

Article

Need Safer Taxi Drivers? Use Psychological Characteristics to Find or Train!

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Abstract: Professional drivers play a key role in urban road network safety. It is therefore important to employ safer drivers, also find the problem, and train the existing ones. However, a direct driving test may not be very useful solely because of drivers' consciousness. This study introduces a latent predictor to expect driving behaviors, by finding the relation between taxi drivers' psychological characteristics and their driving behaviors. A self-report questionnaire was collected from 245 taxi drivers by which their demographic characteristics, psychological characteristics, and driving behaviors were obtained. The psychological characteristics include instrumental attitude, subjective norm, sensation seeking, aggressive mode, conscientiousness, life satisfaction, premeditation, urgency, and selfishness. Driving behaviors questionnaire (DBQ) provides information regarding drivers' violations, aggressive violations, errors, and lapses. The standard linear regression model is used to determine the relationship between driving behavior and psychological characteristics of drivers. The findings show that social anxiety and selfishness are the best predictors of the violations; aggressive mode is a significant predictor of the aggressive violations; urgency has a perfect impact on the errors; and finally, life satisfaction, sensation seeking, conscientiousness, age, and urgency are the best predictors of the lapses.

Keywords: taxi drivers; driving behavior; driving behavior questionnaire (DBQ); psychological characteristics

1. Introduction

Road traffic accidents account for a high number of casualties, which can bring considerable economic and personal costs [1]. Each year, about 1.35 million deaths and around 30 million non-fatal injuries occur all over the world due to crashes [2,3]. In particular, accidents are one of the leading causes of injuries and deaths in developing countries [4,5]. The main cause of most occurring accidents is human factors, which, according to the previous studies, account for more than 90 percent [6,7]. Human factors comprise driving skills and driving style, while driving style is influenced by behavioral–emotional aspects and somatic–cognitive aspects [8,9]. A series of events can lead to an accident that includes disposition of behavior, outcome of behavior, and consequences of behavior. In general, disposition of behavior is represented by the psychological characteristics, outcome of behavior refers to the aberrant driving behavior, and consequences of behavior is associated with driving accidents [10,11].

The previous studies have mainly investigated the relationship between aberrant driving behavior and driving accidents using standardized instruments and limited studies have focused on disposition of behavior and the psychological characteristics of drivers. Using questionnaires is a well-established

approach to scale-measure human behavior. Among these questionnaires, the driver behavior questionnaire (DBQ) is widely used for measuring self-reported driving behavior [12]. DBQ is one of the most widely implemented measurement scales to evaluate the self-reported aberrant driving behavior [13]. The DBQ is designed to classify aberrant driving behaviors into specific categories, which can be used by both researchers and industry personnel to investigate the drivers' behavior and examine the factors associated with crashes.

As mentioned earlier, driving behavior characteristics influence the traffic safety [14]. Limited studies have considered the impact of drivers' psychological characteristics (e.g., subjective norm, instrumental attitudes, and sensation seeking) or the demographic information (e.g., age and gender) of drivers on their driving behavior [15–20]. However, a few psychological characteristics have been investigated in the literature. This study contributes to answering the question regarding which psychological characteristics can be related to aberrant driving behaviors. The question is: Do psychological characteristics of drivers affect their driving? If the answer is yes, which driving behavior of drivers does each of their psychological characteristics affect? Moreover, this study focuses on taxi drivers' driving behavior and their psychological characteristics because taxis play a very important role in developing countries such as Iran. Taxis in developing countries are different from developed countries, and are often used to compensate for shortage of public transportation. In those countries, taxi drivers are at high risk of road fatalities and they are also responsible for a large proportion of road crashes [21,22]. However, the prevalence of taxi accidents varies by region and country. For instance, a study in Vietnam reported an overall crash prevalence of 22.7% among 1214 taxi drivers for the period of 2006–2009 [23]. A report in Africa indicated that among 712 taxi drivers, 26.4% of them had been involved in a crash within 3 years [24].

The driving behaviors that are considered in this study include violations, aggressive violation, errors, and lapses. The drivers' psychological characteristics that have been considered in this study include instrumental attitude, subjective norm, sensation seeking, aggressive mode, conscientiousness, life satisfaction, premeditation, urgency, and selfishness [2,25].

This paper is structured as follows. Section 2 presents a review of the literature on driving behavior and the effects of psychological characteristics on the behavior of drivers. Section 3 presents the research methodology, dataset, and data collection procedures. It is followed by the presentation and discussion of the results from statistical analysis. Finally, the paper is concluded, and the future directions of the research are presented.

2. Literature Review

2.1. Driver Behavior Questionnaire (DBQ)

The original DBQ was provided by Reason et al. [15] to determine the extent of human contribution in accidents and it comprised 50 questions. The original DBQ only focused on two distinct behaviors including errors and violations [15], the scale has been modified to include "slips and lapses" [13]. In order to evaluate people's driving behavior, intentional violations were separated from unintentional violations. Intentional violations were defined as deliberate deviations from the actions required for the safety of the traffic system. Unintentional violations include errors and lapses which can lead to unexpected results for the driver. Errors were described as the failure of planned outcomes. For instance, an error would occur when a driver fails to notice the pedestrians crossing the road when turning into a side-street from a main road. Lapses are those unintentional violations that occur due to memory or attention failures which can lead to an accident [10]. There are different versions of the DBQs which differ in the structure of the questionnaire, and divide the aberrant driving behaviors into different categories and purpose questions based on each group's characteristic. In all different versions of the DBQs, the rate of aberrant driving behaviors is scored [19,26].

In the DBQ, respondents should emphasize how often they have experienced a specific situation. The structure of the questionnaire in each study depends on different factors including the target

country's driving culture, laws, and specific conditions. Parker used a shorter version of the original DBQ shown by Reason and colleagues. The only difference in the factor structure of this DBQ version was moving two items from 'lapses' to 'errors' [27]. Blocky and Hartley [16] applied the method introduced by Reason et al. [15] on the Western Australian drivers' and compared the findings with the results from Reason et al.'s research. The differences between the results of those studies were mainly due to the differences between the driving characteristics of the drivers [16]. Lawton et al. [28] conducted a study using a shortened version of the original DBQ presented by Reason et al. [15] and the results of the analysis demonstrated that in the younger population of drivers' three factors including errors, Highway Code violations, and more interpersonally aggressive violations were found to be the most dominant driving behavior violations. Aberg and Rimmo [17] added new factors to the original DBQ shown by Reason and colleagues, to reflect the driving conditions in Sweden. The questionnaire evaluated sensation seeking, the tendency to engage in risky behaviors (violations, mistakes, inattention, and inexperience errors), traffic offences, and accident involvement. In this study, the "Lapses" factor in earlier studies was divided into two new factors, being "errors due to inattention" and "errors due to inexperience".

2.2. Driving Behavior Modelling

Most articles have examined the relationship between drivers' demographic information (e.g., age and gender) and driving behavior by using linear regression analysis or multi-group analysis of measurement invariance [15–19,29–31]. The results indicated that with the increase in age, violations have declined, but errors have increased. Additionally, the comparison between 'males' and 'females' driving behavior has shown that men commit more violations than women, but women's errors are more frequent than men. Lifestyle traits such as 'religion/tradition', 'driving aimlessly', 'sports', and 'culture' were found to be significant predictors of driving behavior in a multiple regression analysis [32]. Reimer has found that attention deficit hyperactivity disorder (ADHD) and age are significantly related to error, lapse, and violation scores [33].

2.3. Aberrant Driving Behavior among Taxi Drivers

Most studies about driving behaviors of taxi drivers have been conducted in developed countries [20,34,35], and due to the differences between taxies in these countries and developing countries, their results are not very reliable for developing countries such as Iran. There are few studies conducted in developing countries that have examined the driving behaviors of taxi drivers [21,36]. According to the literature, risk-taking and risky driving are among the most important factors in the occurrence of accidents [1,29,37–44]. Previous studies investigated the influence of sensation seeking and drivers' attitude on risky driving behavior [37,38,42–44], the impact of the drivers' attitude towards driving rules and speeding on their risky driving levels [45], and the influence of emotional intelligence on risky driving behaviors [1]. However, few articles have discussed the correlation between driving behavior and the psychological characteristics of drivers, which is the focus of this paper. Further, there have been limited studies evaluating the impact of selfishness and life satisfaction on driving behavior. This study will investigate the influence of drivers' behavior, including violations, aggressive violation, errors, and lapses, on the most common human psychological factors. Besides, there has been little attention paid to the taxi drivers' psychological characteristics in developing countries. In addition, it can be stated that there is no study which has examined the relationship between these characteristics and driving behaviors of taxi drivers in these countries. Now, the question is: Do psychological characteristics of drivers affect their driving? If the answer is yes, which driving behavior of drivers does each of their psychological characteristics affect? Moreover, is the effect of these characteristics on each driving behaviors negative or positive? The present study attempts to answer these questions and shows the importance of paying attention to the psychological characteristics of taxi drivers.

3. Methods

3.1. Participants

A sample of 245 Iranian taxi drivers has been used in this research. All of them were male drivers (the taxi drivers in Iran are mostly male drivers, and few female drivers work as taxi drivers), and their age was between 20 to 75 years (mean age = 46.8, standard deviation = 12.11). More than 70% of the respondents were taxi drivers for more than ten years. Regarding educational attainment, 34% of respondents had undertaken tertiary studies, and 6% of them were illiterate. Participants were selected from 10 random taxi stations from different areas of Metropolitan Tehran, which were geographically and culturally well-distributed. All the questionnaires were completed through a face-to-face interview. The face-to-face interview with taxi drivers led drivers to answer all the questions so the data would not be incomplete and useless. Furthermore, if a question was unclear, it was explained to them. Another advantage of this type of interview is that a significant number of taxi drivers in Iran are elderly and retired people who prefer to be asked questions instead of filling out the questionnaires themselves.

3.2. Data Collection

The questionnaires were distributed among taxi drivers in taxi stations. The taxi stations were selected from different areas of Metropolitan Tehran. The questionnaire consisted of three sections. The first section included questions on demographic characteristics of drivers such as age, education, and driving experience. The calibrated version of DBQ to accommodate Iran's driving condition was employed in the second section of this questionnaire [46], which was derived from its original version [15]. A four-factor structure of the DBQ included violations, aggressive violations, lapses, and errors. The participants had to answer how often they have been engaged in each type of driving violation behavior while driving (1 = never, 3 = few times, 5 = occasionally, and 7 = all the time). The items' scores were summed, and the higher scores indicated more frequent aberrant driving. A third section was added to the questionnaire to establish a relation between the drivers' psychological characteristics and the driving behavior. The psychological characteristics which were investigated in that section included nine specifications, including: instrumental attitude, subjective norm, life satisfaction, sensation seeking, premeditation, urgency, selfishness, aggressive mode, and conscientiousness. The questions in that section were adapted from existing questionnaires in the field of psychology [2,25].

3.3. Statistical Analysis

3.3.1. Cronbach's Alpha Coefficients

To determine the reliability of this survey, the internal consistency of the scales was measured for the last two sections of the questionnaire (driving behavior and psychological characteristics), using Cronbach's alpha coefficient. Cronbach's alpha coefficient is a measure of internal consistency that shows how closely a set of items are related as a group. Cronbach's alpha is a measure of scale reliability in which a "high" value for alpha does not imply that the measure is unidimensional [47]. A Cronbach's alpha of 0.6 to 0.7 is acceptable [48].

3.3.2. Multiple Regression Model

Standard multiple regression model is used to determine the relationships between the drivers' psychological characteristics, their age, and the driving behavior. In this kind of model, the understanding and interpretation of each variable can be given according to the coefficient and does not require very complicated calculations. In addition, according to the literature, most of the studies which investigate the driving behaviors have used standard multiple regression.

The model shows the impact of psychological characteristics on driving behavior. All psychological characteristic subsets were entered as independent variables, and the DBQ subsets were entered as

dependent variables in the model. Thus, four distinct multiple regression models were developed for general violations, aggressive violations, errors, and lapses. The significance of influential paths could be tested by p -value. All tests were two-tailed with 95% accuracy ($p < 0.05$ as significance threshold). All statistical analyses were completed using IBM SPSS version 25 [49].

4. Results

Table 1 shows the internal consistency, means, and standard deviations for all driving behavior and psychological characteristic scales. As presented in this table, the Cronbach's Alpha ranged from 0.6 to 0.85 for all the scales. This shows that the reliability of the scales is generally acceptable and confirms that the survey approach is valid. Exceptionally, the Cronbach's alpha coefficients for selfishness are less than 0.6. A probable explanation is that measuring selfishness consists of a few questions [50]. By comparing the means, we see that the highest mean score is for Violations ($M = 3.333, \pm 1.811$), followed by Aggressive Violations ($M = 2.976, \pm 1.831$), Lapses ($M = 2.881, \pm 1.652$), and then Errors ($M = 2.697, \pm 1.530$).

Table 1. The internal consistency, mean, and standard deviations for driving behavior scales and psychological factors.

Behavior and Psychological Factors		Mean	SD	Cronbach's Alpha	Cronbach's Alpha
Driving behavior scales	Violations	3.333	1.811	0.736	0.736
	Aggressive violations	2.976	1.831	0.734	0.734
	Errors	2.697	1.530	0.738	0.738
	Lapses	2.881	1.652	0.701	0.701
Psychological factors	Instrumental attitude	0.376	0.931	0.642	0.642
	Social anxiety	0.190	0.980	0.756	0.756
	Sensation seeking	0.253	0.972	0.734	0.734
	Aggressive mode	0.176	0.981	0.750	0.750
	Conscientiousness	0.299	0.960	0.652	0.652
	Life satisfaction	0.223	0.972	0.611	0.611
	Premeditation	0.216	0.980	0.841	0.841
	Urgency	0.236	0.971	0.660	0.660
Selfishness	0.104	0.990	0.502	0.502	

4.1. General Violations

As previously mentioned, the drivers' age and psychological characteristic scales were used as independent variables, and the DBQ sub-scales were used as dependent variables in the model development. The summary of the results for each model is presented as follows.

According to the results from the regression model, violations, social anxiety, and selfishness were found to be significant predictors, while sensation seeking, aggressive mode, premeditation, conscientiousness, urgency, and age had less impact on violations and instrumental attitude, and life satisfaction were not significant predictors of violations. The model predicted 41% of the variation in violations ($F(10, 245) = 18.22, p < 0.05$).

Interestingly, the results show that the drivers who have gotten higher scores in social anxiety committed fewer violations while driving. It could be because they are often worried that people will judge or negatively evaluate them. Meanwhile, selfish people only care about their profits and have less consideration for other people, so they may break the rules that are against their interests. The concept of sensation seeking is suitable for individuals who are looking for excitement and new experiences. As presented in Table 2, the results of this study show that an increase in the rate of sensation seeking in people may cause an increase in the level of their violations. Results from previous studies are consistent with the findings of this study. Studies by Rimmo and Aberg [10] showed that violation is the only factor that had a positive association with both the sensation seeking scales (the thrill and adventure seeking and disinhibition). The other factors such as errors and lapses only had a positive association with disinhibition [10,41,42,51]. In this study, both sensation-seeking scales were considered as one scale, thus sensation seeking is the effective predictor for all DBQ scales.

Table 2. Predicting violations with psychological characteristics.

Violations	Beta	t	p-Value	Partial Correlations
instrumental attitude	0.057	0.956	0.340	0.062
social anxiety	−0.258	−4.380	0.000	−0.275
sensation seeking	0.152	2.462	0.015	0.159
Aggressive mode	0.166	2.686	0.008	0.173
Conscientiousness	−0.106	−1.945	0.053	−0.126
Life satisfaction	−0.049	−0.837	0.403	−0.055
Premeditation	−0.158	−2.710	0.007	−0.174
Urgency	0.105	1.899	0.059	0.123
Selfishness	0.221	3.974	0.000	0.251
Age	−0.116	−2.261	0.025	−0.146
Adjusted R Square				0.414

Aggressive mode had positive correlation to violations, possibly due to the specific attitude that aggressive people have toward competitive driving, time urgency, and hyper-competitiveness which is consistent with findings from previous studies [29]. The results demonstrate that individuals who described themselves as more responsible, reliable, self-disciplined, and dependable (more conscientiousness) are less involved in driving accidents [52,53]. No previous research has examined the impact of conscientiousness on driving behavior. The results of this study have shown that taxi drivers who are more conscientious have committed fewer violations. From these results, those who consider themselves to be responsible are more respectful to the rules and are less likely to commit violations.

4.2. Aggressive Violations

The model for aggressive driving violations predicted 51% of the variation, and generally, it was significant ($F(10,245) = 27, p < 0.05$). As expected, aggressive behavior had the most significant impact on this type of driving behavior ($p < 0.001$), followed by instrumental attitude, social anxiety, sensation seeking, life satisfaction, urgency, and selfishness ($p < 0.05$). Three factors of conscientiousness, premeditation, and age had not been significant predictors of aggressive violations. Aggressive violations are somehow related to violations to a degree that, even in some studies, these two psychological characteristics are considered as one specification. According to the results, psychological characteristics such as social anxiety, sensation seeking, and aggressive mode were assumed as significant predictors in both kinds of violations. Among these factors, the impact of aggressive behavior on aggressive violations is higher than general violations. The previous research shows that anger is generally associated with aggressive driving and aggressive violations [54]. Dula et al. [55] showed that through raising social anxiety, drivers do more effort to keep their positive public image and they are less likely to act aggressively even when they are angry. This behavior was also confirmed in this study.

The results from Table 3 indicate that instrumental attitude had a significant negative impact on aggressive violations, which shows that those who are aware of the results of their behaviors and care about their behavior are less likely to behave aggressively. Previous studies showed that attitude towards rule violations and speeding has a direct significant impact on both violation and aggressive violation factors [21,56,57]. However, the results from the current study show that instrumental attitude was not a significant predictor of violation, but it was a significant predictor for aggressive violation. This may be due to an overlap with other predictor variables in the model which were not considered by the previous studies.

Table 3. Predicting aggressive violations with psychological characteristics.

Aggressive Violations	Beta	t	p-Value	Partial Correlations
instrumental attitude	−0.167	−3.116	0.002	−0.200
social anxiety	−0.168	−3.135	0.002	−0.201
sensation seeking	0.140	2.495	0.013	0.161
Aggressive mode	0.402	7.163	0.000	0.424
Conscientiousness	0.049	0.997	0.320	0.065
Life satisfaction	−0.104	−1.986	0.048	−0.129
Premeditation	−0.074	−1.400	0.163	−0.091
Urgency	0.115	2.301	0.022	0.149
Selfishness	0.107	2.117	0.035	0.137
Age	−0.072	−1.549	0.123	−0.101
Adjusted R Square	0.517			

4.3. Errors

The multiple regression model related to errors shows that urgency was the most significant predictor of this type of driving behavior ($p < 0.000$), followed by sensation seeking. The model predicted 31% of the variation in errors ($F(10, 245) = 8.3, p < 0.05$). Other factors were not significant in predicting errors.

The results from Table 4 shows that the drivers who cannot control the panic situation during an emergency (lower urgency) are more likely to experience errors, because they are more focused on the emergency itself, and they may not be able to control their stress. Therefore, the lack of attention to their surrounding environment makes them prone to erroneous behavior. The increase in the rate of sensation seeking has also led to an increase in errors, which may be due to the fact that the individuals who are more enthusiastic about new experiences may pay less attention to their surroundings.

Table 4. Predicting errors with psychological characteristics.

Aggressive Violations	Beta	T	p-Value	Partial Correlations
instrumental attitude	−0.053	−0.778	0.438	−0.051
social anxiety	0.120	1.786	0.075	0.116
sensation seeking	0.214	3.020	0.003	0.194
Aggressive mode	−0.126	−1.785	0.075	−0.116
Conscientiousness	−0.073	−1.173	0.242	−0.076
Life satisfaction	−0.117	−1.761	0.080	−0.114
Premeditation	0.002	0.036	0.972	0.002
Urgency	−0.383	−6.055	0.000	−0.368
Selfishness	0.055	0.859	0.391	0.056
age	0.035	0.589	0.557	0.038
Adjusted R Square	0.310			

4.4. Lapses

The last multiple regression model which is related to lapses indicates that life satisfaction, sensation seeking, age, urgency, and conscientiousness were the best predictors of this model, respectively, and other factors were not significant predictors of this model. Generally, the model predicted 21% of the variation in lapses ($F(10, 245) = 7.5, p < 0.05$). This model is less accurate and predicted less percentage of variation compared with the last three models developed in this study; however, the model is still accurate and the level of significance is consistent with the literature [41,42,51].

As it was mentioned in the literature, lapses are more related to those errors caused by an individual's forgetfulness, which can be due to aging. Besides, the results from Table 5 indicate that the level of life satisfaction can also affect this oblivion. The more a person is satisfied with their life,

the less likely they will commit lapses. The effects of sensation seeking and urgency can be the same as their effect on errors, because lapses are considered as some kinds of errors.

Table 5. Predicting lapses with psychological characteristics.

Aggressive Violations	Beta	T	p-Value	Partial Correlations
instrumental attitude	0.028	0.415	0.679	0.027
social anxiety	−0.018	−0.266	0.790	−0.017
sensation seeking	0.181	2.527	0.012	0.163
Aggressive mode	0.033	0.456	0.649	0.030
Conscientiousness	−0.128	−2.019	0.045	−0.131
Life satisfaction	−0.274	−4.082	0.000	−0.258
Premeditation	0.024	0.363	0.717	0.024
Urgency	−0.146	−2.284	0.023	−0.148
Selfishness	0.090	1.391	0.166	0.091
age	0.146	2.445	0.015	0.158
Adjusted R Square	0.212			

5. Limitations

The project had to be completed within a certain time limit, thus the time-consuming procedure of interviewing taxi drivers took us away from collecting more samples. Increasing the sample size could enhance the reliability of the study findings. Furthermore, in Iran, less than 1 percent of taxi drivers are women. Thus, it was practically impossible to consider female drivers in this study, while considering female drivers may affect the results. Furthermore, the presented analysis is specific to a country and may vary from place to place. It is worth analyzing different samples and statistical methods. Another important point is that the drivers' actual behavior may be different from what they stated in the questionnaire.

6. Conclusions

Driving behavior is one of the contributing factors in road accidents and the consequent casualties. Drivers' psychological characteristics affect their driving behavior. The current study used a questionnaire survey to collect reliable data on driving behavior and psychological characteristics among taxi drivers of Metropolitan Tehran. This questionnaire was provided by modifying the original DBQ version, according to Iran's driving condition. In this study, the impact of nine psychological factors (instrumental attitude, subjective norm, life satisfaction, sensation seeking, premeditation, urgency, selfishness, aggressive mode, and conscientiousness) on each case of driving behavior (violations, aggressive violations, errors, and lapses) has been investigated and compared with each other. As a result, social anxiety and selfishness were the best predictors of the violations, aggressive mode was a significant predictor of the aggressive violations, urgency had a perfect impact on the errors, and finally, life satisfaction, sensation seeking, conscientiousness, age, and urgency were the best predictors of the lapses.

The findings can be useful for the managers who need to employ or train taxi drivers. They can use the results of this study to predict driver's behaviors, in order to employ safer ones. In addition, improving taxi drivers' driving behaviors increase users' satisfaction with this mode of transportation. Besides, in countries where taxi companies are privately operating, and there is a competition between them, considering the implication of this study helps to raise the quality level of the company and attract more customers. The companies can easily train and monitor their drivers by developing a testing and evaluation framework of taxi drivers, based on the results of this study. It is worth mentioning that their attention to detail will pay off, if their drivers are committed to the company for the long term. In summary, training taxi drivers based on their psychological characteristics as well as the types of violations that they generally commit may be the main application of this study in

practice. The study of how ordinary drivers' psychological characteristics affect their driving behaviors, and discussing its significance, could be a suitable material to steer future research in this direction.

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