledgements

The authors acknowledge the support of the Nigerian Institute of Transport Technology Zaria for funding this research.

Authors' contributions

OA collected/analyzed the data and drafted the manuscript. NM carried out validation, conceptualization, and supervision for the study. SA carried out the supervisory role. RM supervised the study. All authors read and approved the final manuscript.

Funding

This study was funded by the Nigerian Institute of Transport Technology Zaria, vote number R. J130000.7309.4B689 (PY/2021/00646).

Availability of data and materials

The data for the current study are not publicly available due to the assurance of privacy given to the respondents and organizations but can be made available through the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare that they have no competing interests.

Received: 27 December 2023 Accepted: 26 February 2024 Published online: 08 March 2024

References

- Ang BH, Chen WS, Lee SW (2019) The Malay Manchester Driver Behaviour Questionnaire: a cross-sectional study of geriatric population in Malaysia. J Transp Health 14(January):100573. https://doi.org/10.1016/j.jth.2019.100573
- Ba X, Zhou F, Wang Y (2018) Predicting personal injury crash risk through working conditions, job strain, and risky driving behaviors among taxi drivers. Eur Transp Res Rev 10(2). https://doi.org/10.1186/s12544-018-0320-x
- Beanland V, Sellbom M, Johnson AK (2014) Personality domains and traits that predict self-reported aberrant driving behaviours in a southeastern US university sample. Accid Anal Prev 72:184–192
- 4. Benallou I, Azmani A, Azmani M (2023) Evaluation of the accidents risk caused by truck drivers using a Fuzzy Bayesian Approach. Int J Adv Comp Sci Appl 14(6):173–182. https://doi.org/10.14569/IJACSA.2023.0140620
- Chen M, Chen P, Gao X, Yang C (2020) Examining injury severity in truck-involved collisions using a cumulative link mixed model. J Transp Health 19:100942
- Chu W, Wu C, Atombo C, Zhang H, Özkan T (2019) Traffic climate, driver behaviour, and accidents involvement in China. Accid Anal Prev 122(1178):119–126. https://doi.org/10.1016/j.aap.2018.09.007
- Cohen J (1988) Statistical power analysis Jbr the behavioral. Sciences. Lawrence Erlbaum Associates, Hillsdale, pp 18–74
- Cordazzo STDD, Scialfa CT, Ross RJ (2016) Modernization of the driver behaviour questionnaire. Accid Anal Prev 87:83–91. https://doi.org/10.1016/j.aap.2015.11.016
- 9. Dayyabu A, Umar I, Ozsoy U (2017) Severity Assessment of Truck Involved Accident in Northwest Nigeria Some of the authors of this publication are also working on these related projects : Emotional Artificial Neural Network View project Mechanical Property of Reinforcement Steel View proje
- De Winter JCF, Dodou D (2010) The driver behaviour questionnaire as a predictor of accidents: a meta-analysis. J Safety Res 41(6):463–470. https://doi.org/10.1016/j.jsr.2010.10.007
- 11 Dias C, Kharbeche M, Muley D, Kashem A, Fahed MA, Iral SV, Abdelfattah N (2022) Are professional drivers more aggressive than general drivers? A case study from Doha, Qatar. Proc Comp Sci 201(C):16–23. https://doi.org/10. 1016/j.procs.2022.03.005
- 12. Dotse JE, Rowe R (2021) Modelling Ghanaian road crash risk using the Manchester driver behaviour questionnaire. Saf Sci 139(2021):105213. https://doi.org/10.1016/j.ssci.2021.105213
- Elshamly AF, El-Hakim RA, Afify HA (2017) Factors affecting accidents risks among truck drivers in Egypt. MATEC Web Conf 124:10–14. https://doi.org/10.1051/matecconf/201712404009
- 14. Guého L, Granié MA, Abric JC (2014) French validation of a new version of the Driver Behavior Questionnaire (DBQ) for drivers of all ages and level of experiences. Accid Anal Prev 63:41–48. https://doi.org/10.1016/j.aap.2013.10.024
- Gupta L, Goswami S, Kumar R (2021) Analysis of driver behaviours towards road safety measures using DBQ in the Indian context. Trans Transp Sci 12(1):12–18. https://doi.org/10.5507/tots.2021.001
- Hair JF, Hult GTM, Ringle CM, Sarstedt M, Danks NP, Ray S (2021) Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R. Springer International Publishing. https://doi.org/10.1007/978-3-030-80519-7
- 17. Hair JF, Risher JJ, Sarstedt M, Ringle CM (2019) When to use and how to report the results of PLS-SEM. Eur Bus Rev 31(1):2–24. https://doi.org/10.1108/EBR-11-2018-0203
- Hair JF Jr, Matthews LM, Matthews RL, Sarstedt M, Hair JF Jr, Matthews LM, Matthews RL, Sarstedt M (2017) PLS-SEM or CB-SEM: updated guidelines on which method to use. Int J Multivar Data Anal 1(2):107. https://doi.org/10.1504/ ijmda.2017.10008574
- Han W, Zhao J (2020) Driver behaviour and traffic accident involvement among professional urban bus drivers in China. Transp Res F: Traffic Psychol Behav 74:184–197. https://doi.org/10.1016/j.trf.2020.08.007
- 20 Han W, Zhao J, Chang Y (2021) Driver behaviour and traffic accident involvement among professional heavy semitrailer truck drivers in China. PLoS ONE 16(12 December):1–11. https://doi.org/10.1371/journal.pone.0260217
- Hezaveh AM, Nordfjærn T, Mamdoohi AR, Şimşekoğlu Ö (2018) Predictors of self-reported crashes among Iranian drivers: exploratory analysis of an extended driver behaviour questionnaire. Promet - Traffic - Traffic 30(1):35–43. https://doi.org/10.7307/ptt.v30i1.2412
- Hu L, Bao X, Wu H, Wu W (2020) A study on correlation of traffic accident tendency with driver characters using indepth traffic accident data. J Adv Transp 2020. https://doi.org/10.1155/2020/9084245
- 23 Huang Y, Ng ECY, Zhou JL, Surawski NC, Chan EFC, Hong G (2018) Eco-driving technology for sustainable road transport: a review. Renew Sustain Energy Rev 93(January 2019):596–609. https://doi.org/10.1016/j.rser.2018.05.030
- 24. Huang YW, Lin PC, Wang J (2018) The influence of bus and taxi drivers' public self-consciousness and social anxiety on aberrant driving behaviors. Accid Anal Prev 117(March):145–153. https://doi.org/10.1016/i.aap.2018.04.014
- Hussain B, Sato H, Miwa T, Morikawa T (2020) Influence of personality traits on aberrant driving behaviors: a comparison of Japanese, Chinese, and Vietnamese drivers. J Safety Res 75:178–188. https://doi.org/10.1016/j.jsr.2020.09. 011
- 26 Luo X, Ge Y, Qu W (2023) The association between the Big Five personality traits and driving behaviors: A systematic review and meta-analysis. Accid Anal Prev 183(October 2022):106968. https://doi.org/10.1016/j.aap.2023.106968
- Marcoulides KM, Raykov T (2019) Evaluation of variance inflation factors in regression models using latent variable modeling methods. Educ Psychol Measur 79(5):874–882. https://doi.org/10.1177/0013164418817803
- Martinussen LM, Hakamies-Blomqvist L, Møller M, Özkan T, Lajunen T (2013) Age, gender, mileage and the DBQ: the validity of the Driver Behavior Questionnaire in different driver groups. Accid Anal Prev 52:228–236. https://doi.org/ 10.1016/j.aap.2012.12.036
- Maslać M, Antić B, Lipovac K, Pešić D, Milutinović N (2018) Behaviours of drivers in Serbia: Non-professional versus professional drivers. Transport Res F: Traffic Psychol Behav 52:101–111. https://doi.org/10.1016/j.trf.2017.11.020

- Maslać M, Antić B, Pešić D, Milutinović N (2017) Behaviours of professional drivers: validation of the DBQ for drivers who transport dangerous goods in Serbia. Transport Res F: Traffic Psychol Behav 50:80–88. https://doi.org/10.1016/j. trf.2017.08.001
- Mattsson M, O'Brien F, Lajunen T, Gormley M, Summala H (2015) Measurement invariance of the Driver Behavior Questionnaire across samples of young drivers from Finland and Ireland. Accid Anal Prev 78:185–200
- Mehdizadeh M, Shariat-Mohaymany A, Nordfjaern T (2019) Driver behaviour and crash involvement among professional taxi and truck drivers: light passenger cars versus heavy goods vehicles. Transport Res F: Traffic Psychol Behav 62:86–98. https://doi.org/10.1016/j.trf.2018.12.010
- 33 Memon MA, Cheah JH, Ramayah T, Ting H, Chuah F, Cham TH (2019) Moderation analysis: issues and guidelines. J Appl Struct Equ Model 3(1):i–xi
- 34. National Bureau of Statistics, R. T. D. (Q2 2020) (2022) Road Transport Data (2022) (Issue November)
- Oluwadiya KS, Popoola SO, Onyemaechi NO, Kortor JN, Denen-Akaa P (2020) Adaptation of the driver behaviour questionnaire and behavioural risk factors for traffic violation arrest and self-reported crash involvement among Nigerian drivers. Niger Postgrad Med J 27(2). https://doi.org/10.4103/npmj.npmj_172_19
- Özkan T, Lajunen T (2005) Multidimensional Traffic Locus of Control Scale (T-LOC): factor structure and relationship to risky driving. Personality Individ Differ 38(3):533–545. https://doi.org/10.1016/j.paid.2004.05.007
- 37. Özkan T, Lajunen T, Ozkan T, Lajunen T, Özkan T, Lajunen T (2005) A new addition to DBQ: positive driver behaviours scale. Transport Res F: Traffic Psychol Behav 8(4–5):355–368. https://doi.org/10.1016/j.trf.2005.04.018
- Peng Z, Wang Y, Luo X (2020) How does financial burden influence the crash rate among taxi drivers? A self-reported questionnaire study in China. Traffic Inj Prev 21(5):324–329. https://doi.org/10.1080/15389588.2020.17590
 46
- 39. Qin L, Li ZR, Chen Z, Bill MA, Noyce D (2019) Understanding driver distractions in fatal crashes: An exploratory empirical analysis. J Saf Res 69:23–31. https://www.sciencedirect.com/science/article/pii/S0022437518300574
- Reason J, Manstead A, Stephen S, Baxter J, Campbell K (1990) Errors and violations on the roads: a real distinction? Ergonomics 33(10–11):1315–1332. https://doi.org/10.1080/00140139008925335
- Rejali S, Aghabayk K, Shiwakoti N (2022) A clustering approach to identify high-risk taxi drivers based on selfreported driving behavior. J Adv Transp 2022. https://doi.org/10.1155/2022/6511225
- Rezapour M, Wulff SS, Ksaibati K (2018) Predicting truck at-fault crashes using crash and traffic offence data. Open Transp J 12(1):128–138. https://doi.org/10.2174/18744478018120100128
- Shams Z, Sanij HK, Afshani A, Ramezani-Khansari E, Nejad FM, Olazar M (2022) Studying the effect of fatigue and sleepiness of long-haul truck drivers on road accidents by adopting structural equation models analysis. Jurnal Kejuruteraan 34(2):325–336. https://doi.org/10.17576/jkukm-2022-34(2)-16
- 44. Sinclair M (2013) Attitudes, norms and driving behaviour: a comparison of young drivers in South Africa and Sweden. Transport Res F: Traffic Psychol Behav 20:170–181. https://doi.org/10.1016/j.trf.2013.07.001
- 45 Singh H, Kathuria A (2023) Self-reported aberrant driving behavior among Bus Rapid Transit drivers. J Public Transp 25(December 2022):100040. https://doi.org/10.1016/j.jpubtr.2023.100040
- Song KH, Choi S (2021) A study on the perception change of passengers on sustainable air transport following covid-19 progress. Sustainability (Switzerland) 13(14). https://doi.org/10.3390/su13148056
- Stephens AN, Fitzharris M (2016) Validation of the Driver Behaviour Questionnaire in a representative sample of drivers in Australia. Accid Anal Prev 86(June):186–198. https://doi.org/10.1016/j.aap.2015.10.030
- Sucha M, Sramkova L, Risser R (2014) The Manchester driver behaviour questionnaire: self-reports of aberrant behaviour among Czech drivers. Eur Transp Res Rev 6(4):493–502. https://doi.org/10.1007/s12544-014-0147-z
- Sullman MJM, Stephens AN, Taylor JE (2019) Multigroup invariance of the DAS across a random and an internetsourced sample. Accid Anal Prev 131(June):137–145. https://doi.org/10.1016/j.aap.2019.06.013
- 50 Tehseen S, Ramayah T, Sajilan S (2017) Testing and controlling for common method variance: a review of available methods. J Manag Sci 4(2):142–168. https://doi.org/10.20547/jms.2014.1704202
- Umar IK, Bashir S (2020) Investigation of the factors contributing to truck driver's involvement in an injury accident. Pamukkale Univ J Eng Sci 26(3):402–408. https://doi.org/10.5505/pajes.2019.65391
- Useche SA, Cendales B, Alonso F, Montoro L, Pastor JC (2019) Trait driving anger and driving styles among Colombian professional drivers. Heliyon 5(8):e02259. https://doi.org/10.1016/j.heliyon.2019.e02259
- Useche SA, Cendales B, Lijarcio I, Llamazares FJ (2021) Validation of the F-DBQ: a short (and accurate) risky driving behavior questionnaire for long-haul professional drivers. Transport Res F: Traffic Psychol Behav 82(April):190–201. https://doi.org/10.1016/j.trf.2021.08.013
- Useche SA, Ortiz VG, Cendales BE (2017) Stress-related psychosocial factors at work, fatigue, and risky driving behavior in bus rapid transport (BRT) drivers. Accid Anal Prev 104:106–114
- 55. Vahedi J, Mohaymany AS, Tabibi Z, Mehdizadeh M, ShariatMohaymany A, Tabibi Z, Mehdizadeh M, Mohaymany AS, Tabibi Z, Mehdizadeh M (2018) Aberrant driving behaviour, risk involvement, and their related factors among taxi drivers. Int J Environ Res Public Health 15(8):1626. https://doi.org/10.3390/ijerph15081626
- Wang X, Jiao Y, Huo J, Li R, Zhou C, Pan H, Chai C (2021) Analysis of safety climate and individual factors affecting bus drivers' crash involvement using a two-level logit model. Accid Anal Prev 154(November 2019):106087. https://doi. org/10.1016/j.aap.2021.106087
- Wang Y, Qu W, Ge Y, Sun X, Zhang K (2018). Effect of personality traits on driving style: psychometric adaption of the multidimensional driving style inventory in a Chinese sample. PLoS ONE 13(9). https://doi.org/10.1371/journal.pone. 0202126
- 58. World Health Organization (2023) Road safety (https://www.who.int/health-topics/road-safety#tab=tab_1)
- 59. World Health Organization (2022) Road traffic injuries
- 60. Xie C, Parker D (2002) A social psychological approach to driving violations in two Chinese cities. Transport Res F: Traffic Psychol Behav 5(4):293–308
- Yan M, Chen W, Wang J, Zhang M, Zhao L (2021) Characteristics and causes of particularly major road traffic accidents involving commercial vehicles in China. Int J Environ Res Public Health 18(8). https://doi.org/10.3390/ijerp h18083878

- 62. Yao M, Zhou Y, Li J, Gao X (2019) Violent video games exposure and aggression: the role of moral disengagement, anger, hostility, and disinhibition. Aggress Behav 45(6):662–670
- Zahid M, Chen Y, Khan S, Jamal A, Ijaz M, Ahmed T (2020) Predicting risky and aggressive driving behavior among taxi drivers: do spatio-temporal attributes matter? Int J Environ Res Public Health 17(11):1–21. https://doi.org/10. 3390/ijerph17113937
- Zhao Y, Jun Z, He X (2015) Risk factors contributing to taxi involved crashes: a case study in Xi'an, China. Period Polytech Transp Eng 43(4):189–198. https://doi.org/10.3311/PPtr.7742
- 65. Zhu Y, Ma Y, Chen S, Khattak AJ, Pang Q (2022) Identifying potentially risky intersections for heavy-duty truck drivers based on individual driving styles. Appl Sci (Switzerland) 12(9):1–21. https://doi.org/10.3390/app12094678

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