EFFECT OF DEMOGRAGHIC VARIABLES ON DRIVING SAFETY

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Abstract: This study is a pilot study about the effect of demographic variables on driving safety. It is a part of assessment system of drivers' proneness to traffic accidents. The main method adopted in this study was questionnaires. After preliminary survey and formal survey stages, a structure was generated including gender, age, occupation, years of driving, automobile mode, property of operation, type of drivers, and goals for driving.
Keywords: *demographic variables, driving safety, proneness to traffic accidents*

1 Introduction

Safety in driving is affected by many factors, such as situation of road, weather, performance of cars, and the driving ability and mental situation of drivers. The most important factor among them is human (drivers and pedestrians), especially the drivers.

This study is for establishing a subsystem of assessment system of drivers' proneness to traffic accidents. This system was developed by Lab of Engineering Psychology and Human Factors in Institute of Psychology, Chinese Academy of Sciences and financed by Beijing Sunheart Simulation Technology LTD. The system is composed by four subsystems: demographic variables survey, personality questionnaire, cognitive abilities testing and simulated driving testing.

There are some researches about the effect of all kinds of demographic variables on driving behavior, such as age, gender, accumulated driving time, and so on.

1.1 Age

Chen et al. (2007a) used questionnaires and BP neural network to establish a set of neural network structure with different hidden layer, neuron number and transfer

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function. In their study, it was found that the number of traffic accidents decreased with age from 25-60 years old, while the number increased with age below 25 and above 60 years old.

1.2 Gender

Many researchers have explored the relation between gender and driving behavior (e.g., Taubman-Ben-Ari & Findler, Shope, Waller, & Lang). There were comparatively significant differences in driving behavior between male and female drivers (Chen, Gao, Wei, & Li, 2007a). Men were more inclined to have aggressive violations than women in driving (e.g., Zhuang, Bai, & Xie, 2007c). In addition, male drivers were more competitive, inflammable, and pursuit of excitement, so they had more traffic accidents than female drivers (Laapotti & Keskinen, 1998).

But there were also opposite views. Lawrence (2004) analyzed police reports of all road traffic accidents that occurred on the roads between 1996 and 2000 in New South Wales and then got the conclusions that female taxi drivers were at a higher risk of crash-related mortality and injury than their male counterparts. This result was also in agreement with data reported in a study on road crashes among women in Australia.

1.3 Accumulated driving time

The accumulated driving time plays an important role for driving safety. Those drivers who have more driving experience have fewer traffic accidents (e.g., Chen, Gao, Wei, & Li, 2007a; Zhuang, Bai, & Xie, 2007c). It was suggested that the drivers who had more driving experience were not only able to do more accurate judgment for the environment, but also more laxative in an emergency.

1.4 Goals of this study

There had not been a special and systematic analysis and prediction of the relationship between demographic variables and driving accidents. The main goal of this pilot study is to solve this problem, and then construct a simple model to predict drivers' proneness to traffic accidents. The results would help us to find out a way to reduce the number of traffic accident and the economic loss.

2 Methods

The main method adopted in this study was questionnaire. And the main course was composed of data summarization of Annual Statistical Report of Highway Traffic Accidents in the last seven years (ASRHTA, 2001-2007b), preliminary survey for scoring model construction and formal survey for model verifying.

2.1 Participants

The preliminary survey was carried in a driving battalion in Beijing where 22 soldiers attended this survey. There were 3 soldiers who didn't finish the following simulated driving. As the performance of driving test would be used as criterion, their data were discarded.

The formal questionnaires for survey were distributed in random and received 110

valid ones from all kinds of drivers.

Because of the limit space of paper, we are unable to list the detailed distribution of participants in each variable.

2.2 Questionnaire and procedures

The main document resource is ASRHTA. Considering the official secrecy provision in our country, we can not use the raw records of accidents. The demographic variables listed in 'Part 5: the person responsible for the accident' were selected to form our initial questionnaire of demographic variables. Then several policemen, trainers in driving training school, full-time drivers, skilled drivers, novel drivers and experts on the researches of traffic accidents were invited to comment on the questionnaire. As a result, some variables were deleted according to their advice. For example, the distribution of driving hours in day and night was excluded in the questionnaire because many drivers might be confused by this item. The selected variables were gender, age, occupation, years of driving, automobile mode, property of operation, type of drivers, and goals for driving. Initially, these variables were set to have the same weight.

Meanwhile, the scoring rules were determined according to the accident data distribution within each variable supplied by ASRHTA. For example, Table 1 gives an example of scoring rules: We divided the drivers in ten age levels and supposed the numbers of drivers in each age level were the same. As a result, the probabilities of accident in each age level were set the same (10%). If the mean actual percentage of seven years (2000-2006) in a certain age level was higher than the estimated percentage (e.g., 21-25 years old), we assigned one point to this level, which indicated the proneness of traffic accidents was relatively high; and in contrast, those levels whose actual percentages were lower than the estimated percentage, we assigned no point to them. We could not list scoring rules of all the variables due to the limit of restriction of paper length.

Table 1. Example of scoring rules used in questionnaire

Age range	Supposed percentage	Actual percentage	Score
16-20	10%	4%	0
21-25	10%	15%	1
26-30	10%	20%	1
31-35	10%	20%	1
36-40	10%	17%	1
41-45	10%	11%	0
46-50	10%	6%	0
51-55	10%	3%	0
56-60	10%	1%	0
Above 60	10%	2%	0

In the preliminary survey, the criterion used to determine the weight of each variable was the task finishing time in the following simulated driving testing. After the questionnaires were completed by the soldiers, the demographic variables were weighted according to the relationship between them and the criterion.

In the formal survey, new questionnaire was composed according to the results got from preliminary survey. Each participant was rated at each variable according to their answers in the questionnaire. For example, if a driver was in the range of 21-25 years old, he would get one point. Finally, his ratings of all the variables would be multiplied by corresponding weight and added up. The criterion used in this stage was the situation of their violation by self-report. Validity of this questionnaire was examined in this stage.

3 Results

3.1 Results of preliminary survey

The drivers' mean completing times in twenty simulated driving tasks were compared according the grouping in each demographic variable by One-way Analysis of Variance (ANOVA). The results supplied by SPSS indicated that years of driving ($F(2,16)=5.266$, $p<0.05$, $MSW=1,226$) and automobile mode($F(2,16)=5.697$, $p<0.05$, $MSW=1,433$) affected the soldiers' completing time of simulated driving: The drivers with above 10 years of driving experiences (M=238ms, SD=19ms) completed the simulated driving tasks quicker (ps<0.05) than those with 5-10 years of driving experiences (M=289ms, SD=15ms) and with below 5 years of driving experiences (M=299ms, SD=57ms). So we modified their weight value to two points. The drivers driving coaches (M=246ms, SD=33ms) completed tasks quicker than those driving vans (M=291ms, SD=39ms). But it must be paid attention to the truth that in that battalion the new soldiers should practice with vans firstly and they could not turn to practice with coaches until they become skilled drivers. As a result, the weight of automobile mode was not modified.

Moreover, as there were different opinions on the effect of gender on driving behavior, the weight value of gender was reduced to 0.5 point. So we got the final scoring structure as Figure 1 shows.

3.2 Results of formal survey

In the formal survey, each participant's score was calculated according to the above mentioned scoring structure.

All the drivers were divided into two groups: without violation record (54 participants), with violation records (56 participants), and their scores were compared by One-way ANOVA. There was no significant main effect ($F(1, 109)=0.783$, $p>0.10$, $MSW=0.851$) found. The results indicated only a tendency that drivers without violation record got more scores (M=4.60, SD=0.81) than those ones with violation records (M=4.43, SD=1.01), that was to say that drivers without

violation record were more likely to have accidents than those ones with violation records. This result might be inconsistent with our hypothesis, but a truth got from Pearson Chi-Square was that the number of accidents was connected with the years of driving experiences (χ^2 (3)=10.737, p<0.05), so the difference of scores could be explained by the driving experiences.

	Gender (X1):	0.5
	Age (X2):	1
	Occupation (X3):	1
	Years of driving (X4):	2
	Automobile Mode (X5):	1
	Property of operation (X6):	1
	Type of drivers (full time or not) (X7):	1
+	Goals for driving (X8):	1
	Total (Y):	8.5

Figure 1. Scoring structure including all the variables

Then the drivers with violation records were ranked in a increasing according to their number of violations. The drivers at about 0-27 percentiles (with only one violation) and about 73-100 percentiles (with more than 3 violations) were selected as low violations group and high violations group separately. There was a tendency that high violations group got more scores (M=4.76, SD=0.81) than low violations group (M=4.52, SD=0.97), but the effect was not significant (F(1, 32)=0.583, p>0.10, MSW=0.830).

4 Conclusions and discussions

In summary, this subsystem can predict drivers' proneness to traffic accidents to a certain extent. And this is the first special and systematic study of demographic variables on driving safety in China. But the scoring structure was very simple, so it needs to be modified continually by more large-scale testing in the future.

Accurate and scientific analysis of accidents, not only providing reliable basis for planning the development of road construction, traffic management and scientific decision-making and related laws, but also supplying important references for the development of security technologies related with the development of enterprises (Yuan, 2005). So it is necessary to carry reasonable and scientific analysis for the

structure of current accidents to enable it to meet the needs of preventing traffic accidents.

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