Study the proneness of long-distance driving accident

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Abstract. The damages caused by road traffic on people are increasing every year. Among them, the traffic accidents caused by long-distance driving have occupied a large proportion of such problems. So studying the effects of the accident factors on long-distance driving has been as a hot topic by domestic and foreign experts and scholars. Based on the background, this article studied the problem of accident proneness in the process of long-distance driving. In he research, accident proneness was quantified with a evaluation index system. A statistical analysis tool named SPSS was used to extract the key factors affecting accident proneness on the driver's long-distance driving. The recommendations and countermeasures of the accident proneness on effectively reducing long-distance driving were raised on the basis of analyzing the quantitative relationship between the main factors extracted and accident proneness.

Introduction

Relevant statistics show that the harm caused by traffic accidents on people is increasing every year. Among them, traffic accidents caused in the process of long-distance driving occupied larger proportion. Therefore it has great significance for the study of accident proneness in the process of long-distance driving. In previous studies, most of experts and scholars researched from the perspective of qualitative analysis on the impact of driver fatigue, mood swings, driving skills on the tendency of the accident. Their analysis did not find the key factors affecting the accident proneness, made certain one-sidedness. To avoid the one-sidedness, this article researched from the quantitative analysis, combined with the related theory, established an accident proneness model in long-distance driving process. Then extracted three key factors of the accident proneness affecting the long-distance driving through factor analysis method. The article have give reasonable suggestions for improvement, avoided the simple analysis of the one-sidedness on one factor which previous studies having. So the paper has a certain reference value and reference.

Long-distance driving accident proneness Evaluation System

Among a long-distance driving, the factors caused the accident can be divided into direct factors and indirect factors, misplay or known delays. Some research results show that the decision errors and perceptual errors are common problems in a driving process. The indirect accident can analyze from psychological factors, physiological factors and experience factors. These three areas describe the cause of the accident from different perspective. Such as the level of social pressure, mood swing and panic exist the pertinence with the long-distance driving accident happening on mentality. Therefore, we can see that the long-distance driving accident happening can be quantified from direct factors and indirect factors. The article established the tropism accident factor model for long-distance driving analysis, is based on this theory.

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Tendentious impact factors on long-distance driving accident proneness	Direct factors	Decision-making errors	Vision limited	X11
			Visual fatigue	X12
			Not concentrate	X13
		Known to delay	Road conditions judging error	X21
			Error predicting the speeds	X22
			Inappropriate decision-making	X23
	Indirect factors	Psychological factors	Anxiety	X31
			Mood swing	X32
			Psychological flexibility	X33
		Physiological levels	Physical strength	X41
			Driver fatigue	X42
			Motor and sensory	X43
		Experience level	Work accuracy	X51
			Acting according to circumstances	X52
			Ability to judge speed	X53

Long-distance traffic accident proneness evaluation process analysis

Experimental Design

Based evaluation model on the analysis above, designed the questionnaire, a five scale of chart was adopted to describe the relevant circumstances of the long-distance driving. During the whole experiment, a total of 187 questionnaires were extended. Valid questionnaires had 180, response rate was of 96.25%. By reliability test on valid questionnaires using SPSS 18.0, it could be seen that the system reliability reached 0.82. That proved the index system designed in this article was scientific.

Extract the key factor of long-distance traffic accident proneness

Using the statistical analysis of the factor in SPSS, the results of the key factors related statistics of long-distance driving accident tendency were as shown in Table 2.1. By the correlation analysis, we could see it were high correlation between the various factors. Which indicated that each factors had a significant linear relationship. And thus met the conditions of factor analysis, and factor analysis could be used to analyze.

Table 2.1 Factor correlation of long-distance traffic accident proneness

	X11	X12	X13	X21	X22	X23	X31	X32	X33	X41	X42	X43	X51	X52	X53
X11	1														
X12	.959	1													
X13	.969	.914	1												
X21	.869	.988	.944	1											
X22	.956	.971	.902	.939	1										
X23	.891	.923	.945	.934	.952	1									
X31	.844	.942	.945	.921	.923	.986	1								
X32	.431	.323	.365	.343	.343	.264	.345	1							
X33	.945	.934	.987	.913	.922	.944	.965	.390	1						
X41	.934	.987	.954	.743	.934	.745	.876	.423	.805	1					
X42	.854	.942	.925	.923	.965	.972	.978	.334	.955	.896	1				
X43	.553	.572	.623	.732	.573	.586	.798	-.0623	.507	.585	.745	1			
X51	.935	.827	.843	.624	.821	.728	.798	.345	.856	.909	.756	.456	1		

X52	.923	.954	.953	.923	.945	.923	.967	.367	.948	.880	.948	.757	.746	1	
X53	.923	.923	.923	.945	.923	.934	.978	.423	.969	.978	.966	.578	.845	.969	1

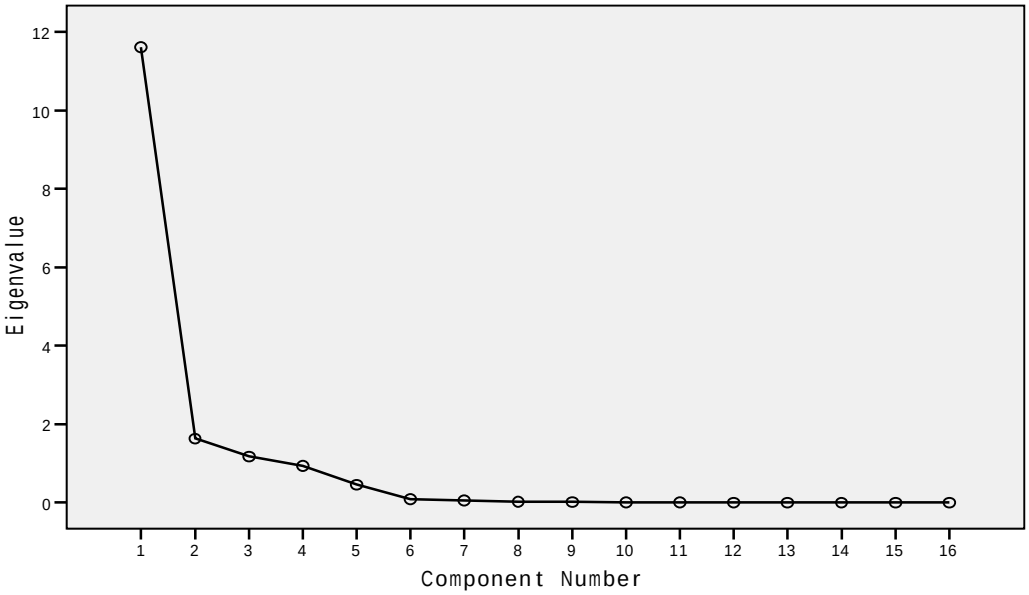
From Table 2.2, it could be seen that in all samples, as high correlation existed between the multiple index system, the variables in the index of Initial Eigen values were three. It showed that the three scalars could represent the samples. By analyzing the Cumulative index, the overall characteristics of the three scalars could be explained by a total sample of 89.973%. That indicated that these three variables could represent 89.973% of the sample characteristics in the sample index. As them explained the extent of the original data well, the three indicators could be used to reduce the dimension of the original data. The second part in this table described the situation, which the three extracted factors explained to the total variance. Three factors could be extracted as the main factors of this article through the analysis of the table.

Table 2.2 explain of the total variance of the key factors on the long-distance traffic accident proneness

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.345	72.430	72.430	11.345	72.430	72.430
2	1.645	10.53	82.742	1.645	10.201	82.631
3	1.134	7.354	90.083	1.135	7.342	89.973
4	.984	5.343	95.536			
5	.453	2.342	97.691			
6	.048	.5874	98.333			
7	.043	.373	99.4334			
8	.034	.191	99. 438			
9	.015	.068	99.487			
10	.007	.020	99.968			
11	.003	.021	99.998			
12	.001	.007	100.000			
13	7.38E-005	.000	100.000			

The key factor in which the driver of long-distance traffic accident proneness could use the gravel diagram to represent. Shown in Figure 2.3. Through the gravel diagram could help to select the main factor. In the gravel diagram, the number of factors could be represented with the horizontal axis, and the characteristic roots could be represented with the vertical axis. By analyzing in Figure 2.3, we could see the eigenvalue of the first three factors explained 89% of the sample, but from the fourth factor, the factor eigenvalues were less than 1. According to statistics principle, the main factors were selected with the three factors which eigenvalues were greater than one in this paper.

Table 2.3, long-distance traffic accident proneness key factor analysis with a gravel figure.



In order to explain which indicator has the significance on those main factors extracted, loading matrixes of the critical factors for long-distance driving accident proneness were indicated. Loading matrixes for above factors were shown in Table 2.4.

Table 2.4 rotated factor matrix

	Component		
	1	2	3
Z(X11)	-.242	.268	-.188
Z(X12)	.283	.178	-.985
Z(X13)	.942	.059	.045
Z(X21)	.167	-.099	-.949
Z(X22)	.238	-.297	-.979
Z(X23)	.239	-.289	-.882
Z(X31)	.058	.818	.054
Z(X32)	.365	.984	-.156
Z(X33)	.477	-.953	.045
Z(X41)	-.899	.234	-.169
Z(X42)	.935	-.178	-.067
Z(X43)	.064	.063	.986
Z(X51)	.975	-.215	.067
Z(X52)	.250	-.958	.285
Z(X53)	.420	-.997	.086

By the analysis, we could learn each factor extracted explained which one well on those indicators. That is, the data characteristics of those indicators could be taken advantage of the factors to represent. Following, analyzed the three common factors extracted to explain the meaning of the indicators.

First of all, the first common factor extracted had strong explanatory power to the X12, X13, X41, X42, X51 indicators. The extent to Explain had reached more than 0.9. To the statistical results referred from Table 2.4, It could be seen that the common factor denoted 72.430% of the overall sample characteristics. Analysis could be seen from the perspective of explaining variables, these variables were mostly the description of the driver driving in the course of fatigue. That was the fatigue

factor on the driver's accident proneness. Therefore, the first common factor could be named as "driver fatigue". Similarly, the second common factor had strong explanatory power on the X32, X33, X33, X52, X53 indicator. According to the above data, this factor could explain 10.201% of the original data. It reflected the emotional state influenced on the driver's accident proneness. So the second common factor could be named with the "psychological quality". Finally, from Table 3.3, the third common factor had strong explanatory power on X21, X22, X23, X43. It could represent 7.342% of the sample characteristics of the raw data. These indicators were described from the driver's experience. So it could be named with the "driving experience".

Correlation analysis of the main factors and accident proneness

Through the above analysis, the key factors of the accident proneness in long-distance driver driving process were found. Then how these key factors affected the accident proneness was the key issues in this section. For such problems, in this section correlation analysis were used in-depth to analysis the main factors extracted and the accident proneness in long-distance driving process.

Pearson Correlation test in the SPSS18.0 was used. The correlation coefficient related to three main factors and accident proneness was greater than 0.7. And the significant levels of SIG were less than 0.05. So there was a significant correlation between the three main factors to the accident proneness.

Table 2.5, Pearson correlation analysis of the main factors and accident proneness

		Accident proneness
Driver fatigue	Correlation coefficient	.878(**)
	Sig.	.000
	N	121
Psychological quality	Correlation coefficient	.639(**)
	Sig.	.000
	N	121
Driving experience	Correlation coefficient	-.623(**)
	Sig.	.000
	N	121

**Correlation is significant at the0.01 level (2- tailed).

Through the correlation analysis it could be seen that driver fatigue and accident proneness had a positive relationship. It indicated the degree of fatigue, which the driver took in driving process, had a significant impact on traffic safety. That existed between the psychological qualities and accident proneness too, but the driving experience had a significant negative correlation with accident proneness. It showed that if a driver had enough experience, he or she could judged on the surrounding environment well and thus effectively avoided traffic accidents.

Measures of a driver reduced long-distance driving accident proneness

Through the above analysis, in the process of the long-distance driving, driver fatigue, mood swings and driving experience were the key factors affecting the driver's long-distance traffic for safety. And driving fatigue and mood swings had a positive correlation to accident proneness. There were significant negative correlation between the driving experience and accident proneness. Therefore, in order to reduce long-distance driving accident proneness three aspects shall be proceeded with:

First, establish a sense of safety, avoid driving fatigue

In the process of a long-distance driving, the driver fatigue phenomenon has been occurred sometimes. Driver fatigue can be divided into mental fatigue and physical fatigue. Each one of the fatigues will affect a driver's judgment on the surrounding environment, thereby increases the tendency of the accident. Therefore, in the process of a long-distance traffic, it shall be reasonable to arrange arrangements, avoid driving fatigue. It is much important to improve security awareness and psychologically recognize the importance of safety.

Secondly, control driving mood, improve the driver's psychological qualities.

According to the present statistical analysis results, it can be seen that the driver's psychology and emotion have an important influence on long-distance traffic safety. In order to avoid traffic accidents, we have to submit a driver's psychological qualities. By improving a driver's psychology qualities, improve the response characteristics of the driver's abilities of perception, stress, judgment, character, self-control and so on. Improving the driver's emotion controlling ability to avoid the formation of anxiety and other psychologies in the driving process. Thus achieves the purpose of reducing long distance traffic in the accident proneness.

Finally, establish training mechanisms, improve a driver's experience

The driving experience has a significant impact on long-distance traffic safety related, so training mechanisms should be established. Long-distance drivers must be trained to improve their judgment on the surrounding environment. Through "Mentoring" approach promote interaction among the driver to learn together. On the other hand, the relevant government departments should establish a monitoring mechanism to make the necessary qualification to the driver of long-distance traffic. Strict checks from the driving experience should be taken to effectively reduce traffic accidents.

Conclusion

Through analysis it can be seen that driver fatigue, psychological quality and driving experience are the three key factors affecting the driver's long-distance traffic accident proneness. Therefore, reduce long-distance driving accident proneness requires not only the driver establishes safety awareness and avoids driver fatigue, the relevant government departments should also qualify the driver engaged in long-distance driving. Establish a mechanism for training and certification mechanisms, from the perspective of their qualification to strictly control the driver's psychological quality and driving experience, thus achieves the goal of reducing accident proneness.

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