Analysis of Taxi drivers' behavior and Intention to violations based on the theory of planned behavior by using structural equation modeling

Mohammad reza Bakhtiary, Mohammad hosein Qasemi, Hamid reza Behnood*[1]

Transportation Department, Faculty of Engineering, Imam Khomeini International University, Qazvin, Iran

Abstract

The theory of planned behavior has been used in various studies to understand human behavior in various traffic studies, including the understanding of the risky behavior of drivers. Considering the importance of violation in the occurrence of crashes, we tried to measure the contribution of each human factor in its occurrence and analyze the existing relationships between them according to the theory of planned behavior. According to the use of this theory, a large number of independent and dependent parameters were found in the research, and structural equation modeling was used to analyze and investigate the relationships between them. Also, exploratory and confirmatory factor analysis was used for statistical analysis of data. A strong relationship was found between the driver's Intention toward violations and the frequency of crashes. The structures examined in this theory, which included attitude and subjective norms and perceived behavioral control, directly affected the driver's Intention a violation. The greatest impact belonged to the variable of the first scenario, which included a special category of indicators. These indicators included the indicators used in the discussion of perceived behavioral control and subjective norms in the descriptive norms section, which were used simultaneously in an item titled the first scenario. In the positions after that, the attitude and second scenario were placed. The second scenario included a group of indicators that examined subjective norms in the brief norms section. Also, a significant relationship was found between the two variables of slip and error with the frequency of crashes.

Keywords

Traffic crash, Theory of planned behavior, Structural equation modeling, Driver behavior, Intention to violations

1. Introduction

Human factors are more involved in traffic crashes than road environment and vehicle factors. According to the studies, the human factor is involved in more than 90% of road crashes and in about 60% it is the absolute cause of crashes [1-3]. Due to the high amount of traffic exposure (traveled distance, high operation time and traffic maneuvers) in the city, taxis account for a significant part of urban traffic crashes. That the human factor plays a large part is beyond doubt, but this information is too general, and it is not very helpful when we try to introduce measures aimed at reducing road crashes. What is needed is a much deeper understanding of human behaviour. In order to account for drivers' intention for risky behaviour or violations in the crash prediction process, a respondent may not accurately state their true propensity; Therefore, one should predict her/his intentions by using her/his beliefs and attitudes. This issue emphasizes the importance of developing a rational model of intention to commit violations based on drivers' behavioural characteristics. Human behaviour is guided by the intention to perform the behaviour and this intention is influenced by: (1) beliefs and attitudes towards the outcome and evaluation results of a behaviour (attitude), (2) beliefs related to the expectations of others and the motivation to comply with these expectations (subjective and descriptive norms), and (3) Beliefs about the factors facilitating or hindering the performance of a behaviour and the perceived power of these factors [3-7]. This study aims to develop and analyze the model of the intention to violations and dangerous behavior based on behavioral characteristics, demographic information and exposure level and its relationship with the frequency of crash using the structural equation technique. In previous similar studies, the exposure factor (for example, the number of driving hours per day or the number of kilometers traveled per day) was not investigated [8-9].

2. Methodology

Participants in this study were 1000 male taxi drivers working at 52 different taxi terminals in Theran. This data collection was done by visiting the location of taxi stations. The survey to request drivers continued until 1000 data were collected. The questions were loosely based on the Theory of Planned Behaviour (TPB). To present the respondent with a clear understanding of the situation the questions were linked to a scenario and a picture In the scenario the principle of compatibility target context

[1] * Corresponding author.E-mail address: behnood@eng.ikiu.ac.ir (H.R. Behnood).

and time were clearly specified (Figure1). After the introduction of the scenario, a set of questions in the field of errors and lapce, attitudes, perceived behavioral control, subjective norms, intention to violations, the number of major and minor crash in the last 3 years, the number of near-crash events in the last two weeks, and related information Age, driving experience, number of hours and distance traveled per day and education were asked.

Scenario: Suppose you are driving your taxi on the left lane on Hafte-Tir Boulevard (pictured below) and you are approaching the Mesbah signalized cross-road. It is in the middle of the week and the time is around 11:00. The speed limit on this avenue is 40 km/h and in the distance, you can see that the traffic light is green. You want to cross the cross-road before it turns to red and therefore you increase your speed to 60 km/h. With this in mind, rate the following questions.

Figure 1. The scenario

In this study, based on exploratory factor analysis, the constructs used and specifying the desired items in the theory of planned behavior were investigated, and in the next part, the relationship between these items was investigated using confirmatory factor analysis. In the modeling section with confirmatory factor analysis, modeling takes place in two stages. In the first stage, the model is examined based on the constructs of the theory of planned behavior separately, and its inferential statistics are examined based on different fits. In the next step, the general model that showed the relationship between the frequency of crash and the intention to violations is discussed. Finally, the model is evaluated.

3. Results and Discussion

According to the results of the exploratory factor analysis, the indicators of the perceived behavioral control variable along with some indicators of subjective norms that included the group of descriptive norms were simultaneously placed together in one item, which was referred to as the first scenario variable. In the second scenario, other indicators used in the discussion of subjective norms, which included the group of injunctive norms, were referred to as the second scenario. after conducting exploratory factor analysis to determine the examined items, confirmatory factor analysis was conducted, the purpose of which was to determine the degree of coordination of these indicators in estimating the desired parameters

The modeling process was done in two stages. In the first stage, the model was examined based on the constructs of the theory of planned behavior separately. In the next step, the general model that showed the relationship between the frequency of crashes and the intention to violations is presented. Figure 2 represents the final model created (the second model).

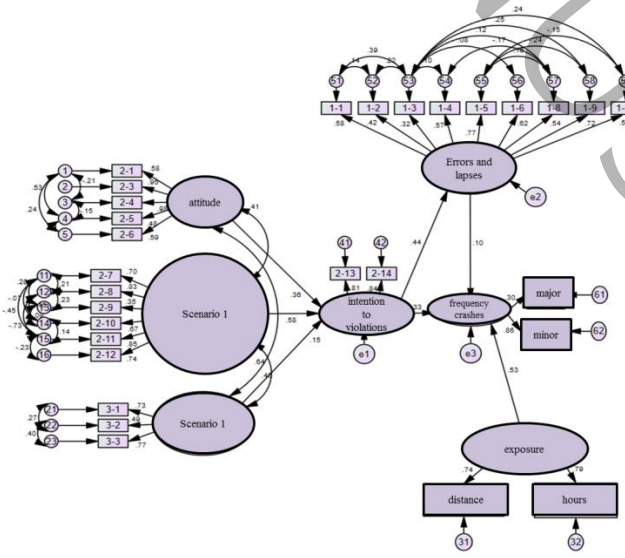

Figure 2: The model developed based on the theory of planned behavior and the relationship between the intention to violation and the frequency of crash (the final model)

According to the results obtained from the output of the software, the coefficients of the path, correlation and significance level of the desired variables were examined (Table 1). According to the obtained results, all the relationships between the variables were direct. Also, they were placed at acceptable levels of significance and had high significance. The path coefficient between the two variables of lapses and errors and the frequency of crashes was 0.10, which indicated a significant relationship between these two variables with a significance level ($0.012 \leq 0.05$).

Table 1: Path coefficients between the studied variables

Path coefficients	t- value	Path coefficients	Path	variables	#
0.000	11.554	0.36	intention to violations ← attitude	intention to violations	1
0.000	12.423	0.58	intention to violations ← first scenario		2
0.000	3.605	0.15	intention to violations ← attitude		3
0.000	8.435	0.33	frequency of crashes ← intention to violations	frequency of crashes	4
0.000	12.162	0.53	frequency of crashes ← exposure		5
0.000	2.498	0.10	frequency of crashes ← errors and lapses		6
0.000	10.804	0.44	Errors and lapses ← intention to violations	Errors and lapses	7

4. Conclusion

In this regard, the following results were obtained in summary:

• Based on this research, the theory of planned behavior has been a suitable tool for predicting the driver's behavior.

• Based on the output results from the software and examining the relationships between them, the variable of the first scenario including subjective norms and perceived behavioral control had the greatest impact in predicting the driver's intention to a violation, and in the following positions, the attitude and the variable of the second scenario including norms They were ordered.

• The highest correlation was between the two variables of the first and second scenario. The reason for this can be found in the variable indicators of the first scenario, because a number of indicators related to the measurement of subjective norms in the descriptive part were used simultaneously along with a number of other parameters related to the indicators of perceived behavioral control.

• The most influential factor, either directly or indirectly, on two types of minor crashes and severe crashes, was the exposure variable, followed by the intention to a violation. All the mentioned relationships were directly related and had high significance. Also, the relationship between the two variables of lapses and errors and crashes had a good level of significance.

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