Analysis of Drivers' Behavior using Manchester Driver Behavior Questionnaire Based on Roadside Interview in Iran

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Abstract

Drivers' behavior is one of the most important factors in traffic safety. Understanding of this issue and its effective factors can be helpful to reduce the influences of human factors on traffic accidents. The objective of this study is to apply Manchester driver behavior questionnaire (DBQ) to a group of drivers who have overtaken on two-lane rural roads and to analyze their behavior. Also, the relationship between DBQ subscales and overtaking type is investigated. Data collection was performed using field method (observations next to the roads). In order to analyze the data, factor analysis, analysis of variance, and logistic regression were used.

Factor analysis led to producing a 4-factor structure including errors, lapses, ordinary violations, and aggressive violations. The results showed that increasing in age and driving experiences gave rise to a decrease in violations scores. Moreover, the results demonstrated a relationship between demographic variables, the score of violations, and type of overtaking. In addition, older drivers had low tendency to commit violations. The purpose of the trip was one of the effective factors for drivers' behavior and types of drivers' overtaking maneuver. Drivers who were on business trips committed more violations and errors than others. Among DBQ factors only the violation factor was effective for predicting the type of overtaking.

Keywords: Driver behavior questionnaire, two-lane, two-way rural roads, overtaking

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1. Introduction

Drivers' behavior is one the most important factors in traffic safety and road accidents. The Human factor is one of the major causes in half of traffic accidents [Lawton, Parker, Manstead, and Stradling, 1997]. Understanding of this issue and its effective factors can reduce the influences of human factors on traffic accidents. In the previous studies on human factors in road accidents, it has been concluded that applying a proper theoretical framework for accident analysis requires differentiation between errors and violations [Reason, Manstead, Stradling, Baxter, and Campbell, 1990]. These two forms of anomalies have different psychological roots and consequently, different reform practices [Xie and Parker, 2002]. One of the beneficial efforts for classifying these behaviors has been done by Manchester driver behavior research group. They provided a questionnaire called "driver behavior questionnaire" (DBQ) that categorizes improper driver behaviors into slips or lapses, errors, and violations. Errors are described as inability and incompetency to make a correct judgment and do a series of designed actions to get the desired result [Özkan, Lajunen, Chliaoutakis, Parker, and Summala, 2006]. Violations are the behaviors which endanger driving safety, such as speeding or driving without a sufficient gap with other vehicles [Eugenia Gras et al., 2006]. Lawton et al (1997) identified another factor which was effective in the outbreak of aberrant behaviors and called it "slips". Slips are a set of problems related to the lack of attention and memory defects that cause embarrassment, like forgetting the place that you parked your car. Also, violations can be divided into aggressive violations (obvious aggressive actions) and ordinary violations (including the ignorance of the rules without any aggressive incentive) [Lawton et al., 1997]. The issue of traffic safety, road accidents, fatalities and consequent related costs, are undoubtedly of the most important issues in the world, in which, low- and middle-income countries are involved more than developing ones. In Iran, car accidents, in addition to economic losses, cause human casualties. It is estimated that one million and two hundred thousand people around the world lose their lives due to road accidents [Organization, 2013]. Studies in Iran have shown that 70% of accidents occur in rural roads. About 50 to 60% of rural accidents happen in two-way two-lane roads that comprise 82% of roads in Iran [Mohaymany, Kashani, and Ranjbari, 2010]. By examining a three-year period accident data, for this type of roads in Iran, it was found that while only 20% of all accidents are related to overtaking maneuver, but 30% of casualties and 50% of deaths are related to the overtaking maneuver [tavakoli, 2011]. According to the reports by Iranian Legal Medicine Organization, in 2014, about 17,000 people were killed in traffic accidents; about 65% of this fatalities was in rural roads. Also, 25.2% of road accidents in 2014 were due to the deviation to the left and overtaking maneuver [Bahadorimonfared et al., 2013]. High contribution of the human factor in accidents, high death rate of accidents caused by overtaking maneuver, and major absence of studies related to overtaking maneuver motivated the researchers of this paper to study the structure of DBQ in a sample of drivers who had attempted overtaking maneuver and also analyze the relationship between aberrant behaviors and overtaking maneuver. In this article we examined two hypotheses.

The First hypotheses: There is a clear difference between driving violations and errors in a sample of drivers who had attempted overtaking maneuver.

The second hypotheses: Demographic variables and driver violations can predict overtaking type.

In this regard it is assumed that, Drivers Responses are reliable and Overtaking maneuver had been carried out without the intervention of someone.

2. Background of Overtaking and Driver Behavior

Since the publication of Reason's research results in 1990 so far, many studies have been conducted on the behaviors of drivers in different countries: 174 studies in 2010 have used DBQ [De Winter and Dodou, 2010]. In a case study using DBQ in England, it was shown that young and male drivers performed more violations than old and female drivers. Furthermore, it was revealed that violation subscale, compared to two other subscales (slip and error), had a more significant relationship with the occurrence of traffic offenses and probable road accidents. It is to be noted that data collection was conducted by mail [Westerman and Haigney, 2000]. Sullman et al (2002) worked on truck drivers' behavior in New Zealand and found out that the DBQ structure and the relation of its subscales with accidents were different from those in the studies on regular car drivers. In their study, the questionnaires were sent to drivers' workplaces. In another study in year 2013, De Wintter applied a driving simulator de-

vice to examining novice drivers' behaviors and comparing them in the simulated environment with their behaviors on roads (real environment). Primary results showed that violations and speed in the simulator predicted their self-reported violations. In other studies, drivers' behavior have been compared in various countries. Şimşekoğlu et al (2013) examined drivers' behavior in Turkey and Iran, Lajunen et al (2004) in Finland and the Netherlands, and Bener et al (2008) in Qatar and the UAE. Also, Ozkan et al (2006a) compared drivers' behavior in 6 countries. Some studies have examined drivers' behavior over time. Ozkan et al (2006b) examined the DBQ variable changes during the period of three years. Also, Iversen and Randemo (2012) investigated changes in attitude and behavior of Norwegian drivers during 9 years. In Iran, Ayati et al (2011) examined the factors affecting the driving behavior of drivers in Mashhad (such as speed choice, gender, and sensation seeking to study the impact of culture on aggressive driving. Ghotbiravandi et al. (2012) investigated the effects of human factor (from different aspects such as gender, personality, and behavior) in accidents and traffic offenses. The results showed that, on average, men had more crimes than women. Also, Mamdoohi et al (2014) investigated the DBQ structure among Iranian drivers by expanding the geographical distribution of the sample through the collection of data on social networks and e-mail service. This research was conducted in Iran for drivers of private cars, but Malekpur et al (2012) examined the behavior of motorcyclists in Tehran, and Varmazyar et al (2014) examined the DBQ structure and the relationship between demographic variables and DBQ factors with self-repot crash involvement among bus drivers.

However nowadays, in most cases, other methods such as simulation are used to analyze speeding and overtaking; but, it seems that simulation influences drivers› behavior, because driving environment is unreal and drivers perceive no risk. In fact, drivers consider that there is no risk while overtaking in a simulated environment; therefore, they act differently from when they are in a real environment [Bella, 2011].

In recent years, several studies have been conducted to evaluate drivers› behavior, but the behavior of drivers in different driving maneuvers such as overtaking maneuver have rarely been investigated. The purpose of this research is to identify and analyze the behavior of drivers in overtaking maneuver as a dangerous maneuver on two-lane, two-way roads. In fact the sample of the study included a special case of drivers (drivers who have attempted overtaking) and all drivers are not included. The sample of this study and also sampling method is the novelty of the study. It should be noted that Study of driver behavior in various driving maneuvers, can help us to identify and better control the dangerous maneuvers.

3. Manchester Driver Behavior Questionnaire

This questionnaire was provided by Reason et al (1990) at Faculty of Psychology, University of Manchester. This scale has been executed and validated in different countries such as Britain, Finland, Netherlands [Lajunen et al., 2004], New Zealand [Sullman et al., 2002], Czech [Sucha, Sramkova, and Risser, 2014], Australia [Freeman et al., 2014], China [Li, van Zuylen, and van der Horst, 2014], Iran and Turkey [Şimşekoğlu et al., 2013], and Norway [Iversen and Rundmo, 2012]. This questionnaire is based on the idea that errors and violations have different psychological roots and reform practices and must be differentiated. The questionnaire used in this study had two parts. The first part included demographic variables as well as vehicle, trip, and road variables and the second part contained the Persian version of 28-item DBQ questionnaire which had 8 item on violations, 8 item on slips, 6 item on ordinary violations, and 6 item on aggressive violations. The drivers were asked to answer these questions in a 6-point Likert range (0 = never to 5 = always). It is to be noted that the English and Spanish versions of 28-item DBQ questionnaire have been used in several studies [Chapman, Roberts, and Underwood, 2001; Mesken, Lajunen, and Summala, 2002; Sullman et al., 2002].

4. Data Collection and Analysis

4.1 Participants

The number of drivers who performed permitted or unpermitted overtaking on two-lane rural roads of Eastern Azerbaijan and Zanjan Provinces and participated in the study, was five hundred and fourteen. The data in this study were collected in the field. Eleven number of participants, Due to improper and incomplete information, were not considered in the analysis. Also, 98.01% of the questionnaires belonged to male drivers, while 1.99% of them were related to females. The reason of this distribution was the low contribution of female drivers on rural roads in Iran.

4.2 Case Study and Experimental Data

In this study, field method (next to the road survey) was applied. Data collection was performed by an expert –a transportation engineer– accompanied by the police. They observed cars during overtaking and then stopped them for an interview. Since data collection in this research was very time-consuming and costly, five main suburban roads in the provinces of Eastern Azerbaijan and Zanjan were considered as the physical area of the study in September and October 2014. It should be mentioned that the police were camouflaged; therefore, the presence of traffic police in the area did not influence the drivers› behavior when performing overtaking maneuvers. Considering that the aim of this study was to investigate drivers› behavior in overtaking maneuver, it was necessary to sample drivers who had attempted to perform this maneuver. Therefore, the sample should be included both permitted and unpermitted overtaking to be compared. For these reasons, roadside survey was chosen. According to moral principles, drivers informed about ongoing research and in agreement with the drivers, Manchester Driver Behavior Questionnaire was delivered to them. It is worth mentioning if the driver refused to respond to the questionnaire, there was no force application in order to make the responses reliable. Factor analysis was used to determine the questionnaire's structure, ANOVA was used to understand significant differences between the groups, and logistic regression was used to predict factor scores and overtaking type.

Totally, 514 overtaking were observed and 503 questionnaires were correctly filled out. 44.14% of the cases were performed permitted overtaking and 55.86% were unpermitted. The mean age of the drivers was 36.72 and the mean driving experiences was 11.42 (Table 1). The mean and standard deviation of the DBQ questions for the data were calculated and provided in Table 2 in a descending order of the mean value.

Table 2 shows that the most frequent violation committed by drivers was the use of horn when getting mad at other drivers (mean of 1.24) and the least violation was racing with other drivers (mean of 0.493). The highest number of occurred errors was inattention to pedestrians while turning to a side street (mean of 1.049) and the least was misreading the traffic signs and exiting from a roundabout on the wrong road (mean of 0.178).

4.3 Factor Analysis

In order to understand the factor structure of DBQ, the questions were tested by principal component analysis Using varimax rotation [Kontogiannis, Kossiavelou, and Marmaras, 2002; Lajunen et al., 2004]. The result of Kiser-Mayer-Olkisen test (KMO= 0.912) was satisfactory and that of Kervit Bartlet test ($p<0/00001$) was significant. Although the analysis showed six factors with eigenvalues >1, the examination of the scree plot confirmed four interpretable factors. Then, factor analysis was repeated while considering the four factors as output factors [Cordazzo, Scialfa, Bubric, and Ross, 2014]. Four groups of questions with the factor loading greater than 0.4 were obtained and the results are shown in Table 3.

These four factors accounted for about 46.20% of total variance. The first factor "ordinary violations" contained 14.67% of total variance, including 5 items of ordinary violations and 2 items of aggressive violations. The second factor constitutes 13.36% of total variance, encompassing 7 items of errors and 1 item of aggressive violations. Due to the high percentage of errors in this factor, it was called, "errors". The third factor comprised 9.98% of total variance and contained 8 items of lapses and 1 item of errors. This factor was called, "lapses". The fourth factor that included 3 items was known as "aggressive violations", because all 3 questions were on aggressive violations. This factor contained 8.19% of total variance.

Table 1. Characteristics of the variables

Variables	Group	Number	Percentage
Age(year)	18 -26	92	18.29
	27-30	93	18.49
	31-36	112	22.27
	37-45	93	28.49
	>45	113	22.47
Driving experience (year)	1-4	107	21.27
	5-8	111	22.07
	9-12	116	23.06
	13-18	81	16.10
	>18	88	17.50
Overtaking type	permitted	222	44.14
	Not permitted	281	55.86
Driving frequency	High (everyday)	278	55.27
	Medium(some days a week)	167	33.20
	Low(some days a month)	58	11.53
purpose of the trip	business	294	58.45
	recreational	209	41.55

Table 2. Means and standard deviations of DBQ items

No	Item	Average	SD
Errors			
1	Underestimate the speed of an oncoming vehicle when overtaking	0.876	0.865
2	Fail to check rear-view mirror before a maneuver	0.872	1.011
3	Miss ‘‘give way‘‘ sign and narrowly avoid a collision	0.757	0.957
4	Attempt to overtake someone signaling a right turn	0.749	0.830
5	Queuing to turn left, nearly hit the car in front	0.864	0.902
6	Fail to notice pedestrians crossing when turning into a side street	1.049	1.023
7	Brake too quickly, or steer the wrong way into a skid	0.443	0.736
8	On turning right, nearly hit a cyclist coming up on your inside	0.705	0.793
Lapses			
1	Attempt to drive away from the traffic lights in third gear	0.568	0.931
2	Get into the wrong lane approaching a roundabout or junction	0.723	0.856
3	Forget where you left your car in the car park	0.833	1.027
4	Wake up’’ to find yourself on a wrong, but more familiar destination’’	0.769	0.819
5	Switch on one thing when you meant to switch on something else	0.735	0.834
6	Misread the signs and exit from a roundabout on the wrong road	0.178	0.527
7	No clear recollection of the road along which you have just travelled	0.608	0.810
8	Hit something when reversing that you have not previously seen	0.530	0.710
ordinary violations			
1	Disregard the speed limit on a residential road	1.172	1.168
2	Cross an intersection knowing the traffic lights have already turned against you	1.079	1.028
3	Overtake a slow driver on the inside	1.073	1.384
4	Drive when you suspect you may be over the legal alcohol limit	1.057	1.142
5	Disregard the speed limit on the highway	1.019	1.094
6	Drive close to the car in front, making it difficult to stop in an emergency	0.902	0.992
Aggressive violations			
1	Sound your horn to indicate your annoyance at another road user	1.240	1.072
2	Stay in a lane about to close until the last minute, then dive in	0.894	1.057
3	Pull out of an intersection so far you force your way into the traffic	0.884	1.070
4	Angered by a certain type of driver, show your hostility	0.711	1.032
5	Angered by another driver, give chase	0.568	0.898
6	Race away from the traffic lights to beat another driver	0.493	0.874

Table 3. Four-factor solution of the DBQ items and eigenvalues

No. of item in questionnaire	item	1	2	3	4
11	(Disregard the speed limit on a residential road(OV	0.758			
28	Disregard the speed limit on the highway(OV)	0.703			
10	Pull out of an intersection so far you force your way into the traffic(AV)	0.687			
24	Cross an intersection knowing the traffic lights have already turned against you(OV)	0.679			
3	Drive when you suspect you may be over the legal alcohol limit(OV)	0.659			
20	Overtake a slow driver on the inside (OV)	0.548	0.447		
21	Race away from the traffic lights to beat another driver (AV)	0.492			
5	Queuing to turn left, nearly hit the car in front (E)		0.685		
6	Fail to notice pedestrians crossing when turning into a side street (E)		0.65		
13	On turning right, nearly hit a cyclist coming up on your inside (E)		0.608		
23	Drive close to the car in front, making it difficult to stop in an emergency (OV)		0.552		
18	Stay in a lane about to close until the last minute, then dive in (AV)		0.527		
8	Fail to check rear-view mirror before a maneuver (E)		0.523		
16	Attempt to overtake someone signaling a right turn (E)		0.519		
14	Miss "give way" sign and narrowly avoid a collision (E)	0.477	0.503		
27	Underestimate the speed of an oncoming vehicle when overtaking (E)		0.437		
12	Switch on one thing when you meant to switch on something else (L)			0.663	
9	Brake too quickly, or steer the wrong way into a skid (E)			0.552	
4	Get into the wrong lane approaching a roundabout or junction (L)			0.52	
19	Forget where you left your car in the car park (L)			0.517	
22	Misread the signs and exit from a roundabout on the wrong road (L)			0.486	
1	Hit something when reversing that you have not previously seen (L)			0.472	
26	No clear recollection of the road along which you have just travelled (L)			0.455	
2	"Wake up" to find yourself on a wrong, but more familiar destination (L)			0.452	
15	Attempt to drive away from the traffic lights in third gear (L)			0.429	
25	Angered by a certain type of driver, show your hostility (AV)				0.77
17	Angered by another driver, give chase (AV)				0.704
7	Sound your horn to indicate your annoyance at another road user (AV)	0.455			0.544
Variance explained		14.67	13.36	9.98	8.19

E= errors, L= lapses, OV= ordinary violations, AV= aggressive violations

Table 4. Alpha reliability coefficients of the Measurement Scales

Type of the aberrant Behaviour	Alpha reliability coefficients
Errors	0.822
Lapses	0.819
Ordinary violation	0.725
Aggressive violation	0.769

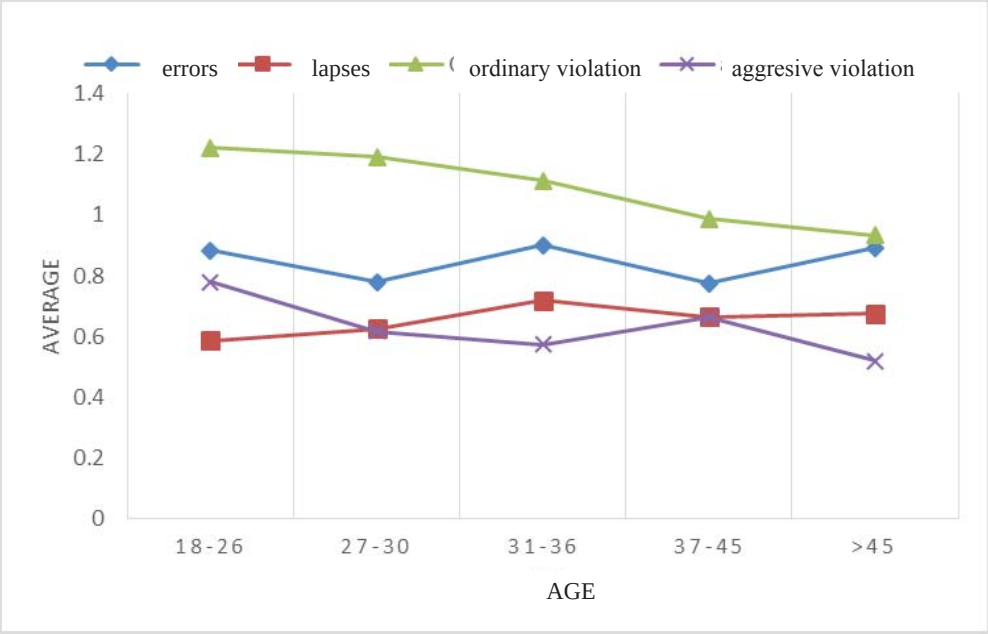

Figure 1. Mean scores of DBQ factors in terms of age

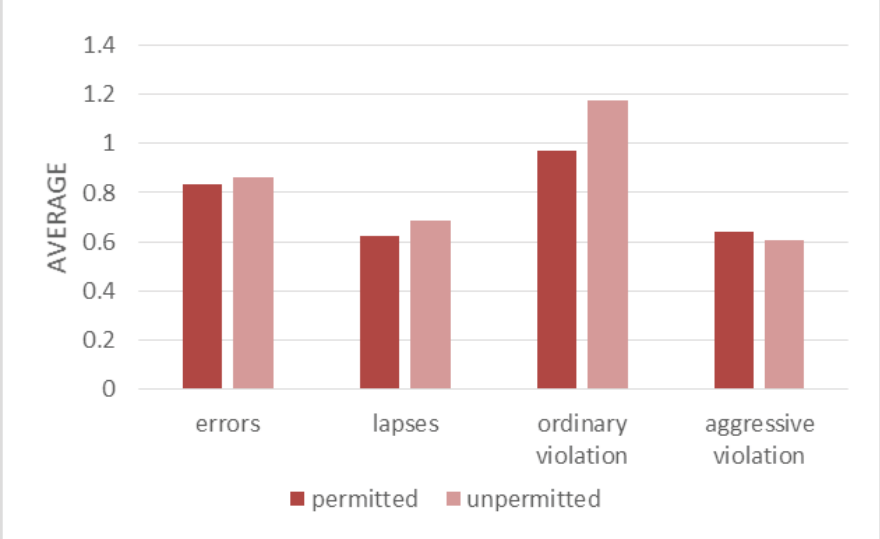

Figure 2. Mean scores of DBQ factors for permitted and unpermitted overtaking

4.4 Analysis of Drivers' Behavior

Analysis of drivers' behaviors in terms of age showed that drivers committed fewer violations with an increase in age ($p<0.03$). Drivers older than 45 committed about 24% fewer violations than the younger ones (18 to 26). In addition, according to Figure 1, slips increased with an increase in age. In other cases, no statistically significant differences were observed (Figure 1).

According to Figure 2, it can be inferred that the drivers who overtook illegally had higher scores in three groups of ordinary violations, lapses, and errors than the drivers who overtook legally. Such a difference was more perceptible for ordinary violations than other subscales and was statistically significant ($p<0.005$).

Analysis of drivers' behaviors in terms of their experience showed that the more experienced the drivers, the fewer the number of ordinary and aggressive violations, but the more the lapses committed would be. Furthermore, drivers with more than 18 years of experience committed minimum violations. In other words, drivers

with more than 18 years of driving experience committed about 33% fewer violations than the less experienced ones. No specific trend was observed in terms of errors (Figure 3).

Analysis of drivers' behavior in terms of trip aim (Figure 4) showed that those who were on business trips had higher scores in all behavior subgroups than those who traveled with a recreational purpose; also, differences in ordinary violations and errors subscales were reliable at the significance level of 5%. In other words, drivers who traveled with a business purpose committed more violations and errors.

Analysis of driving behaviors and purpose of trip in terms of overtaking type (Figure 5) showed that drivers who overtook illegally had higher scores in violations and errors than those performing permitted overtaking. The following figure shows the ascending trend of violation and error scores in two groups of drivers with business and recreational purposes. Drivers with the business purpose of trip that performed unpermitted overtaking had more violations and errors than the drivers with a recreation purpose of trip that performed unpermitted overtaking. This trend is also true in relation to the drivers performed permitted overtaking.

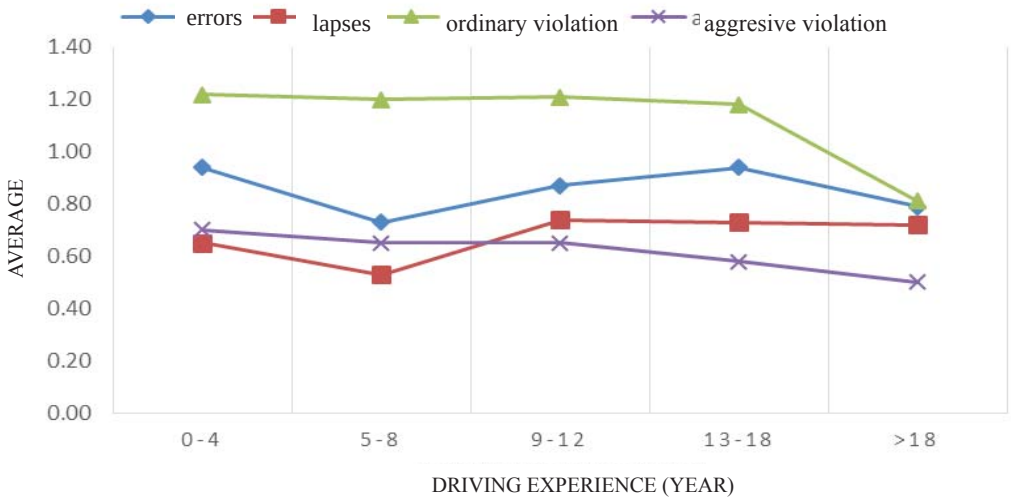

Figure 3. Mean scores of DBQ factors in terms of driving experience

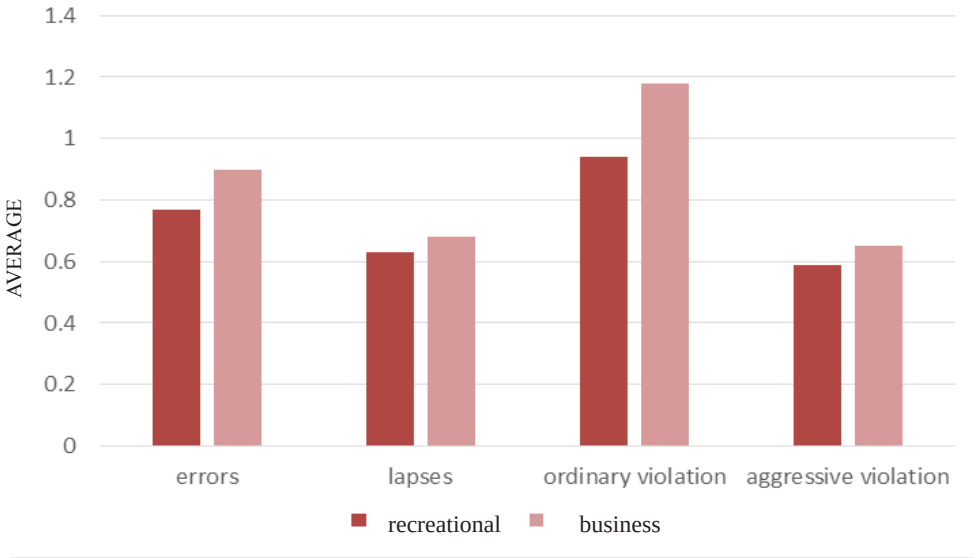

Figure 4. Mean scores of DBQ factors in terms of purpose of trip

Figure 5. Mean scores of DBQ factors in terms of purpose of trip and overtaking type

Table 6. Results of logistic regression

block	variable	chi-square	Correctly classified%	-2LL	SE	df	B	wald	Exp(B)
1	age	8.769	55.7	681.6	0.013	1	0.033	6.385*	1.034
1	Trip aim				0.188	1	0.012	0.002	1.012
1	Driving experience				0.017	1	0.046	7.825**	1.047
1	Driving frequency				0.125	1	0.039	0.103	1.039
2	Ordinary violation	24.188***	59.6	666.1	0.021	1	-0.078	14.19***	0.93
2	Aggressive violation				0.046		-0.111	5.915*	0.895

p<0.05 ،**p<0.01 ،p<0.001**

Table 5. Pearson correlation coefficients between questionnaire's subscales

	errors	lapses	Ordinary violation	Aggressive violation
errors	1	.652**	.576**	.470**
lapses		1	.471**	.452**
Ordinary violation			1	.511**
Aggressive violation				1

p<0.05 ،**p<0.01 ،p<0.001**

Analysis of the data showed that there are a significant relationship between questionnaire's subscales. The correlation coefficients are more than 0.45 at the significance level of 0.01 (Table 5). Analysis of other variables such as age and driving experience with the average of subscales showed that, with an increase in age and driving experience, violations would decrease.

4.5 Prediction of Overtaking Type

Manchester driver behavior questionnaire is one of the most common tools for examining the relationship

between driver behaviors and road accidents, which is used in many studies. In this study, considering the data, the ability of Manchester driver behavior questionnaire's variables in terms of predicting overtaking type was tested (Table 6). In order to predict overtaking type, the logistic regression was used. The reason for using logistic regression was that overtaking type was discrete and binary variable (permitted and unpermitted) and that logistic regression is not sensitive to the distribution of independent variables and their discretion or continuity; thus, both independent variable types can be entered into the model simultaneously. In the first step, demographic variables were considered the independent variable. Then, scores of DBQ subscales were entered into the model by leading method of maximum likelihood ratio. Consequently, the model was improved at the significance level of 5 %.

Table 7. Model summary and Hosmer and Lemeshow Test

Model Summary				
Step	Log like- -2 lihood	Cox and Snell R Square		Nagelkerke R Square
2	663.778	0.639		0.893
Hosmer and Lemeshow Test				
Step	Chi-square	df	.Sig	
2	12.056	8	465.	

As shown in Table 6, among the demographic variables and descriptive variables, only the driver's age and driving experience were effective for predicting overtaking type. After entering the DBQ scale scores, it was observed that violations were entered into the model with significant coefficients and were successful in predicting the overtaking type. The goodness of fit indexes, Chi-square test, and -2 log likelihood (-2LL) showed that the final model fitted data as desired and the addition of DBQ subscales in the second step improved the model.

5. Discussion

In this study, in cooperation with the traffic police, 503 drivers who performed permitted and unpermitted overtaking were interviewed and recorded. In other words, the data in this study were collected by the field method and were completely real (opposite to the simulated environment).

The results of this study showed that DBQ questionnaire had a clear factor structure, with a relatively high factor loading and acceptable internal consistency. In the factor analysis, 4 factors of lapses, ordinary violations, errors, and aggressive violations were obtained and differentiated clearly. Results of factor structure examination in the studies by Reason et al (1990), Sullman et al (2002), and Mesken et al (2002) have also verified two structures of errors and violations. However, in various studies, different factor structures have been obtained; but in present study, the distinction between lapses and errors were revealed.

By comparing the results of the current study with previous studies, some adaptations in the results were observed. Ordinary violations included 7 items that clearly showed the distinction between errors and violations. However, two items of aggressive violations ("Pull out of an intersection so far you force your way into the traffic" and "Race away from the traffic lights to beat another driver") were accidentally entered into this factor, while these two items seemed not to be related to the direct hostility of drivers to other road users. The existing items in errors showed high adaptability with the findings of previous studies [Parker, Reason, Manstead, and Stradling, 1995]. But, it also included one item of aggressive violations ("Stay in a lane about to close until the last minute; then, dive in") and one item of ordinary violations ("Drive close to the car in front, making it difficult to stop in an emergency"). The reason can be that many drivers do not consider these two items as violations and, consequently, in most cases, they do not care about it. The third factor was lapses. This factor included all the lapses items in the questionnaire and one item of errors ("Brake too quickly or steer the wrong way into a skid"). This factor clearly and correctly showed the distinction between lapses and errors. Aggressive violations had three items that showed direct hostility towards other road users. Unlike the study by Gras et al (2006) which reported that Cronbach's alpha of aggressive violations unreliable (0.46), in this study, alpha coefficient for aggressive violations was calculated as 0.769, which was fairly reliable. In the present study, using exploratory factor analysis, aberrant behavior of Iranian drivers was divided into 4 factors of "slip", "ordinary violations", "errors", and " ag-

gressive violations". This four-factor structure covered 46.2% of the variance of Iranian drivers' aberrant behavior, which was greater than the value obtained in some studies in Iran [Mamdoohi et al., 2014; Varmazyar et al., 2014]. The distinction between errors, lapses, and violations was the notable point of present study.

Analysis of drivers' behaviors in terms of age and driving experience showed that drivers committed fewer violations with an increase in age and driving experience. It seems that, aging and increasing driving experience, decrease drivers sensation seeking and increase the respect to traffic laws. But in contrast with Reason et al (1990) lapses are increasing with aging. And also results showed that, drivers who had unpermitted overtaking, reported higher violation scores. It can be inferred from this result that drivers who had unpermitted overtaking, are very risky drivers. Then again, drivers who were on business trips had higher scores in all behavioral subgroups than those who traveled with a recreational purpose. Having a hurry is the most important reason of unpermitted overtaking in business trips.

Table 5 shows that there is a relatively high correlation between the questionnaire's subscales. An increase in one of them increases other subscales as well. Table 6 also demonstrates that driving experience is one of the significant variables for predicting overtaking type. In addition, drivers' age have a positive coefficient in the prediction of overtaking type in the first step. It means that increasing in age and driving experience, decrease the probability of performing unpermitted overtaking. In the second step and after adding DBQ subscales, Results of the study show that violations can significantly predict overtaking type. Increasing in the violation scores, increases the probability of performing unpermitted overtaking maneuver. In many studies in which drivers' behaviors have been examined, the relationship between driver behavior and accidents and traffic offenses has been investigated. In most of these studies, violation factor has been the predictor of accidents [Eugenia Gras et al., 2006]. Mamdoohi et al (20014) have conducted a study on Iranian drivers and concluded that error and violation factors were significantly related to accidents. Some studies also have found out that errors associated with accidents, and violations related to tickets received in last year [Lucidi et al. 2014]. The result of present study showed that violations factor is related to overtaking type and predicting it properly.

6. Conclusions and Recommendations

In the current study, the condition of passenger car drivers' behaviors on two-lane, two-way rural roads was examined by an experimental study and the following results were obtained:

1. Investigation of drivers' violations showed that ignoring legal speed and unpermitted overtaking were the most ordinary violations that drivers committed after using the horn. Considering that these two violations are the major reasons of accidents on two-lane roads. More control on roads is one of the practical solutions to reduce such violations.
2. Investigation of errors showed that pedestrians are in danger when the vehicle turns, which increases fatal accidents.
3. Results of factor analysis showed that driver behavior questionnaire had a 4-factor structure with acceptable internal correlation coefficients

Figure 1 shows that drivers' age have negative impact on their committed violations and an increase in age reduces the inclination to commit violations.

Figure 2 demonstrates that drivers who made unpermitted overtaking committed more violations than those with permitted overtaking.

Figure 3 shows that drivers' experience caused a reduction on violations, while slips had a relatively ascending trend.

Figures 4 and 5 represent that the purpose of trip was one of the effective factors for drivers' behavior and type of their overtaking maneuver. Drivers with business purposes committed more violations and errors than other drivers. Also, the mean of violations and errors of drivers with business purpose of trip who had unpermitted overtaking, was higher than other groups. Violation subscales were effective factors for the prediction of overtaking type. According to previous studies which have introduced DBQ as an efficient tool for investigating the relationship between accidents and human behaviors, it can be concluded that DBQ can be efficient and reliable in investigating the relationship of human behaviors and overtaking.

Generally, the results of the current study showed

that using DBQ questionnaire in a field study on a real sample of drivers whose maneuver type was observed with direct observation next to the road can be effective in recognizing drivers' behavioral patterns and identifying improper behaviors when overtaking; Which in turn Can be used for future planning and reducing such behaviors. So, major solutions can be traffic safety training and more control on drivers' driving style and roads so that changes in their behaviors might be concluded. As Parker et al(1995) suggested, it seems that safety culture for reducing violations could be improved by changing ideas, beliefs, and norms.

It is obvious that training plays an important role in safety regulations and preventing dangerous maneuvers such as unpermitted overtaking and, consequently, accidents. Training can be only made after the identification of risky behaviors and by providing regular training plans for drivers before obtaining a driving license or even thereafter.

The present study using the above-mentioned method was conducted for the first time in Iran and had many limitations. It is suggested that, in future studies, the relationship of other aspects of human factor such as attitudes and personality with overtaking maneuver and also speed choice be studied. Further, more studies should be carried out by taking further samples and expanding the sampling locations to get more reliable results.

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