IATSS Research 46 (2022) 73–81

Contents lists available at ScienceDirect

IATSS Research

Research Article

Investigating the attitudes of Egyptian drivers toward traffic safety

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ARTICLE INFO

Article history:
Received 24 August 2021
Received in revised form 5 November 2021
Accepted 19 November 2021
Available online 23 November 2021

Keywords:
Road safety
Egypt
Driving behavior
Traffic safety

ABSTRACT

One of the main pillars for improving road safety in any country is a good understanding of traffic safety culture and the driving behavior of local drivers. The primary aim of this study was to determine whether Egyptian drivers differ in traffic safety attitudes and level of acceptance of risky driving behavior. A questionnaire survey was conducted on the driving cognition of the participants. An exploratory factor analysis was used to assess the number of factors that differentiated the three types of drivers. Then a hierarchical cluster analysis was performed to group the drivers with similar patterns of scores on the factors into clusters. Three driver clusters emerged: The drivers in cluster 1 were "drivers who rigidly followed regulations" (51.7%). The drivers in cluster 2 were "drivers who violated safety precautions" (23.3%). The drivers in cluster 3 were "drivers who had a tendency to violate regulations" (25.0%). A similarity between the social norms and personal attitudes of drivers was found. This can be explained by the high social norm of violating traffic laws, which can lead to more drivers accepting violations. The majority of the older drivers and drivers with no violations or traffic accident on their record in the past 2 years were in cluster 1. Cluster 2 had the highest proportion of young drivers who wore their seat belts and used hands-free phones while driving. Cluster 3 drivers accepted very dangerous violations, such as texting while driving, driving while intoxicated, and driving at very high speeds. They reported significantly more traffic accidents, but no more violations than the other two clusters. The results of this study can be used to improve road safety programs for education and enforcement in Egypt.

1. Introduction

1.1. Background and study motivation

Road safety is a global issue involving various factors that influence the safety of traffic and contribute to road traffic crashes (RTCs). Driver-related factors, along with determinants related to road environment and vehicle characteristics, have been found to have the greatest influence [1,2]. Driving behavior plays a significant role in traffic safety, causing more than 90% of RTCs, often triggered by human error, reduced attention, intoxication, or aggressive and impulsive risk-taking [3–6]. Driving behavior is a multi-faceted aspect of traffic safety with overlapping associations between driver demographics [7], psychological influences [8,9], social norms and cultural impacts, legal regulations, enforcement levels, and socioeconomic backgrounds [10]. Driving behavior is also largely impacted by the driver's knowledge of traffic rules and road safety practices and the driver's attitudes toward traffic safety [11–13].

Despite the importance of understanding driver behavior, attitude, and awareness regarding traffic safety, few studies have addressed this issue in Egypt. Egypt is the largest developing country in the Middle East region, with a population of over 100 million with increasing rate of 2.7% annually and more than 11 million registered vehicles with an increasing rate of 10.0% annually (51% cars, 14% trucks, 1% buses, and 34% motorcycles and others). The car ownership is about 0.12 vehicle per person. During the last ten years, the average number of traffic accidents is 14,500 that led to more than 5 thousand fatalities and more than 23 thousand injuries (the fatality rate about 7.0 fatalities per 100,000 inhabitants). More than 80% of the traffic accidents in Egypt are caused by human error [14].

1.2. Study objectives

Nevertheless, the actual traffic safety culture of Egyptian drivers and their attitudes toward traffic safety practices and dangerous driving behaviors have not been sufficiently studied, despite their essential role in

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Peer review under responsibility of International Association of Traffic and Safety Sciences.

https://doi.org/10.1016/j.iatssr.2021.11.007

improving traffic safety in the country. Hence, this study aimed to address this gap in the research by investigating the traffic safety culture of Egyptian drivers, the drivers' attitudes toward traffic violations, their opinion of the evolution of traffic safety problems occurring in Egypt over the past 3 years, and their self-reported number of violations and RTCs over the past 2 years. The overall aim of this study was to determine whether Egyptian drivers differ in traffic safety attitudes and level of acceptance of risky driving behavior using the following research questions:

- Do Egyptian drivers differ in their acceptance of traffic violations, and which factors differentiate their attitudes toward traffic safety from one another?
- Can Egyptian drivers be categorized into distinct driver clusters?
- Which traffic safety attitudes are characteristic of each driving cluster?

It is crucial that these questions be answered in order to create an understanding of traffic safety culture in Egypt for the development of national traffic safety action plans that can be targeted and directed to specific driver groups with different attitudes regarding traffic safety.

1.3. Literature review

The attitudes of drivers toward traffic safety are often defined by the traffic safety culture of a driving population and are based on safety attitudes, norms, values, and beliefs of other drivers in their environment [15]. A population of drivers in a certain country or region often share certain ideas about traffic safety because shared values, beliefs, and similar practices determine collective attitudes about acceptable ways to drive and behave in traffic [16]. Social norms in a society are determined by the observed behaviors of others. When certain regulations are violated by multiple members of society, the violations are interpreted as normal and acceptable [16]. With a high likelihood of other drivers within the same city violating traffic regulations, individual drivers are also more likely to cognitively justify these violations. Consequently, a driver's personal attitude toward violating traffic safety becomes more acceptable and is rationalized based on social norms [17]. In line with this, traffic safety culture describes the societal and personal attitudes and beliefs about traffic safety, the acceptance of certain dangerous driving behaviors [18], and the support for safety policies and traffic laws [19].

Risky driving violations are leading to high numbers of RTCs globally and result in extensive numbers of injuries and fatalities, especially in low- or middle-income countries [12,20]. Nevertheless, the number of fatalities and level of traffic safety show international differences [2], and traffic safety culture varies across countries [21]. According to the World Health Organization (WHO), the WHO African region has the highest number of fatalities, particularly in comparison to the WHO European region [22,23]. Egypt has serious traffic safety issues, with an enormous number of Egyptian drivers ending up with a long-term disability caused by RTCs and 12 thousand crash-related traffic fatalities per year, making Egypt the country with the most serious traffic safety issues among the countries in Africa and the Middle East [2,24]. Several studies have examined traffic safety, RTCs, and driving behavior of Egyptian drivers, using the Arabic version of the self-reported Driving Behavior Questionnaire (DBQ) [25–27] or analyzing RTC records [28,29], revealing some of the major driver-related contributors of RTCs in Egypt, such as losing control over the steering wheel while driving, driving faster than the speed limit, misjudgment of the gaps between cars, sudden braking, careless lane changes, and incorrect overtaking. Furthermore, differences in driving behaviors were found between different age groups in Egypt [26] and between professional and non-professional drivers [25,30]. In addition, the positive effect of implementing traffic safety education has been examined in Egypt to improve the knowledge of traffic safety practices [12].

Traffic safety culture is a complex construct with various levels of measurement and is therefore often analyzed using multivariate analysis methods. Multivariate analysis methods provide the opportunity to analyze data with more than one type of observation and to analyze multiple statistical variables at once. Previous studies have used a variety of multivariate analysis methods to examine (traffic) safety culture, such as exploratory factor analysis, confirmatory factor analysis, structural equation modelling (SEM) and cluster analysis. For example, using a safety culture survey, the variety of aspects that impact safety culture among workers is explored and exploratory factor analysis is applied to determine the number of specific core factors with significant variance to safety culture [31]. To establish whether the explored factors were reliable, a confirmatory factor analysis was performed to determine the hierarchical structure and the accuracy of the proposed model of variance of the core factors with safety culture. Factor analysis is a multivariate analysis method often used within large datasets to reduce the number of components. Several variables are analyzed based on theoretical models and latent factors in relation to the observed variables to determine which observed variables or items load on which latent factor [31]. Structural Equation Modelling (SEM) is another type of multivariate statistical analysis that consists of dual components, starting with the measurement component with confirmatory factor analysis to measure the relationship between the latent variables and the observed factors. However, an additional structural component is added in SEM with a path model analysis that visualizes how the latent variables are related to the factors in a structural model [32; 33]. For instance, in a previous study ten factors that explain risky driving behaviors were explored and modelled using SEM (comparing low risk drivers with different groups of problematic drivers). Based on the theory of planned behavior, SEM was applied to model the structural relationship of ten risky driving factors with different traffic safety cultures [32]. Another example is a study in which the relationship between traffic safety culture, acceptability of distracted driving, impaired driving, and speeding, support for related enforcement and driver's socio-demographic are modelled using SEM. Confirmatory factors analysis measures the relationship between the latent variables and the observed factors and a path model visualizes the structural model [33]. Another visual representation of traffic safety culture data in a type of spatial cluster analysis is Multidimensional Scaling Analysis in which a pattern of data points is clustered based on spatial proximity [34]. In addition, cluster analysis is previously applied in studies of traffic safety culture, analyzing the perception of transport risks among different clusters of individuals with similarity on three personality traits and seven cultural measures [35]. Cluster analysis identifies groups that have the same pattern of scores on specific variables or factors. Once the core factors or main variables are determined, the complete sample can be analyzed and divided into clusters with similar scores on these specific factors that represent different traffic safety cultures [35].

2. Methodology

2.1. Questionnaire on traffic culture of Egyptian drivers

A self-reported questionnaire survey was conducted on a random sample of Egyptian drivers. This survey was part of a multi-country survey that was prepared for an international comparison study conducted by the International Association of Traffic and Safety Sciences. A similar questionnaire has been used in other countries to assess traffic safety culture [34,36]. The questionnaire consisted of multiple sections referring to different practices and attitudes regarding traffic safety. Initially, the driver's demographic information was collected with items on age, driving experience, driving purpose, number of violations, and RTCs, etc. The questionnaire also evaluated the change in traffic safety in Egypt by measuring whether drivers perceived improvement or deterioration over the past 3 years. For example, "From your point of view, please indicate how much of the following traffic related problems

have changed nowadays compared to the past 3 years". This question was measured on five-point Likert scale ranging from "much bigger problem today" to "much smaller problem today", for 5 traffic-related problems (traffic congestion, traffic safety, aggressive driving, distracted drivers, and drivers using alcohol and/or illegal drugs). Another section of the questionnaire measured the driver's acceptance of different risky driving behaviors. The questionnaire therefore contained items on the driver's attitudes toward personally violating traffic rules and his or her interpretation of the attitudes of most drivers in the same city. Personal and social acceptance of social norms on violating traffic safety, as reported by the drivers, were measured on a four-point Likert scale ranging from "completely acceptable" to "completely unacceptable" for 12 traffic safety violations. For instance, "How acceptable would do you personally feel about the following driver behaviors?" and "How acceptable would most people in your city consider the following driver behaviors?". The twelve driver behaviors that were questioned measured traffic safety violations related to speeding on different type of roads, phone use while driving, drowsy driving, seatbelt use, red-light running and driving under influence of alcohol or illegal drugs. Finally, the driver's level of support for stricter traffic regulations was measured on a four-point Likert scale ranging from 'strongly support' to 'strongly oppose'. For example, "How strongly do you support or oppose the following laws?". The questionnaire assessed traffic laws related to the same types of traffic safety violations as described above.

2.2. Sample

2.2.1. Sample size

A representative sample of Egyptian drivers was obtained by handing out the survey form to Egyptian licensed drivers in public areas such as car agencies and government service locations in large cities in Egypt (Cairo, Giza, and Alexandria). The data were then cleaned by eliminating duplicate and missing answers and abnormal values, such as an age below 18 years. The final sample included in the analysis consisted of 559 drivers.

2.2.2. Sample characteristics

The sample in this study consisted of 559 drivers (84% men; 16% women). The average age was 37.8 years (standard deviation = 10.89 years), and the majority of the drivers (63%) were aged between 31 and 55 years. Thirty-three percent were aged 30 years or less, and only 7% were aged 55 years or more. The average number of years of driving experience of the sample was 13.2 years (standard deviation = 9.52 years). Fifty percent of the drivers had more than 10 years of driving experience, 39% had 3–10 years of driving experience, and only 12% had less than 3 years of driving experience. Eighty-three percent were non-professional drivers, of whom 57% drove to work, 13% drove when carrying out shopping or leisure activities, and 6% or less had other driving purposes such as education or commercial driving. Seventeen percent of the sample are working as drivers. Forty-four percent of the drivers reported having received no tickets for moving violations in the past 2 years, 21% reported receiving two tickets, 20% reported receiving three or more tickets, and 15% reported receiving one ticket. With regard to the self-reported number of RTCs while driving in the past 2 years, 59% of the drivers reported zero RTCs, 21% reported one RTC, 11% reported three or more RTCs, and 9% reported two RTCs.

2.3. Analysis

The demographic characteristics of the Egyptian drivers and the number of traffic violations and RTCs were analyzed using descriptive analysis. The descriptive analysis was also conducted to measure the drivers' level of acceptance of traffic safety violations, and this personal attitude was compared with the level of acceptance of most drivers in the same city for similar traffic safety violations. Level of support for stricter traffic regulation and the perceived change in traffic-related problems were also analyzed using descriptive statistics.

After the initial descriptive analyses were conducted, drivers' personal attitudes toward 12 driving behaviors that violate traffic safety were investigated using an exploratory factor analysis (EFA) to assess the number of factors that differentiate the Egyptian driver sample based on their level of acceptance of traffic safety violations. The exploratory factor analysis used principal axis factoring and direct oblimin rotation on the full dataset of 559 drivers [31,37].

After establishing the factors of driver acceptance of traffic safety violations through the exploratory factor analysis, a hierarchical cluster analysis was performed to group the drivers with similar patterns of scores on the factors into clusters. The hierarchical cluster analysis was initially used to determine the optimal number of clusters among Egyptian drivers [35]. Proposed heuristics suggests that the largest jump in coefficients that represent the distance between each cluster suggests the optimum stopping point for merging clusters; hence, this indicates the best number of clusters within the current dataset [38]. A hierarchical cluster analysis using the Ward method was conducted to allocate each driver to one of the clusters based on the optimal number of clusters.

Chi-square tests were subsequently applied to determine the demographic characteristics of each of the clusters and their views on the social norms among local drivers of violating traffic safety, their perceived changes in traffic safety problems in Egypt, and whether they support or oppose stricter traffic regulations. Data were analyzed using SPSS version 20 (IBM Corporation, Armonk, NY, USA) and conducted with a significance level of $\alpha < 0.05$.

3. Results

3.1. Drivers' acceptance of risks

3.1.1. Drivers' acceptance of traffic safety violations

Results of the analysis of driver-reported level of personal and social acceptance of their city's social norms regarding traffic safety violations are presented in Table 1. Table 1 shows that the highest level of acceptance was for speeding violations, with over-speeding on a highway, residential street, and rural areas being somewhat accepted by 45%–47% of the drivers, while over-speeding in a school zone was somewhat accepted by 34% and completely unacceptable to 35% of the drivers. The social norms regarding speeding showed higher levels of acceptance by the drivers, with 50%–54% for over-speeding on highways, residential streets, and rural areas, and the perception of higher social acceptance of speeding in a school zone (40%) among other drivers with fewer of them finding the behavior completely unacceptable (23%).

Violating safety regulations, such as driving without wearing a seat belt or with passengers without a seat belt was somewhat acceptable to 29%–31% of the drivers. Drivers also indicated that they expected an even higher percentage of all drivers in the same city to somewhat accept this traffic violation (33%–34%). This is also reflected in the drivers' personal attitudes and their perception of the attitudes of other drivers toward hands-free phone use, which was somewhat accepted by 30% of the drivers. However, handheld phone use was completely unacceptable to 40% of the drivers, and texting while driving was completely unacceptable to 53% of the drivers. Traffic violations that were completely unacceptable to the majority of drivers in the study included driving under the influence of alcohol/illegal drugs (74%), red light running (RLR) (69%), and driving while feeling tired or sleepy (52%). Drivers also indicate that they expected these traffic violations to be unacceptable to lower percentages of all drivers in the same city (driving under the influence [64%], RLR [55%], driving while tired or sleepy [43%]).

Table 1
Driver-reported personal and social acceptance of traffic safety violations in their city.

$N = 559$	Personal acceptance		Social acceptance	
Traffic safety violation	Somewhat acceptable	Completely unacceptable	Somewhat acceptable	Completely unacceptable
Drive 20 kph above the speed limit on a freeway	45%	13%	50%	8%
Drive 10 kph above the speed limit on a residential street	47%	15%	54%	9%
Drive 10 kph above the speed limit on an urban street	46%	16%	52%	10%
Drive 10 kph above the speed limit in a school zone	34%	35%	40%	23%
Talk on a cell-phone while driving hands-free	30%	22%	35%	17%
Talk on a cell-phone while driving using hands	26%	40%	32%	32%
Text while driving	21%	53%	25%	42%
Drive while feeling tired or sleepy	21%	52%	26%	43%
Drive without wearing a seat belt	29%	41%	33%	33%
Drive with passengers not wearing a seat belt	31%	31%	34%	25%
Drive through a red light (with the ability to stop easily and safely)	15%	69%	21%	55%
Drive under the influence of alcohol/illegal drugs	12%	74%	18%	64%

3.1.2. Development of traffic problems and driver support for rigid regulations

All five traffic-related problems on the roads that were examined in the study were perceived as being a much bigger problem today than they were 3 years ago. Traffic congestion was considered to be the biggest problem; 80% of the drivers indicated that it was a much bigger problem today. Aggressive driving, distracted drivers, traffic safety, and drunk driving were viewed by 65%, 61%, 50%, and 40% of drivers, respectively, as much bigger problem today.

The descriptive analysis of attitudes toward more rigid regulations revealed that all stricter regulations included in the study were strongly supported by more than 52% of the drivers, except for a law against using any type of cell phone while driving (handheld or hands-free) for which 21% of drivers strongly opposed the regulation.

3.1.3. Factors related to driver acceptance of traffic safety violations

Egyptian drivers' personal attitudes toward 12 driving behaviors that violate traffic safety were assessed with an EFA. The EFA yielded three factors that could be differentiated by the drivers' level of acceptance of safety violations. Table 2 displays the results of the EFA and the division of the 12 safety violations into three factors. Factor 1 was labelled "speeding violations" and consisted of four driving behaviors: "drive 20 kph over the speed limit on a freeway/highway," "drive 10 kph over the speed limit on a residential street," "drive 10 kph over the speed limit in an urban area," and "drive 10 kph over the speed limit in a school zone." Factor 2 was labelled "dangerous violations" and consisted of five driving behaviors: "talk on a hand-held cell phone while driving," "type text messages or e-mails while driving," "drive when they're so sleepy that they have trouble keeping their eyes open," "drive through a light that just turned red, when they could have stopped safely," and "drive when they are under the influence of alcohol/illegal drugs." Factor 3 was labelled "safety precaution violations" and consisted of three driving behaviors: "talk on a hands-free cell phone while driving," "drive without wearing their seat belt," and "drive with passengers not wearing seat belts."

3.2. Egyptian driver clusters

After establishing the factors based on the drivers' level of acceptance of traffic safety violations, drivers with similar patterns of scores on the factors were grouped together into separate clusters, and each driver was allocated to one of the clusters. Table 3 lists the sizes of each driver cluster and their average scores for the three factors. Cluster 1 ($n = 289$, 51.7%) can be described as "drivers who rigidly followed regulations," because these drivers had high levels of unacceptance for all three of the factors. Cluster 2 ($n = 130$, 23.7%) can be described as "drivers who violated safety precautions," because only these drivers reported accepting the violation of safety precautions in factor 3, such as not wearing a seat belt as a driver or passenger and not using hands-free calling while driving and talking on the phone, but these drivers showed a high level of unacceptance of all the safety violations in factors 1 and 2. Cluster 3 ($n = 140$, 25.0%) can be described as "drivers with the tendency to violate regulations," because these drivers considered the speeding violations in Factor 1, the dangerous violations in Factor 2, and the safety precaution violations in Factor 3 to be either somewhat or completely acceptable.

Fig. 1 visualizes the drivers' age division between the three clusters. The majority of drivers were in cluster 1, and the average age of these drivers was 39 years; despite the majority of drivers (59%) within this

Table 2
Three factors differentiated by the drivers' level of acceptance of safety violations.

Traffic safety violation	Factor 1	Factor 2	Factor 3	Communality
	Speeding violations	Dangerous violations	Safety precaution violations	
20 kph over speed limit on freeways	**0.797**	−0.119	0.187	0.674
10 kph over speed limit on a residential street	**0.926**	−0.031	0.003	0.836
10 kph over speed limit in an urban area	**0.858**	0.090	0.012	0.814
10 kph over speed limit in school zone	**0.705**	0.348	−0.242	0.733
Hand-held phone use while driving	0.242	**0.490**	0.355	0.674
Type a text while driving	0.172	**0.722**	0.211	0.810
Drowsy driving	0.077	**0.761**	0.211	0.784
Red light running	0.016	**0.929**	−0.091	0.830
Intoxicated driving	0.041	**0.928**	−0.196	0.816
Hands-free phone while driving	0.222	−0.092	**0.755**	0.657
No seat belt for driver	−0.046	0.599	**0.509**	0.773
No seat belt for passengers	−0.090	0.446	**0.625**	0.708
Eigen value	6.351	1.681	1.076	
Contribution rate	52.9%	14%	9%	
Cumulative contribution rate	52.9%	66.9%	75.9%	

Table 3
Driver clusters with size and average scores for the three factors.

Cluster	Number	Factor 1	Factor 2	Factor 3
		Speeding violations	Dangerous violations	Safety precaution violations
1	289	−0.508	−1.772	−1.174
2	130	−0.437	−1.248	0.633
3	140	1.177	0.853	0.955

Note: scores <0 indicate an unaccepting attitude and scored >0 indicate an accepting attitude.

cluster being aged between 31 and 54 years, the highest number of older drivers (55 years or older) were also found within cluster 1. Drivers in cluster 2 were on average 36 years, and the majority of drivers (52%) within this cluster were aged 31–54 years, but the highest number of younger drivers (30 years or younger) were found within cluster 2. The highest number of middle-aged drivers (31–54 years) were in cluster 3. Most drivers in all three clusters have more than 10 years of driving experience.

The percentage of violations and RTCs for each driver cluster are displayed in Fig. 2, comparing traffic violations in Fig. 2a with RTCs in Fig. 2b. The highest number of drivers without any ticket for moving violations in the past 2 years was found within cluster 1 (48%), followed by cluster 3 (44%), and then cluster 2 (36%). The highest number of drivers with one violation was found in cluster 3 (20%), followed by cluster 2 (18%), and then cluster 1 (12%). The highest percentage of drivers with two or more violations was found in cluster 2. The highest percentage of drivers without any RTC in the past 2 years was also found in cluster 1 (65%), followed by cluster 3 (54%), and then cluster 2 (52%). The highest number of drivers with one or two RTCs in the past 2 years was found in cluster 2, and the highest percentage of drivers with three or more RTCs were found in cluster 3 (17%), followed by cluster 2 (14%), and cluster 1 (7%).

3.3. Traffic safety attitudes of each driver cluster

3.3.1. Acceptance of social norms within each cluster

The perceived acceptance of violations by other drivers in the same city (social norm) differed significantly between clusters ($p < .001$). The highest number of drivers in cluster 3 thought other drivers found speeding violations acceptable, but drivers in cluster 1 thought other drivers in their city found speeding violations unacceptable. The social norm of phone use while driving also revealed clear distinctions between the clusters, with the highest number of drivers in cluster 3 reporting that other drivers considered handheld phone use and texting while driving acceptable, but the highest number of drivers in cluster 2 reported that other drivers in their city found only hands-free phone use while driving acceptable. Drivers in cluster 1 expected other drivers to find all phone use (handheld, texting, and hands-free) unacceptable. Not using a seat belt as a driver or passenger was expected to be accepted by the highest number of drivers in cluster 2 but was reported as unacceptable to other drivers in cluster 1. Dangerous violations such as driving while tired or sleepy, driving while intoxicated, and RLR are expected by drivers in cluster 3 to be acceptable violations to other drivers in their city, but are reported to be unacceptable to others by drivers in cluster 1. Fig. 3 visualizes the percentage of social acceptance within the three driver clusters, with Fig. 3a showing acceptance toward traffic violations and Fig. 3b unacceptance toward traffic violations.

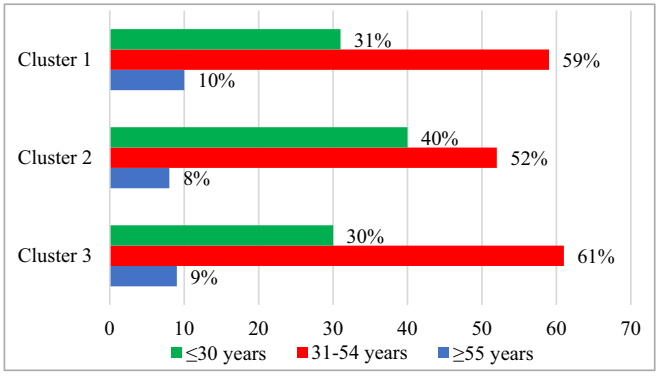

Fig. 1. Drivers' age division within cluster 1 ($N = 289$) cluster 2 ($N = 130$) and cluster 3 ($N = 140$).

3.3.2. Perceived changes in traffic problems within each cluster

The drivers' perception of traffic problems over the past three years have been portrayed in Fig. 4. A significantly higher percentage of drivers in cluster 3 (90%; $p < .05$) perceived traffic congestion in Egypt as a much bigger problem than 3 years ago, compared with clusters 1 (78%) and 2 (72%). A significantly higher percentage of drivers in cluster 3 (77%; $p < .001$) perceived traffic crashes in Egypt as a much bigger problem compared with clusters 1 (45%) and 2 (38%). Significantly more drivers in cluster 3 (78%) ($p < .01$) perceived aggressive drivers in Egypt as a much bigger problem, compared with clusters 2 (63%) and 1 (60%). Distracted drivers in Egypt were viewed as a much bigger problem because of the significantly higher number of drivers in cluster 3 (71%; $p < .05$) compared with cluster 1 (59%) and 2 (55%). Significantly more drivers in cluster 3 (64%; $p < .001$) perceived drivers who use alcohol and/or illegal drugs as a much bigger traffic problem in Egypt over the past 3 years, compared with clusters 1 (35%) and 2 (29%).

3.3.3. Support for rigid regulations within each cluster

Table 4 reveals the percentage of support and opposition toward traffic regulations for each driver cluster. Most drivers support more rigid traffic regulations for over-speeding, handheld phone use while driving, and anti-distraction or anti-alcohol devices, except for a stricter law against any phone (including hands-free), which is rather opposed to drivers. Drivers in cluster 2 are more often opposed to this law (51%), while the majority of drivers in cluster 3 and cluster 1 support stricter regulations against any type of phone use while driving (58% and 57%, respectively). No significant differences between clusters were found for stricter laws against handheld phone use or texting while driving, with more than 85% of drivers in all clusters supporting these stricter regulations. Despite no significant differences between the clusters, all supporting stricter regulations against speeding violations, the highest percentage of drivers within cluster 1 (>90%) supported these rigid laws. Stricter regulations against alcohol use were supported by the highest number of drivers in cluster 3 (96%), while stricter regulations against RLR were supported by the highest number of drivers in cluster 1 (97%).

4. Discussion

The overall aim of this study was to investigate whether Egyptian drivers differ in traffic safety attitudes, because this knowledge can help guide the development of targeted national traffic safety interventions. The results of this study are discussed in terms of the study's research questions.

4.1. Do Egyptian drivers differ in their acceptance of traffic violations and which factors differentiate their attitudes toward traffic safety from one another?

The Egyptian drivers within this sample clearly differed in safety attitudes, with level of acceptability varying for different types of traffic safety violations. Three factors could be differentiated from the traffic

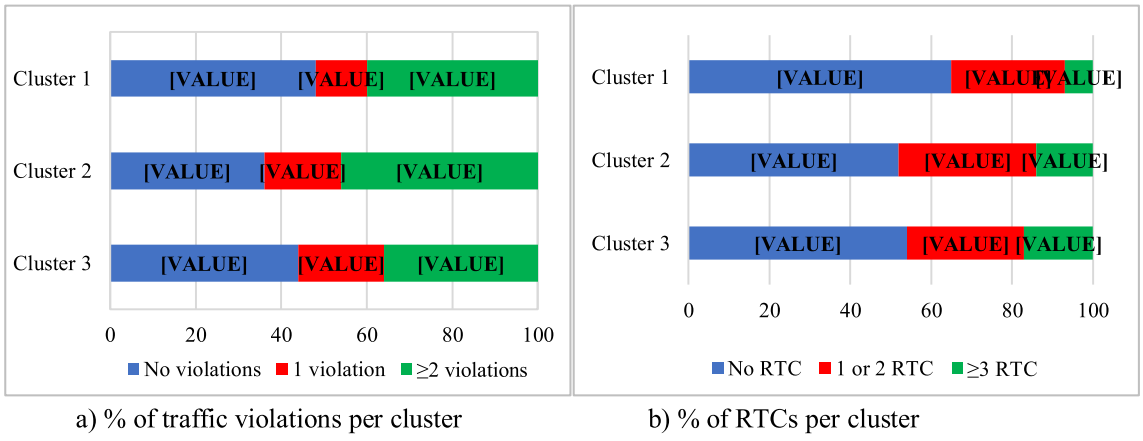

Fig. 2. The percentage of tickets for violations and RTCs within the three clusters.

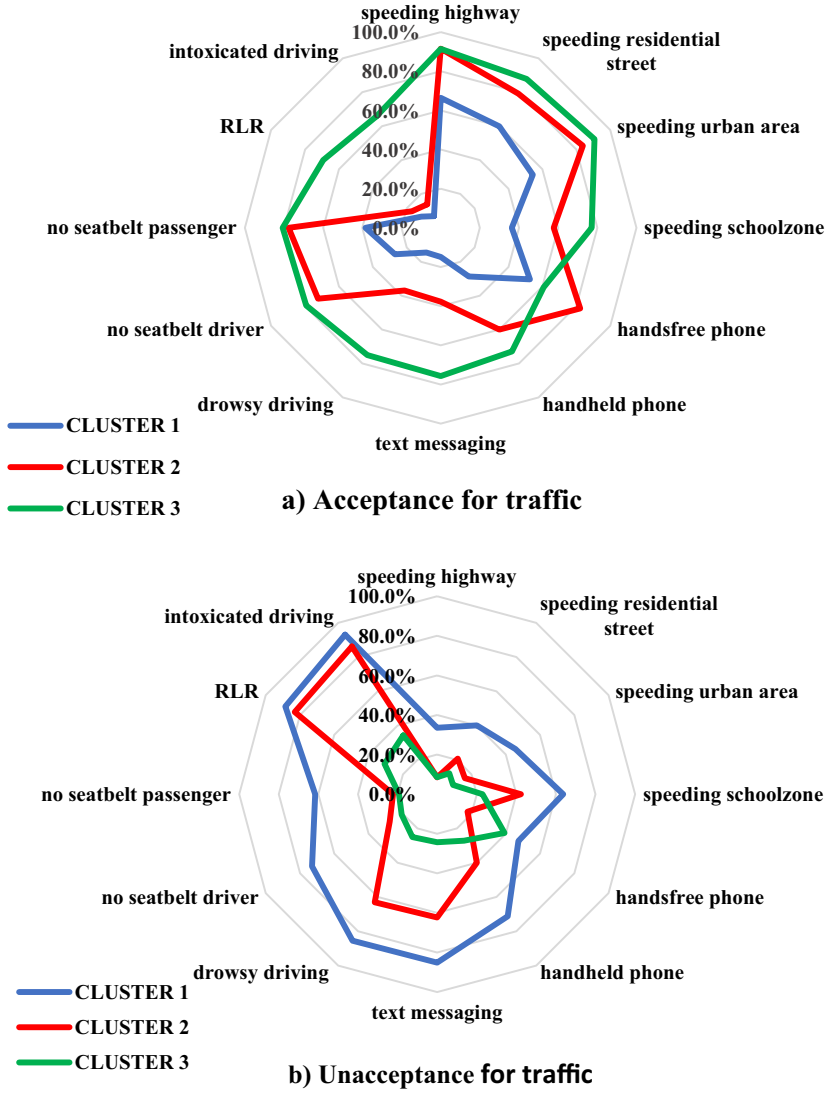

Fig. 3. The level of social acceptance and unacceptance for traffic violations within each driver cluster.

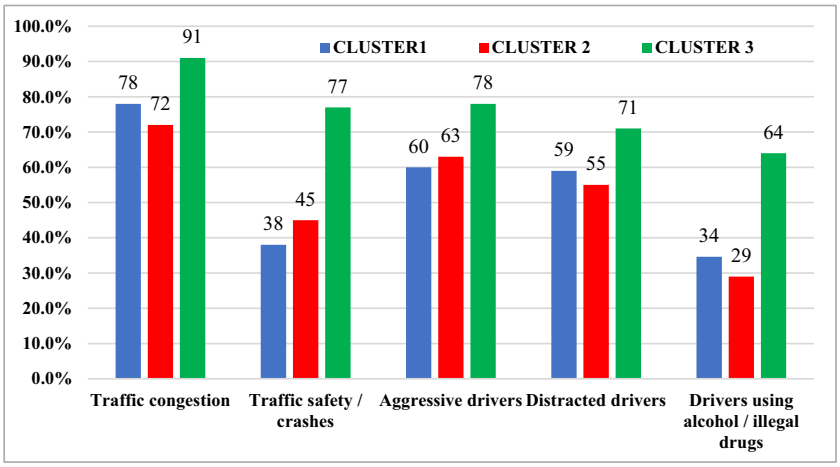

Fig. 4. Perceived changes in traffic problems within cluster 1 ($N = 289$) cluster 2 ($N = 130$) and cluster 3 ($N = 140$).

safety questionnaire used in this study, based on the drivers' personal attitudes toward 12 driving behaviors that violate traffic safety: "speeding violations," "dangerous violations," and "safety precaution violations." The factor "speeding violations" consisted of four driving behaviors that describe violating speeding regulations on different road infrastructures (highway, urban area, residential street, and school zone). The factor "dangerous violations' consisted of driving behaviors that were extremely dangerous, with traffic violations such as RLR, driving while intoxicated, driving while tired or sleepy, and handheld phone use or texting while driving. The factor "safety precaution violations" refers to driving behaviors that are in place for precautionary reasons to assure or maximize safety on the roads. For instance, wearing a seat belt is a major precautionary safety measure to maximize safety when driving, because it reduces the possibility of fatal or serious injury when involved in a RTC, and this measure is important for both the driver and his or her passengers. For this reason, wearing a seat belt while driving is obligatory by law, but in certain countries, such as Egypt, the enforcement of seat belt regulations is more flexible and not very rigid [39]. In addition, hands-free phone use while driving is officially not seen as a traffic violation but can better be interpreted as violating a precautionary safety measure, because the distraction caused by hands-free phones can also lead to a higher risk for RTCs due to reduced reaction time and alertness [40,41]. It would therefore be wise to make regulations against all phone use when driving (including hands-free phone use) stricter to maximize safety on the roads. This study found that Egyptian drivers tend to support stricter regulations for handheld phone use but not hands-free phone use.

After comparing the level of acceptability of traffic safety violations of the drivers in the study and their perceived level of acceptability of traffic safety violations for other drivers in the same city, the results reveal that there is a similarity between the social norms and personal attitudes of the drivers. This can be explained by the high social norm of all drivers accepting violations, which can lead to more drivers accepting violations. This was also confirmed in an international comparison study investigating the acceptance of not wearing a seat belt in Egypt [39]. The observed violations of traffic safety regulations committed by other drivers in the same city affect the attitudes and acceptance of violations of individual drivers. The social norm of accepting driving violations rationalizes these violations as normal and common, thereby making them acceptable as individual and social attitudes toward traffic safety [16].

Unlike other countries with a heterogeneous driving population with many different nationalities who have many subcultures with different traffic safety cultures [34], this sample of Egyptian drivers consists of very little cultural variation, with 99% of the drivers having Egyptian nationality. This is in line with the results of a cultural comparison by Hofstede insights (2020) [42], in which Egypt is described as a collectivistic culture rather than an individualistic culture, with close commitment to the societal group, which can even overrule societal regulations.

Table 4
Support or Opposition for more rigid traffic regulations within each driver cluster.

Traffic regulations	Law agaist texting		Law against hand-held phone use		Law against any type of phone use (including handsfree)			
	% Support	% Oppose	% Support	% Oppose	% Support	% Oppose		
Claster 1	89	11	86	14	57	43		
Claster 2	94	6	85	15	49	51		
Claster 3	92	8	91	9	58	42		
Traffic regulations	Law against speeding in highways		Law against speeding in residential areas		Law against speeding in urban areas		Law against speeding in school zones	
	% Support	% Oppose	% Support	% Oppose	% Support	% Oppose	% Support	% Oppose
Claster 1	90	10	92	8	91	9	96	4
Claster 2	79	21	85	15	85	15	95	5
Claster 3	89	11	87	13	87	13	89	11
Traffic regulations	Law implementing alcohol lock for DWI driver		Law implementing alcohol lock in all new cars		Law against RLR in urban areas		Law against RLR in residential areas	
	% Support	% Oppose	% Support	% Oppose	% Support	% Oppose	% Support	% Oppose
Claster 1	94	6	92	8	97	3	97	3
Claster 2	89	11	85	15	96	4	95	5
Claster 3	96	4,0%	96	4	94	6	93	7

Nonetheless, the drivers in our study perceived the level of acceptability of traffic safety violations among other drivers in the same city to be higher than their own, which can be explained by the social and psychological construct "the better than others effect." This could explain why individual drivers evaluate themselves as better than the average of the people in their environment [43,44].

4.2. Can Egyptian drivers be categorized into distinct driver clusters?

The drivers in this Egyptian study sample were divided into three groups based on their scores on each of the three factors, with each driving cluster having a typical level of acceptance for a distinctive set of safety violations. The characteristics of each driving cluster describe the type of driver and its attributes. The largest group of drivers (n = 289 drivers) was the "drivers who rigidly followed regulations" and included 52% of the drivers in the study sample. The highest proportion of older drivers in this study sample (aged 55 years or above) followed all the traffic rules examined in the study. The majority of drivers in this cluster self-reported not receiving any violations or being involved in any RTCs in the past 2 years. These results support those of an earlier study conducted in Egypt that found that older drivers had fewer violations [26].

The second cluster, "drivers who violated safety precautions" was the smallest group, with 130 drivers (23%). This cluster had the highest proportion of younger drivers (aged 30 years or below) in the study sample who viewed seat belt violations and hands-free phone use while driving as acceptable. This result is in line with previous studies on young drivers in Egypt, who were less likely use a seat belt compared with middle-aged or older drivers [26]. These drivers report more tickets for moving violations, but not more RTCs in comparison to the other driver clusters. This can be explained by the type of violations these drivers find acceptable, because violating safety precautions such as seat belt use and hands-free calling while driving would lead to tickets for violations rather than crashes.

The third cluster, "drivers with the tendency to violate regulations" consisted of 25% of the study sample. They were mostly middle-aged drivers (31–55 years) who found dangerous traffic violations to be acceptable. This driver cluster reports significantly more RTCs, but not more violations, compared with the other clusters. Acceptance of violations among drivers in this cluster is reflected in the higher level of RTCs. The highest number of RTCs but not violations among drivers with violation tendencies can be clarified by their acceptance of very dangerous violations such as texting while driving, driving while under the influence, RLR, and driving while tired or sleepy, which are all dangerous driving behaviors that increase the risk of collisions and RTCs.

4.3. Which traffic safety attitudes are characteristic of each driving cluster?

The drivers in cluster 1, "drivers who rigidly followed regulations," did not consider any traffic safety violation to be acceptable, and they believed that other drivers in the same city also did not consider driving behaviors that violate safety regulations. All stricter traffic regulations were supported by the drivers in this cluster. Perceived increase in traffic problems on the Egyptian roads in the past 3 years was reported among all driver clusters, but drivers in this first cluster showed the smallest increase in comparison to all other clusters. Their more optimistic views, compared with the other driver clusters, can be explained by their perception of other drivers in the same city, and their inability to violate traffic regulations.

The drivers in cluster 2, "drivers who violated safety precautions," believed that other drivers in the same city also considered hands-free calling when driving and not wearing a seat belt as a driver or passenger to be acceptable. In line with this finding, these drivers showed the highest proportion of drivers opposing a law against any type of phone use while driving or built-in anti-distraction devices in cars. Drivers in cluster 2 reported that the increase in problems caused by distracted drivers on Egyptian roads in the past 3 years to be the least problematic compared with the other clusters. This might be linked to their high level of approval of hands-free calling and their belief that other drivers in the same city also accept hands-free calling, making distraction while driving not as problematic.

Drivers in cluster 3, "drivers with violation tendencies," reported a high level of acceptance for most violations and assumed that other drivers in the same city were even more accepting of dangerous driving. The social norms regarding traffic safety violations may have caused the drivers in cluster 3 to normalize these driving behaviors and neutralize the seriousness, because they see that other drivers in the same city commit similar violations [15]. This belief that other drivers will violate traffic regulations makes them believe that other drivers are worse than themselves at following the regulations, as indicated by the perceived increase in traffic issues on Egyptian roads. A significantly higher percentage of drivers in cluster 3 perceived all five traffic issues (traffic congestion, traffic safety, aggressive drivers, distracted drivers, and intoxicated drivers) as being a much bigger problem than 3 years ago. Drivers with violation tendencies in cluster 3 seem to blame others for these violations and the decrease in traffic safety and believed that greater problems are caused by "others" and not by their own driving behavior.

The results also show that drivers with violation tendencies reported high levels of support for more rigid traffic regulations. This seems somewhat odd, as this would put drivers in cluster 3 more at risk for tickets. However, this can be rationalized by the lower enforcement of traffic regulations in Egypt. Furthermore, it seems that drivers in cluster 3 believe that a solution for the more problematic traffic issues would be to make traffic regulations stricter, not taking into account their own high levels of self-reported acceptance for violations. Similar to our study, other traffic safety research conducted in Egypt compared traffic regulations and attitudes toward unsafe driving behaviors and found that drivers with a high level of acceptance also support stricter safety policies and traffic regulations [38].

4.4. Recommendations and future research

4.4.1. Limitations

One limitation of this research is related to the division of the age groups within the study sample. There were few older drivers (aged above 55 years), a small group of young drivers (aged below 30 years), and a large group of middle-aged drivers (31–54). This distorted age division makes comparisons between age groups more complex. In addition, the sample consisted of a small group of professional drivers or drivers with educational purposes along a majority of commuters. For this reason, future studies should focus on a younger driving sample, by, for example, administering a similar questionnaire among university students who are driving for educational purposes.

4.4.2. Practical implications

The overall aim of this study was to investigate whether Egyptian drivers differ in traffic safety attitudes; the results of this study show that three driver clusters can be differentiated based on their level of acceptance for traffic safety violations. Hence, this knowledge can help guide the development of targeted national traffic safety interventions. This study suggests the need for adjusted traffic safety education programs for each specific driver cluster. Past research has shown that education on road safety in Egypt can effectively improve road safety behavior, improving knowledge among drivers and raising awareness about the urgency of traffic safety and danger of traffic violations and RTCs [19]. In particular, drivers with violation tendencies should receive education and training to increase their knowledge of traffic regulations, the hazards of violating traffic safety regulations, and dangerous driving behaviors and their consequences. Drivers who violate safety precautions can benefit from targeted training with special attention to the importance and positive effect of the seat belt as a safety measure

for both drivers and passengers. In addition, awareness of distraction while driving should be increased, along with the understanding that talking on the phone in hands-free mode also causes distractions.

The results of this study have also underlined the importance of social norms within a community and the traffic safety attitudes of other drivers in a city. Therefore, alongside targeted training for each driver cluster, this study suggests altering the attitudes of all drivers by focusing on a change in the existing social norm of traffic safety. This can be achieved by increasing community awareness of traffic safety issues in Egypt, which are currently perceived as much more problematic than 3 years ago, as revealed by this study. By increasing the awareness and knowledge of traffic safety, the current perception that other drivers accept violations could change. In addition to any small change in driving behavior, this should lead to fewer observations of other drivers violating traffic regulations, which could improve the impression of other drivers in the same city and could change social norms and the personal acceptance of traffic safety violations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors would like to thank the International Association of Traffic and Safety Sciences for its support through Projects 1601A/1701B/1801C and the Global Research Alliance on Traffic and Safety.

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