

Article

Integration of Theory of Planned Behavior, Sensation Seeking, and Risk Perception to Explain the Risky Driving Behavior of Truck Drivers

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Abstract: Truck-related accidents account for a substantial portion of traffic accidents. Risky driving behavior is a main cause of traffic accidents. Understanding the risky driving behavior of truck drivers is therefore important in reducing truck-related accidents. This study aimed to propose and validate a research model that integrated a theory of planned behavior, sensation seeking, and risk perception to explain the risky driving behavior of truck drivers. A total of 471 valid data were collected from Chinese truck drivers in this study. Structural equation modeling and mediation analysis were used to examine the influence of factors in the research model on the risky driving behavior of truck drivers. Results showed that sensation seeking and risk perception of truck drivers were influential in shaping their intention to drive riskily with the mediation of attitude toward risky driving. Risk perception and attitude toward risky driving also had a negative influence and positive influence on the intention, respectively. On the basis of the findings, practical recommendations for reducing the risky driving behavior of truck drivers were provided for concerned parties.

Keywords: risk perception; risky driving behavior; sensation seeking; theory of planned behavior; truck drivers



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1. Introduction

The National Bureau of Statistics [1] reported that the number of heavy trucks in China increased from 13.7 million in 2009 to 25.7 million in 2018, accounting for a remarkable growth of 87.6%. Moreover, the expressway network length in China had a substantial increase of 119%, from 65,100 km in 2009 to 142,600 km in 2018 [1]. According to the Traffic Management Bureau of Ministry of Public Security [2], truck-related crashes accounted for 21.1% of the total traffic crashes and 36.45% of the total crash deaths in China in 2016. Given these alarming facts, safety issues related to trucks and truck drivers have become urgent topics for transportation safety researchers.

Previous studies considered the design of trucks in improving the safety of truck drivers. For instance, Fors et al. [3] affirmed that a poorly designed truck control board may distract truck drivers from their driving tasks, which then causes their unsafe driving behavior. The introduction of an additional display in a truck control board may be harmful to the driving performance of truck drivers. Du et al. [4] investigated the influence of active and passive suspension truck seats on the vigilance and discomfort of truck drivers. They found that the ergonomic design of truck seats can help reduce the exposure of truck drivers to whole-body vibration (WBV). With less exposure to WBV, the discomfort of truck drivers can be reduced, and their vigilance can be maintained, thereby reducing the risk of truck collisions and improving their health and safety.

Apart from the design of trucks, the personal factors of truck drivers, such as mental disorders, daily fatigue problems, and personality traits, are important to determine their driving

behavior. Alavi et al. [5] evaluated the effect of mental disorders on road traffic accidents among truck drivers and found that the neuroticism of truck drivers may lead to an increase in their truck accidents. Naderi et al. [6] found that the daily fatigue problems of truck drivers may influence their aberrant driving behavior and are inversely affected by truck price and sleep quality. Linkov et al. [7] examined the correlations among personality traits (including neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) and the driving performance of truck drivers. For other types of professional drivers, the driving behavior was also an important topic in transportation safety [8,9].

Risky driving behavior is one of the main causes of traffic accidents [10–12] and defined as any driving behavior that may increase the risk of a road accident [13]. Thus, understanding the risky driving behavior of truck drivers is crucial to reduce truck-related traffic accidents. Although previous studies made some contributions to the literature on the risky driving behavior of truck drivers, several research gaps were identified. First, the effect of risk perception and sensation seeking on attitude toward risky driving and intention to drive riskily of truck drivers has not been examined. Second, no previous study considered theory of planned behavior to explain the risky driving behavior of truck drivers. Third, previous studies did not examine the mediating role of attitude toward risky driving in the relationships between sensation seeking and intention to drive riskily and between risk perception and intention to drive riskily. Therefore, this study aimed to address these limitations and extend truck driver safety literature by proposing and validating a research model that integrates theory of planned behavior, sensation seeking, and risk perception with structural equation modeling (SEM) and mediation analysis. This study can provide an in-depth understanding of the risky driving behavior of truck drivers. The results can be used by concerned authorities to develop effective interventions for reducing the risky driving behavior of truck drivers, thereby decreasing the number of truck-related traffic accidents. The theoretical and practical contributions of this study reflect its significance and novelty.

2. Research Hypotheses and Model

2.1. Theory of Planned Behavior

Theory of planned behavior, which was proposed by Ajzen [14], suggests that a person's intention to act out a behavior is a determinant of the person's behavior. The intention can be influenced by three important constructs, including attitude toward the behavior, perceived behavioral control, and subjective norm. Attitude is the positive or negative evaluation of the behavior. Perceived behavioral control reflects the perception of people about their ability to engage in the behavior. Subjective norm refers to the perceived social pressure to carry out the behavior. According to the theory of planned behavior [14] and given the research context of the current study, attitude toward risky driving is the positive or negative evaluation of the risky driving behavior among truck drivers, subjective norm is the perceived social pressure of truck drivers to drive riskily, and perceived behavioral control is the perception of truck drivers about their ability to drive riskily.

The theory of planned behavior has been widely used to explain different human behaviors, including pedestrian violations [15], mobile device use of undergraduate students [16], pool safety behavior of parents [17], safety behavior of employees [18], mobile phone use of cyclists [19], and personal protective equipment use of construction workers [20]. The utility of the theory in explaining various human behaviors has been explicitly demonstrated in previous studies. Therefore, the theory of planned behavior was chosen as a theoretical framework in this study to develop a research model that explains the risky driving behavior of truck drivers. The following hypotheses were proposed:

Hypothesis 1 (H1). *Attitude toward risky driving positively influences intention to drive riskily.*

Hypothesis 2 (H2). *Perceived behavioral control positively influences intention to drive riskily.*

Hypothesis 3 (H3). *Subjective norm positively influences intention to drive riskily.*

Hypothesis 4 (H4). *Intention to drive riskily positively influences risky driving behavior.*

2.2. Sensation Seeking

Sensation seeking is defined as the desire of a person to seek novel, varied, and complex experiences and sensations [21]. The concept of sensation seeking has been applied to different research areas, such as political violence [22], behavioral addictions [23], transportation safety [24], and construction safety [25]. Previous studies have shown that sensation seeking is positively related to the risk-taking behavior of people [26]. In the context of transportation safety, sensation seeking is regarded as the most important personality trait in relation to risky driving behavior [7] and is positively associated with accident involvement and tickets received [27]. Sensation seeking likewise has a positive influence on the attitude of drivers toward speeding [28]. However, the relationship between sensation seeking and attitude toward risky driving of truck drivers has not been examined. Understanding how attitude toward risky driving is affected by sensation seeking of truck drivers is important to reduce truck accidents [29]. On the basis of the knowledge obtained from previous studies, it was hypothesized that:

Hypothesis 5 (H5). *Sensation seeking positively influences attitude toward risky driving.*

Hypothesis 6 (H6). *Sensation seeking positively influences intention to drive riskily.*

2.3. Risk Perception

Risk perception is defined as an intuitive risk judgment to evaluate hazards by Slovic [30], who proposed psychometric approaches to study risk perception in relation to various technologies and human activities. Particularly, risk perception has been considered a critical factor in understanding the risk-taking behavior of people. The negative relationship between risk perception and risk-taking behavior of people has been identified in various research areas. For instance, Useche et al. [31] indicated that risk perception negatively influences the risky behavior of cyclists. Man et al. [32] found that risk perception is negatively correlated with the risk-taking behavior of construction workers. Hamid [33] discovered that risk perception is negatively related to the risk-taking behavior of investors in an emerging market. Moreover, risk perception is a crucial factor in determining the attitudes toward risk-taking behavior of cyclists [34]. According to the results of previous studies, the following hypothesis was put forward:

Hypothesis 7 (H7). *Risk perception negatively influences attitude toward risky driving.*

Hypothesis 8 (H8). *Risk perception negatively influences intention to drive riskily.*

According to the above literature review, the research model that combines theory of planned behavior, sensation seeking, and risk perception was proposed to explain the risky driving behavior of truck drivers. The research model with the above stated eight hypotheses is shown in Figure 1.

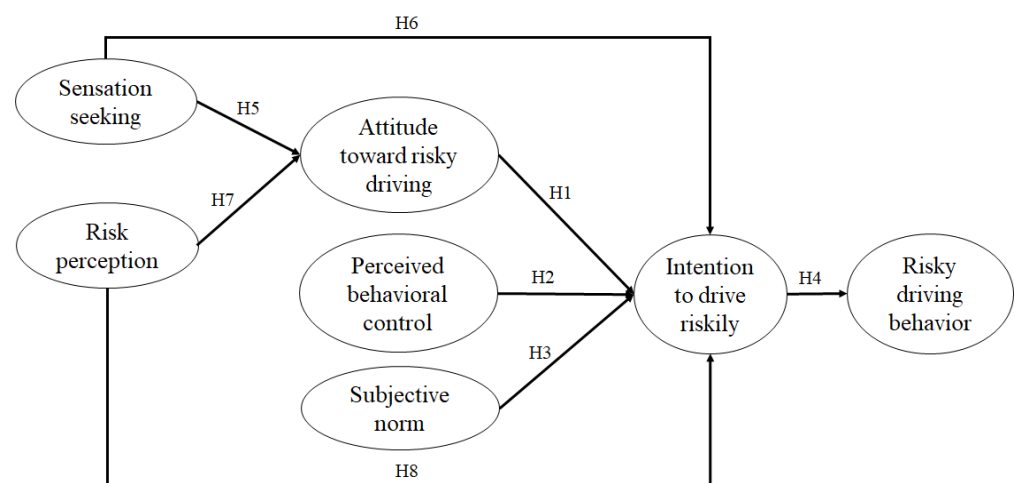


Figure 1. Proposed research model to explain the risky driving behavior of truck drivers.

3. Method

3.1. Measurements

This study employed a self-administered questionnaire survey to collect empirical data. The questionnaire had two sections. The demographic characteristics of the participants, including age, gender, education level, truck driving experience, and region of the country, were collected in the first section. The constructs in the research model were measured in the second section, including sensation seeking, risk perception, attitude toward risky driving, perceived behavioral control, subjective norm, intention to drive riskily, and risky driving behavior of truck drivers. A total of 24 items for measuring the constructs were designed based on the literature review. A five-point Likert-type scale was used in the questionnaire, ranging from 1 = strongly disagree to 5 = strongly agree. The score of the risk perception scale was reversely coded. Therefore, the higher the scale score of the constructs, the higher the level of the construct the participants hold. Table 1 shows the item contents and corresponding references.

Table 1. Item contents and corresponding references.

Construct.	Item	Content	Reference
Sensation seeking (SS)	SS1	You would like to take off on a trip with no pre-planned routes or timetables.	[35]
	SS2	You get restless when you spend too much time at home.	
	SS3	You prefer friends who are excitingly unpredictable.	
Risk perception (RP)	RP1	You think it is safe to take some risks when driving because it makes driving more fun.	[36]
	RP2	You think it is safe to make rude gestures at other drivers.	
	RP3	You think it is safe to do burnouts, donuts, or skids just for the fun of it.	
Attitude toward risky driving (ATRD)	ATRD1	Risky driving would be a good idea.	[37]
	ATRD2	Risky driving would be a wise idea.	
	ATRD 3	You like the idea of risky driving.	
Perceived behavioral control (PBC)	PBC1	You would be able to drive riskily.	[37]
	PBC2	Risky driving is entirely within your control.	
	PBC3	You have the resources, knowledge, and ability to drive riskily.	
Subjective norm (SN)	SN1	People who are important to you (such as your parents, children, and spouse) would think that you should drive riskily in daily work.	[37]
	SN2	People who influence you (such as your coworkers or supervisor) would think that you should drive riskily in daily work.	
	SN3	People who are important to you (such as your parents, children, and spouse) would prefer that you should drive riskily in daily work.	
Intention to drive riskily (ITDR)	ITDR1	You intend to drive riskily in the future.	[37]
	ITDR2	You predict that you would drive riskily in the future.	
	ITDR3	You want to drive riskily in the future.	
Risky driving behavior (RD)	RDB1	You always overtake the car in front even when it keeps an appropriate speed.	[38]
	RDB2	You always ignore traffic rules to proceed faster.	
	RDB3	You always drive faster to catch up on an appointment.	
	RDB4	You always drive too close to the car in front to be able to stop if it should brake.	
	RDB5	You are always distracted because of things happening around you while driving.	
	RDB6	You always create dangerous situations because you are not attentive enough.	

3.2. Participants

The questionnaires were administered to 500 Chinese truck drivers. The selection criterion of the sample was full-time truck drivers with valid driving licenses. Twenty-nine invalid data that had missing values were found and eliminated in this study, leading to 471 valid data (94.2% valid response rate) for analysis. Informed and written consents were obtained from all the participants. The demographics of the participants are shown in Table 2. Most of the participants were aged 30 or above (93.84%) and male (99.36%). The majority of the participants received lower secondary or below education (51.38%) and had more than five years of truck driving experience (77.71%).

Table 2. Demographics of the participants ($n = 471$).

Items	Description	Number of Participants	Percentage (%)
Age group	18–29	29	6.16
	30–39	169	35.88
	40–49	233	49.47
	>50–59	40	8.49
Gender	Female	3	0.64
	Male	468	99.36
Education level	Lower secondary or below	242	51.38
	Higher secondary	162	34.39
	Tertiary education	67	14.23
Truck driving experience (Number of years)	1–5	105	22.29
	6–10	182	38.64
	11–20	155	32.91
	>20	29	6.16
Region of the country	Hangzhou	86	18.26
	Changsha	79	16.77
	Beijing	113	23.99
	Shenzhen	108	22.93
	Chengdu	85	18.05

3.3. Data Analysis

This study used SEM to test the hypotheses and assess the research model. Following the suggestions of Kline [39] and prior to carrying out SEM, the study conducted confirmatory factor analysis (CFA) to verify the validity and reliability of the measurements for the constructs in the proposed research model. Specifically, a measurement model involving the constructs in the proposed research model was tested using CFA. Construct validity is verified when the model fitness indices meet the recommended levels. The model fitness indices include the ratio of chi-square value to the degree of freedom (χ^2/df), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), Tucker–Lewis Index (TLI), and comparative fit (CFI) for assessing the measurement model [39]. A model achieves good model fit when χ^2/df is smaller than 5, SRMR and RMSEA are smaller than 0.08, and TLI and CFI are greater than 0.9 [39,40]. Convergent validity is the extent to which multiple indicators of the same construct are in agreement [41]. In accordance with the recommendations of Fornell and Larcker [42], the composite reliability for each construct and factor loading of items should exceed the required value of 0.7 to confirm the convergent validity of the measurement of each construct. The average variance extracted (AVE) for each construct should be higher than the critical value of 0.5. Discriminant validity is the extent to which constructs empirically differ from one another [41]. When the square root of AVE for each construct is higher than any of the bivariate correlations between that construct and other constructs in the model, the measurement of each construct has acceptable discriminant validity [42]. Cronbach’s alpha is used to measure the internal consistency reliability of the measurement of each construct. When the Cronbach’s alpha for a construct is greater than 0.7, the measurement of the construct is considered to have acceptable internal consistency reliability [43].

In this study, once the measurement model had good model fit, the structural model could be examined using SEM to test the hypotheses in the proposed research model. The model fitness indices and corresponding requirements in SEM, which were the same as in CFA (i.e., $\chi^2/df < 5$, SRMR < 0.08, RMSEA < 0.08, TLI > 0.90, and CFI > 0.90), were used to evaluate the fit of the proposed model [39]. AMOS 22 software was used to conduct CFA and SEM [44].

4. Results

4.1. Measurement Model Assessment

The results showed that the model fit indices of the measurement model, including χ^2/df , SRMR, RMSEA, TLI, and CFI, met the required values (Table 3). Therefore, the

measurement model sufficiently fit the data. Composite reliability for each construct and factor loadings of items exceeded the criterion of 0.7 (Table 4). The values of AVE for all constructs ranged from 0.673 to 0.843 (Table 4), which exceeded the minimum threshold value of 0.5. These results confirmed that the measurement for all constructs had acceptable convergent validity. The values of the square root of AVE for each construct were greater than any of the bivariate correlations between that construct and other constructs in the model (Table 5). Therefore, the measurement of all constructs had acceptable discriminant validity. Cronbach's alpha values for all constructs, ranging from 0.841 to 0.938, were greater than the recommended value of 0.7, indicating that the internal consistency reliability of the measurement for all constructs was acceptable. Overall, the reliability and validity of the measurement model were satisfactory. Subsequently, SEM was conducted to assess the structural model.

Table 3. Model fit indices for the tested models.

Model Fit Index	Recommended Value	Measurement Model	Structural Model
χ^2/df	<5	2.899	3.455
SRMR	<0.08	0.076	0.065
RMSEA	<0.08	0.064	0.072
TLI	>0.90	0.941	0.923
CFI	>0.90	0.950	0.934

Table 4. Model fit indices for the tested models.

Construct	Item	Mean	SD	Factor Loading	AVE	Composite Reliability	Cronbach's Alpha
SS	SS1	2.599	0.949	0.874	0.673	0.861	0.854
	SS2	2.911	1.058	0.794			
	SS3	2.524	0.910	0.791			
RP	RP1	1.713	0.794	0.936	0.764	0.906	0.841
	RP2	1.764	0.818	0.897			
	RP3	2.117	0.883	0.781			
ATRD	ATRD1	3.628	1.255	0.829	0.775	0.912	0.882
	ATRD2	3.539	1.251	0.921			
	ATRD 3	3.817	1.219	0.889			
PBC	PBC1	2.159	1.193	0.895	0.842	0.941	0.938
	PBC2	2.293	1.225	0.919			
	PBC3	2.265	1.196	0.939			
SN	SN1	1.648	0.757	0.933	0.752	0.899	0.893
	SN2	1.709	0.879	0.936			
	SN3	1.660	0.746	0.713			
ITDR	ITDR1	1.541	0.781	0.891	0.843	0.942	0.925
	ITDR2	1.624	0.839	0.915			
	ITDR3	1.544	0.781	0.948			
RDB	RDB1	2.049	0.855	0.828	0.718	0.938	0.915
	RDB2	1.951	0.938	0.767			
	RDB3	1.898	0.949	0.852			
	RDB4	1.970	0.908	0.900			
	RDB5	1.843	0.836	0.892			
	RDB6	1.898	0.859	0.837			

Note: SS means sensation seeking; RP means risk perception; ATRD means attitude toward risky driving; PBC means perceived behavioral control; SN means subjective norm; ITDR means intention to drive riskily; and RDB means risky driving behavior.

Table 5. Results of discriminant validity assessment.

	SS	RP	ATRD	PBC	SN	ITDR	RDB
SS	0.820						
RP	−0.249	0.874					
ATRD	0.267	−0.821	0.880				
PBC	0.361	−0.411	0.489	0.918			
SN	0.268	0.016	0.35	0.25	0.867		
ITDR	0.293	−0.757	0.87	0.461	0.023	0.918	
RDB	0.288	−0.847	0.834	0.435	0.01	0.791	0.847

Note: Diagonal values (in bold) are the square root of AVE of the constructs; values below the diagonal are the correlations among the constructs; SS means sensation seeking; RP means risk perception; ATRD means attitude toward risky driving; PBC means perceived behavioral control; SN means subjective norm; ITDR means intention to drive riskily; and RDB means risky driving behavior.

4.2. Structural Model Assessment

The same five model fit indices as in the measurement model assessment were used to assess the structural model, which is also the research model of this study. All the model fit indices complied with the recommended values (Table 3), indicating that the research model sufficiently represented the hypothesized relationships among the constructs. The results of hypothesis testing are shown in Table 6. Five out of the eight hypotheses were supported. In particular, sensation seeking positively influences attitude toward risky driving, while risk perception negatively influences attitude toward risky driving and intention to drive riskily. Attitude toward risky driving positively influences intention to drive riskily, which positively influences risky driving behavior.

Table 6. Results of hypothesis testing.

Hypothesis	Standardized Path Coefficient	p-Value	Result
H1: Attitude toward risky driving positively influences intention to drive riskily.	0.711	<0.001	Supported
H2: Perceived behavioral control positively influences intention to drive riskily.	0.055	0.081	Not supported
H3: Subjective norm positively influences intention to drive riskily.	−0.025	0.366	Not supported
H4: Intention to drive riskily positively influences risky driving behavior.	0.802	<0.001	Supported
H5: Sensation seeking positively influences attitude toward risky driving.	0.071	0.040	Supported
H6: Sensation seeking positively influences intention to drive riskily.	0.055	0.072	Not supported
H7: Risk perception negatively influences attitude toward risky driving.	−0.809	<0.001	Supported
H8: Risk perception negatively influences intention to drive riskily.	−0.168	0.003	Supported

Figure 2 summarizes the results of hypothesis testing. The research model could explain 68.8%, 80.2%, and 64.3% of the variance in attitude toward risky driving, intention to drive riskily, and risky driving behavior, respectively, indicating the strong explanatory power of the research model for the risky driving behavior of truck drivers. The values represented the proportions of variance in dependent variables (such as attitude toward risky driving, intention to drive riskily, and risky driving behavior) that are explained by the predictors in the model. For example, in order to interpret the value associated with attitude toward risky driving, it is required first to review Figure 1 to identify which factors in the model serve as its predictors. Accordingly, we can determine that 68.8% of the variance associated with attitude toward risky driving was accounted for by its two predictors—sensation seeking and risk perception. Likewise, we can determine that risk perception, sensation seeking, attitude toward risky driving, perceived behavioral

control, and subjective norm explained 80.2% of the variance associated with intention to drive riskily. For risky driving behavior, 64.3% of its variance is explained by the predictor, namely, intention to drive riskily.

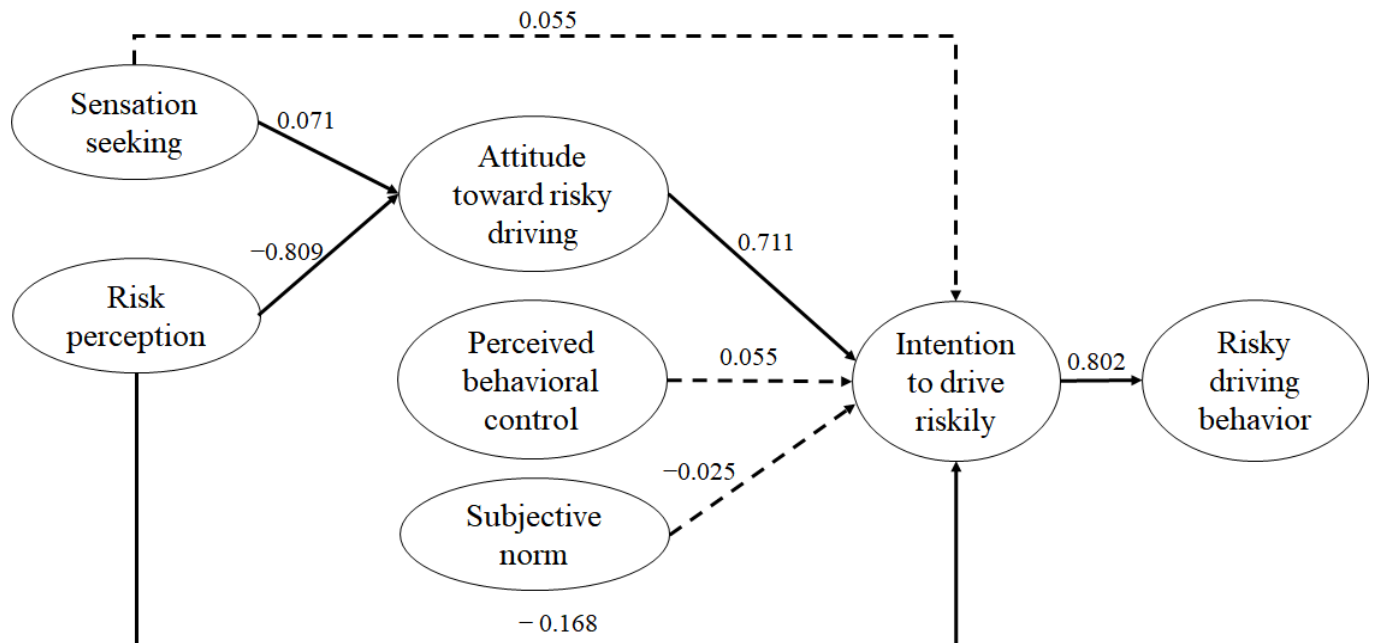


Figure 2. Results of the structural model assessment, where the values near arrows are standardized path coefficients. The solid line indicates significance, and the dotted line indicates non-significance.

4.3. Mediation Analysis

The mediating role of attitude toward risky driving in the relationships between sensation seeking and intention to drive riskily and between risk perception and intention to drive riskily was examined using the p -value program developed by Falk and Biesanz [45]. The results showed that attitude toward risky driving significantly mediates both relationships. Specifically, sensation seeking has a positive indirect effect on intention to drive riskily ($p < 0.05$) while risk perception has a negative indirect effect on intention to drive riskily ($p < 0.001$) with the mediation of attitude toward risky driving of truck drivers.

4.4. Effect of Demographic Variables

The effect of the categorical demographic variables (gender, education level, and region of the country) on risky driving behavior of truck drivers was investigated using ANOVA, but the results showed that the effect of gender ($p = 0.236$), education level ($p = 0.248$), and region of the country ($p = 0.356$) on risky driving behavior of truck drivers was not significant. For the continuous demographic variables (age and truck driving experience), Pearson correlation coefficient was used to investigate the correlation between the demographic variables and risky driving behavior of truck drivers. The results showed that the Pearson correlation coefficients for the relationship between age and risky driving behavior and the relationship between truck driving experience and risky driving behavior were 0.084 ($p = 0.07$) and -0.01 ($p = 0.983$), respectively.

5. Discussion

This study proposed a research model that integrated the theory of planned behavior, sensation seeking, and risk perception to fill the research gaps identified from previous studies. The model suggested sensation seeking and risk perception as important factors that determine whether truck drivers intend to drive riskily. This study contributed to relevant literature and practice in several manners.

5.1. Theoretical Implications

5.1.1. Theory of Planned Behavior

The results of this study supported two hypotheses related to the theory of planned behavior, which was originally proposed to explain different human behaviors [14] (Table 6). The applicability of the theory was partially demonstrated in this study. Specifically, attitude toward risky driving positively influences intention to drive riskily of truck drivers, which positively affects their risky driving behavior. However, subjective norm and perceived behavioral control were found to be insignificant factors in determining intention to drive riskily of truck drivers. These results were in agreement with the findings of Tian and Robinson [46] and Ledesma et al. [47]. Tian and Robinson [46] found that subjective norm insignificantly predicts drivers' intention to answer and make phone calls while driving. Ledesma, Tosi, Díaz-Lázaro, and Poó [47] discovered that perceived behavioral control insignificantly influences drivers' intention to use a seatbelt. Although the theory of planned behavior suggested that subjective norm is a key factor that determines the behaviors of people [14], it was not applicable to explaining the risky driving behavior of truck drivers. The possible reason for this phenomenon may be that truck drivers do not value opinions about whether or not to drive riskily from people who are important to them. As for perceived behavioral control, it was positively correlated with the risky driving behavior of truck drivers in this study. This outcome suggested that truck drivers who have a higher level of perceived behavioral control will more frequently drive riskily. This is similar to the findings of a research on construction safety by Man, Chan, and Alabdulkarim [32], who found that perceived behavioral control is positively correlated with the risk-taking behavior of construction workers.

The results indicated that among the three factors related to theory of planned behavior (i.e., attitude toward risky driving, perceived behavioral control, and subjective norm), attitude toward risky driving is the most important factor that positively influences truck drivers' intention to drive riskily. In addition, the mediating role of attitude toward risky driving in the relationships between sensation seeking and intention to drive riskily and between risk perception and intention to drive riskily was verified. This study is the first to provide evidence for the mediation effect of attitude toward risky driving on the relationships of truck drivers.

Măirean and Havârneanu [48] and Teye-Kwadjo [49] proposed two research models for the risky driving behavior of drivers. However, the explanatory powers of these models were low, accounting, respectively, for only 37.4% and 20.0% of the variance in the risky driving behavior of drivers. In the literature on truck driver safety, to our best knowledge, the present study is a pioneer in applying theory of planned behavior to explain the risky driving behavior of truck drivers. This study also proposed a research model that extended the theory of planned behavior with sensation seeking and risk perception and could explain 64.3% of the variance in truck drivers' risky driving behavior. As a result, this study advanced relevant literature and improved the understanding on the risky driving behavior of truck drivers.

5.1.2. Sensation Seeking

Consistent with the findings of Qu, Zhang, and Ge [21], this study discovered that sensation seeking positively influences intention to drive riskily of truck drivers. Qu, Zhang, and Ge [21] found that sensation seeking is a positive predictor for the risky driving behavior of drivers. Truck drivers who have a high level of sensation seeking have a high level of intention to drive riskily. This may be because risky driving behavior is exciting, which can satisfy the sensation-seeking needs of truck drivers [7,21].

Although previous studies have extensively examined the relationship between sensation seeking and risky driving behavior of drivers, the underlying mechanism of how sensation seeking influences intention of truck drivers to drive riskily is unknown. This study successfully filled this research gap by testing the mediating role of attitude toward risky driving in the relationship between sensation seeking and intention of truck drivers to drive

riskily. The results showed that sensation seeking indirectly positively influences intention to drive riskily with the mediation of attitude toward risky driving of truck drivers.

5.1.3. Risk Perception

In this study, risk perception of truck drivers was found to negatively influence their intention to drive riskily, similar to the findings of Harbeck and Glendon [50]. Harbeck and Glendon [50] found that the risk perception of young drivers has a negative effect on their reported engagement in risky driving behavior. Truck drivers who have a high level of risk perception tend to have a low level of intention to drive riskily. Truck drivers do not drive riskily because they may feel unsafe to perform such behavior, which may lead to traffic accidents. In the context of construction safety, risk perception negatively influences the risk-taking behavior of construction workers [51,52]. In truck driver safety research, the present study further confirmed the importance of risk perception. This study focused on the general risk perception of truck drivers, but did not consider the four dimensions of risk perception, including probability, severity, worry, and unsafety, in explaining the risky driving behavior of truck drivers [53,54]. Research efforts should be exerted to deal with this research area in the future.

In a study on transportation safety, Teye-Kwadjo [49] found that the risk perception of taxi drivers and bus drivers indirectly negatively influences their risky driving behavior with the mediation of attitude toward risky driving. However, in the literature on truck driver safety, previous studies did not examine the indirect effect of risk perception on risky driving behavior with the mediation of attitude toward risky driving of truck drivers. This study contributed to this research area by examining this indirect effect. The results showed that attitude toward risky driving plays an important role in the relationship between risk perception and risky driving of truck drivers.

5.1.4. Demographic Variable Effect

The results showed that the demographic variables, including gender, education level, and region of the country, had no significant effect on risky driving behavior of truck drivers. Additionally, age and truck driving experience were not significantly correlated with risky driving behavior of truck drivers. It was believed that the participants lived in different contexts and their risky driving behavior may be influenced by their living contexts [55]. In the future, more research should be conducted to examine how living contexts affect risky driving behavior of truck drivers.

5.2. Practical Implications

Several practical recommendations can be derived from the findings of this study to reduce truck drivers' risky driving behavior and thereby decrease the number of truck-related traffic accidents. First, logistics companies are suggested to identify truck drivers who have a high level of sensation seeking and provide close safety supervision for them to prevent them from performing risky driving behavior. This suggestion was given on the basis of the finding that sensation seeking of truck drivers indirectly positively influences their intention to drive riskily. Logistics companies can use a reliable and valid scale developed by Zuckerman et al. [56] to measure sensation seeking of truck drivers. Second, immersive virtual reality (VR) technology has been highlighted as an innovative way to present training materials for construction safety [57]. Logistics companies can adopt immersive VR technology in safety training to increase the risk perception of truck drivers [58]. Third, logistics companies should organize safety promotion activities, such as safety gathering, safety video competition, safety rewards, and safety ambassador, to cultivate a negative attitude toward risky driving of truck drivers and improve driving behavior [59].

5.3. Limitations and Future Research Opportunities

Despite the theoretical and practical contributions of this study to truck driver safety, several research limitations were recognized. First, this study collected the data in a cross-sectional questionnaire survey. However, the risky driving behavior of truck drivers is dynamic. Future studies should use longitudinal approaches to generate comprehensive insights into the risky driving behavior of truck drivers. Second, this study did not focus on how risky driving behavior among truck drivers affects their accident risk, leaving a research gap. Future studies may make an attempt to address this research gap. Third, the validity of the results of this study was verified with the data collected from Chinese truck drivers. Specifically, the results of the measurement model and structural model assessments showed that the models fit the data well, implying that the instruments of this study can reliably and validly measure the factors of interest (including sensation seeking, risk perception, attitude toward risky driving, perceived behavioral control, subjective norm, intention to drive riskily, and risky driving behavior). It also implied that the research model of this study can sufficiently explain the risky driving behavior of Chinese truck drivers. However, caution should be made in interpreting the results because of cultural difference that may make the results not applicable to the truck drivers of other countries. Therefore, this study should be replicated in other countries to understand the effects of the factors under examination on the risky driving behavior of truck drivers in different culture. This was recognized as the limitation of this study. Fourth, this study did not focus on the association between punishment for traffic violations and risky driving behavior of truck drivers, leaving a research gap. It is an interesting research area to be investigated in the future. Finally, other important factors, such as work stress [60] and safety climate [61], should be considered to explain the risky driving behavior of truck drivers.

6. Conclusions

This study successfully proposed and validated a research model that combined theory of planned behavior with sensation seeking and risk perception to explain the risky driving behavior of truck drivers. SEM and mediation analysis were used to fully examine the underlying mechanisms of how sensation seeking, risk perception, perceived behavioral control, subjective norm, and attitude toward risky driving influence the risky driving behavior of truck drivers. The results of this study showed that the attitude toward risky driving of truck drivers positively influences their intention to drive riskily, which positively affects their risky driving behavior. In addition, sensation seeking positively influences the attitude toward risky driving of truck drivers while risk perception negatively affects the attitude toward risky driving and intention to drive riskily of truck drivers. With the mediation of the attitude toward risky driving, sensation seeking positively and risk perception negatively indirectly influence the attitude toward risky driving. The importance of sensation seeking, risk perception, and attitude toward risky driving in determining the intention to drive riskily of truck drivers was highlighted. Results of this study not only broadened the relevant literature on truck driver safety, but also offered a theoretical basis for concerned parties to develop effective interventions to reduce the risky driving behavior of truck drivers, thereby reducing the number of truck-related traffic accidents. Specifically, logistics companies should provide truck drivers who have a high level of sensation seeking with close safety supervision to prevent their risky driving behavior. Additionally, safety training should be provided to increase risk perception of truck drivers and safety promotion activities should be organized to cultivate a negative attitude toward risky driving of truck drivers.

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