Indian Journal of Transport Engineering (IJTE)
ISSN: 2582-9300 (Online), Volume-3 Issue-2, November 2023

Road Safety Perception of Different Types of Drivers in Egypt

Aya Raafat Salama, Mona H. M. Abd-Allah, Mohamed Shawky

Abstract*: *The present research examined the variation in driving behaviors among drivers of different types of vehicles in Egypt. Three categories of drivers have been investigated: private car drivers, microbus drivers, and motorcyclists. A customized version of the Manchester Driver Behavior Questionnaire (DBQ) was developed for the data collection process. An exploratory factor analysis (EFA) was applied to the questionnaire data to determine the underlying factors within the set of behavioral items. The EFA has helped identify three robust factors: Errors, Positive Behaviors, and Violations, respectively, within the responses of drivers. Multiple regression analyses were carried out to establish which socio-demographic variables are the best predictors of each of the three deduced factors. One-way ANOVA tests were then conducted to analyze the differences among the three drivers categories in terms of the three EFA factors as well as the history of crashes and violations. It was found that microbus drivers committed a significantly higher number of traffic violations than both motorcyclists and private car drivers. Also, private car drivers were involved in a fewer number of crashes and had more positive driving behavior compared to microbus drivers. The research findings would aid in targeting the high-risk drivers in future road safety educational campaigns and training courses.

Keywords*: *Traffic Safety, Human Error, Driver Behavior Questionnaire (DBQ), Exploratory Factor Analysis (EFA).

I. INTRODUCTION

Road traffic crashes have been one of the leading causes of death globally. Global status report on road safety 2018 issued by World Health Organization showed that the number of deaths from road crashes continues to climb reaching 1.35 million deaths each year. In addition, road traffic crashes have been found to be the eighth leading cause of death for people of all ages and the main cause of death for children and young adults. Different methods are being used to assess road safety and determine the key factors that contribute to traffic crashes. A group of researchers adopts an objective approach that describes the actual threat to road safety. This is achieved through studying the road environment (such as the weather and pavement condition), vehicle-related parameters (such as gap distance and speed), and safety-determining factors (such as the number of road crashes and casualties). Some objective measurements have been made for these assessments by using probe vehicles for example for carrying out in-field experiments [1]. On the other side, some researchers adopt a subjective approach based on people's feeling or perception of safety. These subjective measurements of driving behavior are made through using surveys or questionnaires where road users play an important role in road risk evaluation [2,3]. Rigorous research has been conducted in many countries to study the contribution of human factors in road traffic crashes. Studies carried out in many countries gave similar results acknowledging that human factors are responsible for more than 90% of all traffic crashes [4]. However, human errors are sometimes accountable for a lower percentage of crashes in low- and middle-income countries due to the poor quality of the other two factors: road environment and vehicle condition, which contribute as well to the causation of road traffic crashes. As other countries, human error has been recognized as a major threat to traffic safety in Egypt, accounting for 79.7% of traffic crashes in 2019 [5]. This fact has brought about the rising trend in analyzing drivers' attitude, perception, and behaviors as an essential part of road safety research. One of the most prominent tools used in assessing risky driving behaviors among motorists is the Manchester Driver Behavior Questionnaire (DBQ) [6]. It is a self-report questionnaire consisting of 50 items where respondents are asked to specify how often they commit each type of behavior while driving, on a scale of 0 (never) to 5 (nearly all the time). The data of the original study were then analyzed and were found to be best-fitted by a three-factor solution: violations, errors, and lapses. Various versions of this questionnaire have been used ever since in many countries and the data have been represented through different factor structures [7–11]. Although numerous studies have been carried out in different countries to examine driving behaviors using self-report questionnaires, most of them were involved with the behaviors of private car drivers. Research has been made using customized versions of the questionnaire to study the aberrant behaviors of other categories of drivers such as bus drivers [12], taxi drivers [13], and truck drivers [14], however, the results solely represent one category of drivers alone. The socio-demographic characteristics, skill level, and periods of time spent on the road differ widely between different classes of drivers, and therefore, the results of a particular class cannot be generalized on other types of vehicle drivers.

Manuscript received on 14 June 2023 | Revised Manuscript received on 26 June 2023 | Manuscript Accepted on 15 November 2023 | Manuscript published on 30 November 2023.
*Correspondence Author (s)

Aya Raafat Salama*, Graduate Student, Department of Public Works, Faculty of Engineering, Ain Shams University, Cairo, Egypt. Email: 1902000@eng.asu.edu.eg, ORCID ID: 0009-0004-9974-7741

Prof. Mona H. M. Abd-Allah, Professor, Department of Public Works, Faculty of Engineering, Ain Shams University, Cairo, Egypt. Email: mona_abdallah@eng.asu.edu.eg.

Dr. Mohamed Shawky, Associate Professor, Department of Public Works, Faculty of Engineering, Ain Shams University, Cairo, Egypt. Email: m_shawky@eng.asu.edu.eg.

It is consequently helpful to develop one evaluation tool that can be used as a predictor of self-reported traffic crashes among different types of motorists through assessing their risky driving behaviors.

II. METHOD

The main objective of this research is to investigate the behavior and road safety culture of drivers in Egypt, and to explore the impact of drivers' attitudes on road safety in terms of their crash records and historical traffic violations. This research inspects the differences in driving behaviors between three subject matters: private car drivers; microbus (14-seat) drivers, as an example of public transportation modes; and motorcyclists. These three categories of drivers are considerably dissimilar in terms of their behaviors on the road, and it was therefore sensible to shed some light on these variations. Due to the lack of official and detailed traffic crash data records in developing countries like Egypt, the approach of this research was to use the DBQ tool to examine the relation between self-reported driving behaviors and self-reported crashes and violations. The risky driving behaviors are compared among the drivers' socio-demographic characteristics to determine any correlations, and the variations among the different types of drivers were also recorded.

A. Questionnaire

A custom-made questionnaire was developed for this research, comprising 38 questions aimed at the drivers of the three categories. The questionnaire addresses 4 types of driving behaviors: Violations, Errors, Lapses, and Positive Behaviors. The original 50-item DBQ was used as the key reference in the formation of the aberrant driving behavior questions. The rest of the questions were included based on the observations made of the prominent aberrant driving behaviors on Egypt roads, in addition to questions about some positive driving behaviors. The questionnaire consists of 2 sections: Section I. General Information, which includes 10 questions about the socio-demographic characteristics of the drivers, their driving experience, and their crashes and violations involvement; and Section II. Driving Behaviors, which includes 28 questions tracking the four forms of driving behaviors mentioned above. The driving behavior items of the questionnaire were to be answered through a 5-point Likert scale (1=never; 2=rarely; 3=sometimes; 4=a lot; 5=nearly all the time). The questions were translated into Arabic. The participants were asked to indicate how often they commit each of the aberrant driving behaviors listed in the questionnaire. The research objective was clearly mentioned at the beginning of the questionnaire. No personally-identifying information was collected to ensure the anonymity of participants.

B. Participants and Sample Size

This research targeted the drivers of private cars, microbuses, and motorcycles. Data from private car drivers were collected via an online form. On the other hand, microbus drivers were approached with a paper-based version of the questionnaire through in-person interviews. Finally, data from motorcyclists were collected by means of both methods. The data was collected between August 2022 and January 2023 and a sample size of 547 was reached. Invalid questionnaires with contradictory information and straightlining (i.e. non-differentiation in ratings) were eliminated to improve data quality, resulting in 515 reliable responses (417 private car drivers, 40 microbus drivers, and 58 motorcycle drivers). Egypt had a total of 10.9 million registered vehicles in 2021, out of which 5.4 million are private cars [15]. The percentage of the other two classes being studied is unknown. However, it is known that there are 0.2 million buses and 3.9 million vehicles in the "Others" category which includes tuk-tuks, motorcycles, heavy equipment, and agriculture tractors. From observation, the number of microbuses can be assumed to be twice as much as that of buses (i.e. 0.4 million), and motorcycles were assumed to be a fourth of the "Others" category (i.e. about 1 million). Based on the previous, Fig. 1 shows the composition of the three vehicles categories within the Egyptian population and the sample collected.

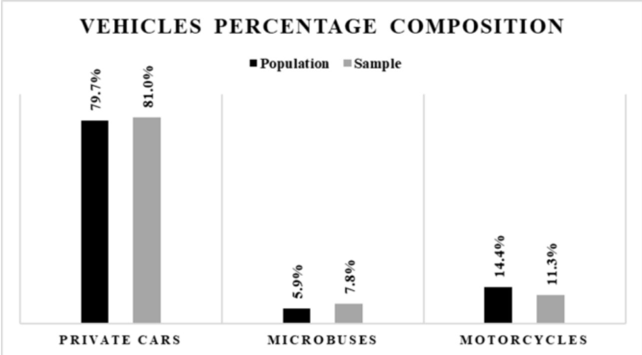

Fig. 1. Percentage composition of the three vehicle types in the population and sample

To determine the required sample size to represent drivers in Egypt, Cochran's sample size formula for categorical data presented below (1) has been used [16,17].

$$n_0 = \frac{(t)^2 \times (p)(q)}{(d)^2} \quad (1)$$

Where n_0 is the required sample size;

t = 1.96, which is the z-score for an alpha a priori at 0.05 (0.025 in each tail) for a confidence level of 95%;

p = 0.5, which is the sample proportion assumed to be 50% to give the maximum possible sample size;

q = (1-p) = 0.5;

therefore, (p)(q) value represents the estimate of variance;

d = 0.05; which is the desired level of precision (i.e. margin of error = ±5%).

Therefore, according to Cochran's formula and the values of the variables presented above, the required sample size is 384. In case the sample size exceeds 5% of the population, Cochran's correction formula presented below is used (2).

$$n_1 = \frac{n_0}{(1+n_0/population)} \quad (2)$$

Where n_1 is the required sample size if sample size (n_0) > 5% of the population.

It can be deduced from (1) and (2) together that a sample size of 384 is enough to represent a population of 1 million and above in order to achieve a confidence level of 95% and a margin of error of 5%. This significance level (at the least) is therefore attainable by the sample size of 515 used in this research. The gender distribution of the private car drivers in the sample is about 76% males (318) and 24% females (99), with their ages ranging between 21 and 70. All the microbus drivers are males (100%; 40 respondents) with ages ranging between 24 and 55. Finally, out of the 58 motorcyclists who participated in the research, only 1 was a female (about 2%), with their ages ranging between 20 and 54. It is important to acknowledge that through observation, males far outnumber females in the Egyptian drivers community. As for microbuses and motorcycles in particular, they are significantly male-dominated with hardly any female drivers.

C. Data Analysis

The flow chart in Fig. 2 shows the types of statistical analyses that were conducted in this research.

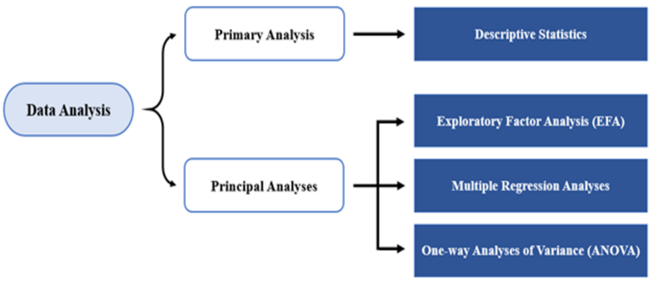

Fig. 2. Flow chart of data analysis process

The role of each step in the data analysis process can be summarized as follows:

1. Descriptive statistics: provide a summary of the data set for the driving behavior items of the questionnaire in terms of means (as a measure of central tendency) and standard deviations (as a measure of dispersion);
2. Exploratory factor analysis (EFA): reduces the measured driving behavior variables and summarizes them into a smaller number of underlying factors or components that represent the unobserved latent variables;
3. Multiple regression analyses: determine the best predictors for each of the factors deduced from the EFA;
4. One-way analyses of variance (ANOVA): analyze the differences among the three different categories of drivers to indicate any significant variation.

IBM SPSS Statistics 25 was the statistical software used for carrying out the analyses. The detailed descriptions of the procedures used are presented in the next section along with the results.

III. RESULTS

A. Descriptive Statistics

The responses to the 28 behavioral items of the questionnaire were first analyzed in terms of means and standard deviations. The items were ranked in a descending order based on their mean values. The five most frequently occurring behaviors (with a mean value greater than 4) are all positive behaviors as follows: using turn signals (M=4.49, SD=0.96); yielding to pedestrians crossing (M=4.36, SD=0.99); giving chance for other vehicles to pass in front of you (M=4.16, SD=1.00); keeping safe gap distance (M=4.13, SD=1.02); and staying in your traffic lane (M=4.12, SD=1.02). The three least occurring behaviors (with a mean value less than 1.5) are all violations as follows: disregarding red lights at pedestrian crossings (M=1.16, SD=0.55); going through red lights at intersections (M=1.16, SD=0.48); and deliberately driving the wrong way (M=1.47, SD=0.78). The means and standard deviations for all the 28 items are given in Table I.

B. Factor Analysis

Responses to the items of Section II. Driving Behaviors were submitted to a principal component analysis (PCA) with varimax rotation. The preliminary run using the responses of all the 28 items did not yield the desired results of EFA. This is due to the fact that the distinction in driving behaviors among the three drivers' groups resulted in inconsistency with regard to the significance of each observed variable. Multiple iterations were tested until a satisfactory factor structure was reached for the whole sample. The data of the chosen 14 items were best-fitted by a three-factor solution. The cutoff criterion for determining the number of components was based on eigenvalues, where factors with an eigenvalue greater than 1 were considered. Kaiser-Meyer-Olkin (KMO) test is a measure of sampling adequacy and was used to determine the suitability of data for factor analysis. The test was run and the KMO value was found to be 0.78. A value of 0.50 is barely acceptable, while a value between 0.70 and 0.80 is regarded as "Good", i.e., factor analysis would give reliable results [18]. Another statistical test known as Bartlett's Test of Sphericity was employed to decide whether the null hypothesis is true, i.e., the original correlation matrix is an identity matrix with no relationship between the variables, and so, the use of factor analysis would be unsuitable. A significance level of $p < 0.05$ is regarded as a rejection of the null hypothesis and therefore indicates that sufficient correlations exist between the variables [19]. Bartlett's test result was found to be significant with $p < 0.001$, indicating that the use of factor analysis is appropriate. The three orthogonal factors accounted for 50.3% of the total variance. All the 14 items had factor loading with an absolute value of over 0.5 as shown in Table II. Factor 1, accounting for 21.1% of the variance, consists of 7 items of the Slips and Mistakes category and will therefore be named as "Errors", which represent unintentional human actions or decisions. Factor 2 accounts for 16.5% of the variance and encompasses 4 "Positive Behaviors" items. Finally, Factor 3 accounts for 12.7% of the variance and comprises 3 items that represent intentional risky behaviors and will consequently be called "Violations". After distinguishing between the underlying qualities within the set of behavioral items, a measure of internal consistency is then employed for each of the three factors. Cronbach's alpha test was run on the sample to determine if the scale used is reliable.

Retrieval Number:100.1/ijte.B1907113223
DOI:10.54105/ijte.B1907.113223
Journal Website: www.ijte.latticescipub.com

Published By:
Lattice Science Publication (LSP)

Table II also shows the results of Cronbach's alpha test for each factor.

Factor 1: Errors gave a value of 0.75, Factor 2: Positive Behaviors yielded a value of 0.73, and Factor 3: Violations resulted in a value of 0.61. A general accepted rule is that an alpha value between 0.6 and 0.7 indicates an acceptable level of reliability, and 0.8 or greater is regarded as a very good level [20].

Table I: Descriptive statistics

Variable	Behavioral Type	Mean	SD
Use your turn signals/indicators when changing lanes or taking turns.	P	4.49	0.96
Yield to give a chance for pedestrians to cross the road whenever noticed.	P	4.36	0.99
Give a chance to other vehicles to pass in front of you when you notice their turn signals/indicators.	P	4.16	1.00
Keep safe distance between your vehicle and the one in front of you.	P	4.13	1.02
Stay in your traffic lane while driving.	P	4.12	1.02
Check your speedometer and discover that you are unknowingly travelling faster that the legal limit.	UV	3.82	1.24
Stop when you see a "STOP" sign at any intersection.	P	3.76	1.29
Exceed the speed limit and slow down when you notice a speed camera.	V	2.97	1.46
Miss your exit on a motorway and have to make a lengthy detour.	S	2.70	1.07
Use a hand-held mobile phone for making or taking calls while driving.	V	2.60	1.26
Deliberately disregard the speed limits especially when you notice there is no speed camera.	V	2.57	1.36
Overtake a slow-moving vehicle in the inside lane or on the hard shoulder of a motorway.	V	2.37	1.15
Distracted or preoccupied, realize belatedly that the vehicle ahead has slowed, and have to slam on the brakes to avoid a collision.	S	2.29	1.00
Fail to notice someone stepping out from behind a bus or parked vehicle until it is nearly too late.	S	2.08	1.01
Hit something when reversing that you had not previously seen.	M	2.03	0.98
"Wake up" to realize that you have no clear recollection of the road along which you have just travelled.	S	2.02	1.15
Drive while feeling tired, drowsy, or after taking a medicine that affects concentration.	M	2.01	1.04
Fail to read the signs correctly and take the wrong road.	S	2.01	1.05
Drive as fast along freeways at night on dipped lights as on full beam.	M	1.97	1.19
Angered by another driver's behavior, you give chase with the intention of giving him/her a piece of your mind.	V	1.88	1.11
Text on your mobile phone while driving.	V	1.80	1.07
In a queue of vehicles turning right onto a main road, pay such close attention to the traffic approaching from the left that you nearly hit the car in front.	S	1.69	1.02
Forget to pay/renew your statutory insurance and discover that you are driving illegally.	UV	1.59	1.09
Park where it is not allowed and risk a fine.	V	1.55	0.90
Misjudge your gap in a car park and nearly (or actually) hit the adjoining vehicle.	M	1.50	0.83
Deliberately drive the wrong way down a deserted one-way street.	V	1.47	0.78
Take a chance and go through lights that have turned red.	V	1.16	0.48
Disregard the red lights at pedestrian crossings.	V	1.16	0.55

Key to Behavioral Type:

M: Mistake; S: Slip; P: Positive Behavior; V: Violation; UV: Unintentional Violation

Retrieval Number:100.1/ijte.B1907113223
DOI:10.54105/ijte.B1907.113223
Journal Website: www.ijte.latticescipub.com

Published By:
Lattice Science Publication (LSP)

Transport Engineering IJTE Indian Journal of
Exploring Innovation
www.ijte.latticescipub.com

Table II: Principal component analysis results

Variable	Item Code	Factor 1	Factor 2	Factor 3
Misjudge your gap in a car park and nearly (or actually) hit the adjoining vehicle.	M1	0.671		
"Wake up" to realize that you have no clear recollection of the road along which you have just travelled.	S1	0.684		
Miss your exit on a motorway and have to make a lengthy detour.	S2	0.669		
Fail to read the signs correctly and take the wrong road.	S3	0.597		
In a queue of vehicles turning right onto a main road, pay such close attention to the traffic approaching from the left that you nearly hit the car in front.	S4	0.613		
Hit something when reversing that you had not previously seen.	M2	0.653		
Fail to notice someone stepping out from behind a bus or parked vehicle until it is nearly too late.	S5	0.579		
Yield to give a chance for pedestrians to cross the road whenever noticed.	P1		0.721	
Give a chance to other vehicles to pass in front of you when you notice their turn signals/indicators.	P2		0.780	
Use your turn signals/indicators when changing lanes or taking turns.	P3		0.775	
Keep safe distance between your vehicle and the one in front of you.	P4		0.644	
Overtake a slow-moving vehicle in the inside lane or on the hard shoulder of a motorway.	V1			0.551
Use a hand-held mobile phone for making or taking calls while driving.	V2			0.826
Text on your mobile phone while driving.	V3			0.812
Percentage of variance explained		21.1%	16.5%	12.7%
Cronbach's Alpha		0.75	0.73	0.61

C. Factor Scores Predictor

Multiple regressions were carried out using factor scores to establish which of the Section I items of the questionnaire provide the best predictors of the 3 factors deduced above: Errors, Positive Behaviors, and Violations. The p-value is used to test the null hypothesis for each predictor variable. A value lower than 0.05 indicates that the null hypothesis is rejected, and therefore, the variable is statistically significant and shall be included in the model. The following variables were examined:

- Gender
- Age
- Educational level
- Years of driving experience
- Driving frequency
- Number of violations in the past two years
- Number of crash involvements in the past two years
- Income level

- *Factor 1: Errors*

The results of the multiple regression analysis summarized in Table III show that there are four variables out of the eight mentioned above that significantly predict the "Errors" factor. Older individuals and those who drive more often committed fewer errors. On the other hand, those who committed violations and those who were involved in crashes reported more errors.

Table III: Predictors of Factor 1 (*Errors*)

Variable	β	t	p
Age	-0.123	-2.748	0.006
Driving frequency	-0.184	-4.122	0.000
Number of violations	0.158	3.610	0.000
Crashes involvement	0.111	2.541	0.011
MLR	**R^2 = 0.090; F = 12.211; p < 0.001**		

- *Factor 2: Positive Behaviors*

Three explanatory variables for the "Positive Behaviors" factor were found significant as shown in Table IV. Positive behaviors are prominent in older individuals and those who drive on a regular basis. Also, drivers who committed fewer violations seem to behave more positively on the road.

Table IV: Predictors of Factor 2 (Positive Behaviors)

Variable	β	t	p
Age	0.112	2.503	0.013
Driving frequency	0.097	2.140	0.033
Number of violations	-0.211	-4.773	0.000
MLR	**R^2 = 0.062; F = 10.950; p < 0.001**		

Retrieval Number:100.1/ijte.B19071l3223
DOI:10.54105/ijte.B1907.113223
Journal Website: www.ijte.latticescipub.com

Published By:
Lattice Science Publication (LSP)

- *Factor 3: Violations*

Table V presents five independent variables that act as significant predictors for the "Violations" factor. It can be concluded from the results that traffic laws are mainly violated by young, experienced drivers who are highly educated, well paid, and have a history of crash involvement.

Table V: Predictors of Factor 3 (Violations)

Variable	β	t	p
Age	-0.430	-4.366	0.000
Educational level	0.145	3.111	0.002
Driving experience	0.283	2.858	0.004
Crashes involvement	0.115	2.566	0.011
Income level	0.124	2.445	0.015
MLR	**R^2 = 0.088; F = 8.962; p < 0.001**		

D. Differences Among Drivers Categories

One-way ANOVA tests were conducted to analyze the difference among the means of the three drivers categories being studied: private car drivers, microbus drivers, and motorcyclists. Five ANOVA tests have been carried out using different dependent variables as will be further investigated in the following subsections. ANOVA results being statistically significant conclude that there is at least one significant difference among the groups. In that case, the Bonferroni post hoc test was then used to determine exactly which drivers groups are different from each other. Partial eta squared was as well calculated to measure the effect size of the independent variable in the ANOVA models.

- *Response Variable: Number of Violations*

ANOVA was carried out to determine if there is any significant difference among drivers groups in terms of their reported number of violations in the past two years. Table VI. shows the analysis results which are statistically significant ($p < 0.05$). Partial eta squared equals 0.225 indicating a very high effect of the explanatory variable on the response variable. The value shows that 22.5% of the variability in the number of committed violations is accounted for by the type of driver.

Table VI also presents the results of the Bonferroni post hoc test. It clearly shows that microbus drivers are significantly different than each of the other two types of drivers. However, there is no significant difference between private car drivers and motorcyclists in terms of committed traffic offences.

- *Response Variable: Number of Crashes*

The same was done to determine the difference between drivers groups with respect to their reported number of crash involvements. The ANOVA results shown in Table VII confirm the presence of a significant difference between the different types of drivers. However, partial eta squared equals 0.024 indicating a small effect size on the involvement in crashes. It can also be inferred from the Bonferroni test results shown in Table VII that there is a significant difference only between the drivers of private cars and microbuses.

Table VI: ANOVA and Bonferroni post hoc test (Violations)

ANOVA and Descriptives		
Driver Category	**Mean**	**SD**
Private Car Driver	2.29	3.568
Microbus Driver	14.00	16.024
Motorcyclist	1.10	1.021
ANOVA	**F = 87.584; p < 0.001;**	**η_p^2 = 0.225**

Bonferroni Post Hoc Test				
Driver Category		**Mean Diff.**	**Std. Error**	**Sig.**
Private Car Driver	Microbus Driver	-11.712*	0.907	0.000
	Motorcyclist	1.184	0.768	0.371
Microbus Driver	Private Car Driver	11.712*	0.907	0.000
	Motorcyclist	12.897*	1.126	0.000
Motorcyclist	Private Car Driver	-1.184	0.768	0.371
	Microbus Driver	-12.897*	1.126	0.000

**The mean difference is significant at the 0.05 level.*

Table VII: ANOVA and Bonferroni post hoc test (Crashes)

ANOVA and Descriptives		
Driver Category	**Mean**	**SD**
Private Car Driver	0.47	0.993
Microbus Driver	1.05	1.535
Motorcyclist	0.64	0.765
ANOVA	**F = 6.273; p = 0.002;**	**η_p^2 = 0.024**

Bonferroni Post Hoc Test				
Driver Category		**Mean Diff.**	**Std. Error**	**Sig.**
Private Car Driver	Microbus Driver	-.582*	0.169	0.002
	Motorcyclist	-0.170	0.143	0.705
Microbus Driver	Private Car Driver	.582*	0.169	0.002
	Motorcyclist	0.412	0.210	0.151
Motorcyclist	Private Car Driver	0.170	0.143	0.705
	Microbus Driver	-0.412	0.210	0.151

**The mean difference is significant at the 0.05 level.*

- *Response Variable: EFA Factors*

Three one-way ANOVA tests have been run using the factor scores of each of the three EFA deduced factors individually as the dependent variable. Table VIII shows the results for the three factors. It is apparent that drivers groups are only significantly different in relation to positive driving behaviors. The Bonferroni test has been therefore carried out using "Positive Behaviors" as the response variable and the results in Table VIII infer that a significant difference exists only between private car drivers and microbus drivers.

Retrieval Number:100.1/ijte.B1907113223
DOI:10.54105/ijte.B1907.113223
Journal Website: www.ijte.latticescipub.com

Published By:
Lattice Science Publication (LSP)

Table VIII: ANOVA and Bonferroni post hoc test (EFA Factors)

ANOVA and Descriptives						
Driver Category	**Errors**		**Positive Behaviors**		**Violations**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Private Car Driver	1.98	0.662	4.32	0.750	2.27	0.884
Microbus Driver	2.21	0.559	3.99	0.617	2.10	0.767
Motorcyclist	1.93	0.587	4.16	0.554	1.98	0.820
ANOVA	**F = 2.556; p = 0.079**		**F = 4.730; p = 0.009**		**F = 1.613; p = 0.200**	
Partial Eta Squared	**0.010**		**0.018**		**0.007**	

Bonferroni Post Hoc Test (EFA Factor 2: Positive Behaviors)				
Driver Category		**Mean Diff.**	**Std. Error**	**Sig.**
Private Car Driver	Microbus Driver	.331*	0.119	0.017
	Motorcyclist	0.163	0.101	0.321
Microbus Driver	Private Car Driver	-.331*	0.119	0.017
	Motorcyclist	-0.168	0.148	0.776
Motorcyclist	Private Car Driver	-0.163	0.101	0.321
	Microbus Driver	0.168	0.148	0.776

**The mean difference is significant at the 0.05 level.*

IV. DISCUSSION

The present research aimed to develop an Egyptian version of the DBQ to be used as an instrument for assessing self-reported risky driving behaviors among different categories of drivers. The driving behavior items of this tool measured violations, mistakes, slips, and positive behaviors. The psychometric properties of the questionnaire were examined on a sample of 515 drivers in Egypt encompassing private car drivers, microbus drivers, and motorcyclists. EFA was carried out to uncover the underlying factors within the set of measured variables. A PCA with varimax rotation revealed that a three-factor model provided the best fit to interpret the collected data, namely errors (mistakes and lapses), positive behaviors, and violations. Three tests were conducted to study the quality of the input and the outcome as follows:

a) KMO test result (0.78) indicated that the data is suitable for performing factor analysis.
b) Bartlett's Test of Sphericity result ($p < 0.001$) confirmed that sufficient correlations exist between the variables, and therefore, the appropriateness of using factor analysis.
c) Cronbach's alpha test results for each of the three factors (ranging between 0.61 and 0.75) verified the reliability, or internal consistency, of the test items.

Further analysis through multiple regressions was carried out to reveal the distinction between the three factors and to discover the contrast between different groups. It was found that age is a significant predictor of the three factors: as age increases, both errors and violations decrease, and on the other hand, positive behaviors increase. This can be due to the fact that senior drivers are expected to be more focused and tolerant on the road than young drivers who are usually bold, distracted, and in a hurry. These results are slightly different from those of the original study where age inversely affected violations only and had no impact on errors [6]. Also, gender has no influence on any of the three factors in this research, as opposed to it having a significant impact on the factors of the aforementioned study. Individuals who reported relatively high number of traffic violations are prone to make more errors and less positive behaviors. It was noticed as well that those who drive frequently tend to make less errors and have a more positive driving attitude. The violations predictors were, however, interesting. It was found that those who have more years of experience in driving, are highly educated, and have a higher income reported more violations. This can be attributed to those individuals being more confident in their driving skills and having the privilege of being able to afford a ticket. However, as for education, it is important to note that the subjects in the collected sample having a high educational level are almost exclusively private car drivers. Therefore, it might be useful, in a future study, to collect a bigger sample of private car drivers that is well-balanced in terms of educational levels and test if education would still be a significant predictor of violations. Lastly, a history of involvement in crashes did predict traffic violations. Finally, one-way ANOVA tests were conducted using "Driver Category" as the independent variable to check for any variation among different groups of drivers. Then, the Bonferroni post hoc test was run to guarantee the results were statistically significant and to determine which groups differ. Using "Number of Violations" as the response variable, the ANOVA test results were found to be significant ($p < 0.05$). Partial eta squared was calculated and was equal to 0.225 reflecting a very high interaction effect. In other words, the driver category accounts for 22.5% of the variability in the number of committed violations in the past two years. The Bonferroni test revealed that significant differences are found between microbus drivers and each of the other two types of drivers in terms of received tickets. The ANOVA test results were significant too when "Number of Crashes" was used as the response variable. The post hoc test results indicated that a significant difference was found between microbus drivers and private car drivers only in terms of number of crash involvements in the past two years.

Lastly, three one-way ANOVA tests were run using the factor scores of each of the three EFA factors at a time as the response variable. The results showed significant differences among the means of the drivers groups in terms of "Positive Behaviors" only. It was then deduced from the Bonferroni test results that the differences in positive behaviors are found between microbus drivers and private car drivers only.

It can be concluded from the above that microbus drivers are significantly different from private car drivers in terms of the number of obtained traffic tickets, involvement in crashes, and positive driving behaviors; where microbus drivers reported a larger number of violations and crashes, and a less positive driving behavior. Also, microbus drivers were found to receive significantly more traffic tickets than motorcyclists. In the end, "Driver Category" as an independent variable or as a factor significantly affects the number of traffic offences obtained.

V. CONCLUSION

The Egyptian version of the DBQ developed in this research aimed to investigate the behaviors of drivers in Egypt. The questionnaire as an instrument was tested and the results confirmed its reliability (internal consistency) and validity (i.e., the items measure the correct concept). A main aspect was to explore any variations among different categories of drivers in terms of driving behaviors and degree of involvement in violations and crashes. One of the key findings was that microbus drivers reported a significantly larger number of traffic tickets and crashes. Also, variations among different socio-demographic groups were identified. These outcomes would aid in targeting the high-risk drivers in future road safety educational campaigns and training courses.

Furthermore, as previously emphasized, one of the main objectives of this research was to identify contrasting behaviors among different drivers groups. It is therefore recommended to extend testing this questionnaire on other categories of drivers with especially distinct behaviors that weren't covered in this paper, such as heavy vehicles drivers, and document the new findings for a wider comparison. It is also encouraged to experiment this version of the DBQ in different cities and/or countries in future research to check its consistency.

DECLARATION

On behalf of all the authors, the corresponding author hereby declares that the submitted research paper is entirely our original work, in our own words, and that all sources used in researching it are fully acknowledged.

Funding	The authors received no financial support for the research, authorship, and/or publication of this article.
Conflicts of Interest	We wish to confirm that there are no known conflicts of interest associated with this publication.
Consent to Participate	Informed consent was obtained from all the individuals who participated in the research questionnaire. The purpose of the research was clearly stated beforehand. The anonymity of the participants was maintained; no personally-identifying information or sensitive data were collected.
Availability of Data	The data that support the findings of this research (such as the questionnaire form and raw data) are available from the corresponding author upon reasonable request.
Authors Contributions	**Aya Raafat Salama** contributed to collecting the questionnaire data, performing the analyses, interpreting the results, and writing the paper. **Prof. Mona H. M. Abd-allah** and **Dr. Mohamed Shawky** contributed to the establishment of the concept of the research, supervised the work, provided critical feedback on the original draft, and gave the final approval of the research paper.

REFERENCES

1. Ederer DJ, Rodgers MO, Hunter MP, Watkins KE. Case Study using Probe Vehicle Speeds to Assess Roadway Safety in Georgia. Transp Res Rec [Internet]. 2020 Sep 10;2674(11):554–62. Available from: https://doi.org/10.1177/0361198120948858 [CrossRef]
2. Ambros J, Viktorová L, Turek R, Šucha M. How do we perceive traffic risk ? HOW DO WE PERCEIVE TRAFFIC RISK ? 2016;(November).
3. de Winter JCF, Dodou D. The Driver Behaviour Questionnaire as a predictor of accidents: A meta-analysis. J Safety Res [Internet]. 2010;41(6):463–70. Available from: https://www.sciencedirect.com/science/article/pii/S0022437510001131 [CrossRef]
4. Tsala SAZ, Ayissi MZ, Azeh G, Noah PA, Ebanda FB, Ohandja LMA. An in-depth analysis of the causes of road accidents in developing countries: case study of Douala-Dschang Highway in Cameroon. J Transp Technol (Irvine, Calif) [Internet]. 2021;11(3):455–70. Available from: http://dx.doi.org/10.4236/jtts.2021.113030 [CrossRef]
5. CAPMAS. The Annual Bulletin of Car & Train Accidents 2019. (Central Agency for Public Mobilization and Statistics, Egypt.) [Internet]. 2020. Available from: https://censusinfo.capmas.gov.eg
6. REASON J, MANSTEAD A, STRADLING S, BAXTER J, CAMPBELL K. Errors and violations on the roads: a real distinction? Ergonomics [Internet]. 1990 Oct 1;33(10–11):1315–32. Available from: https://doi.org/10.1080/00140139008925335 [CrossRef]
7. Shao H, Yin J, Yu W hao, Wang Q ling. Aberrant Driving Behaviours on Risk Involvement among Drivers in China. J Adv Transp. 2020 Jun 29;2020:1–8. [CrossRef]
8. Mekonnen T, Tesfaye Y, Moges H, Berhe R. Factors associated with risky driving behaviors for road traffic crashes among professional car drivers in Bahirdar city, northwest Ethiopia, 2016: A cross-sectional study. Environ Health Prev Med. 2019 Dec 1;24. [CrossRef]
9. Bener A, Yildirim E, Bolat E, Özkan T, Lajunen T. The Driver Behaviour Questionnaire as an Accident Predictor in Cross-cultural Countries in Qatar and Turkey: Global Public Health Problem. Br J Med Med Res. 2016 Jan 10;15:1–9. [CrossRef]
10. Sucha M, Sramkova L, Risser R. The Manchester driver behaviour questionnaire: self-reports of aberrant behaviour among Czech drivers. Eur Transp Res Rev. 2014 Dec 1;6. CrossRef
11. Bener A, Özkan T, Lajunen T. The Driver Behaviour Questionnaire in Arab Gulf countries: Qatar and United Arab Emirates. Accid Anal Prev. 2008 Aug 1;40:1411–7. [CrossRef]
12. Bandyopadhyaya V, Bandyopadhyaya R, Barman S. Understanding Key Behavioral Factors Affecting Road Traffic Citation and Crash Involvement of Professional Bus and Passenger Van Drivers Using Modified Driver Behavior Questionnaire – An Indian Perspective. Int J Occup Saf Ergon JOSE. 2022 Oct 27; [CrossRef]
13. Kalhori RP, Ziapour A. A Survey of Interurban Taxi Drivers ' driving Behaviors across. 2017;(April). [CrossRef]

14. Sullman M, Meadows M, Pajo K. Aberrant Driving Behaviours Amongst New Zealand Truck Drivers. Transp Res Part F Traffic Psychol Behav. 2002 Sep 1;5:217–32. [CrossRef]
15. CAPMAS. Bulletin of Licensed Vehicles Statistics in 31/12/2021. (Central Agency for Public Mobilization and Statistics, Egypt.) [Internet]. 2022. Available from: https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&YearID=23468
16. Ahmad H, Halim H. Determining Sample Size for Research Activities: The Case of Organizational Research. Bus Rev [Internet]. 2017;2(1):20–34. Available from: https://sbr.journals.unisel.edu.my/ojs/index.php/sbr/article/view/12/20
17. Bartlett JE, Kotrlik J, Higgins C. Organizational Research: Determining Appropriate Sample Size in Survey Research. Inf Technol Learn Perform J. 2001 Jan 1;19.
18. Naseer M, Ashfaq M, Hassan S, Abbas A, Razzaq A, Mehdi M, et al. Critical Issues at the Upstream Level in Sustainable Supply Chain Management of Agri-Food Industries: Evidence from Pakistan's Citrus Industry. Sustainability. 2019 Mar 3;11:1–19. [CrossRef]
19. Renault B, Agumba J, Ansary N. An exploratory factor analysis of risk management practices: A study among small and medium contractors in Gauteng. Acta Structilia [Internet]. 2018;25:1–39. Available from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2415-04872018000100001&nrm=iso [CrossRef]
20. Ursachi G, Horodnic IA, Zait A. How Reliable are Measurement Scales? External Factors with Indirect Influence on Reliability Estimators. Procedia Econ Financ [Internet]. 2015;20:679–86. Available from: https://www.sciencedirect.com/science/article/pii/S2212567115001239 [CrossRef]

AUTHORS PROFILE

Aya Raafat Salama is a traffic and transportation engineer working in a consultancy based in Cairo, Egypt. She received her bachelor's degree in civil engineering from Ain Shams University, Egypt in 2018, with a concentration in transportation and traffic engineering. She is currently pursuing a master's degree from Ain Shams University as well, with a thesis focused on investigating drivers' behaviors in Egypt and examining the variation in the attitudes of drivers of different types of vehicles.

Prof. Mona H. M. Abd-allah is a professor of Transportation Planning & Traffic Engineering, Public Works Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt. She has more than 35 years technical and research experience in transportation planning, traffic engineering, and highway design covering projects in Egypt. She is a reviewer in many specialized scientific periodicals. She is also a member of local, regional, and international professional institutions.

Dr. Mohamed Shawky is an associate professor in Faculty of Engineering, Ain Shams University, Cairo, Egypt. He was awarded his bachelor's and master's degrees from Ain Shams University. He got his Ph.D. in traffic engineering from Nagoya University, Japan in 2007. He has more than thirty years' experience in technical, teaching, and research works in traffic and road safety engineering.