Psychometric properties of the Traffic locus of control scale – Arabic version (T-LOC-A) among Lebanese drivers

Dalal Youssef (dalalyoussef.esu@gmail.com)
Ministry of Public Health

Pascale Salameh
Institut National de Santé Publique, Epidémiologie Clinique et Toxicologie (INSPECT- LB)

Linda Abou-Abbas
Lebanese University

Louis-Rachid Salmi
Bordeaux University

Research Article

Keywords: Traffic locus of control scale, psychometric properties, driving behavior, T-LOC-A, Lebanon

Posted Date: April 4th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1508766/v1

Abstract

Background: The Traffic Locus of Control scale (T-LOC) measures a personality attribute revealing how a driver generally perceives possible causes of traffic crashes.

Objective: This study aimed to assess the psychometric properties of the Arabic version of T-LOC (T-LOC-A) among Lebanese drivers and to test its reliability and construct validity.

Methods: A cross-sectional study was conducted between October and December 2019 among a national sample of Lebanese drivers aged 18 years old and above, from all Lebanese governorates. A standardized questionnaire, developed in the Arabic language, includes three sections: Socio-demographic characteristics section, driving variables section; and the measurements section including the T-LOC and the driver behavior questionnaire. The internal consistency of the scale was assessed using Cronbach's alpha. Exploratory factor analysis and confirmatory factor analysis were performed to examine the construct validity of the T-LOC. Correlation between T-LOC and driver behavior was assessed using Pearson correlation. In addition, the associations between T-LOC-A and sociodemographic characteristics were evaluated.

Results:

A total of 568 drivers participated in the study. Of the total, 69% were male and aged between 18- and 82-years-old. In the previous three years, around 40% of the surveyed drivers had been involved in accidents and 50.4% were penalized for traffic offenses. The T-LOC-A had adequate psychometric properties, revealing good to excellent reliability levels and support the original four-factor structure of the T-LOC (α=0.85), including self (α=0.88), other drivers (α=0.91), vehicle/environment (α=0.86), and fate (α=0.66). The confirmatory factor analysis revealed a good data fit. Men reported a higher tendency to attribute the responsibility for driving situations to the other drivers ($p=0.024$), while women believed more in fate and luck than men ($p=0.0012$). Other drivers' subscale ($r=0.387$, $p<0.05$), and self-related dimensions of T-LOC-A ($r=0.155$, $p<0.05$) were positively correlated with the aggressive violation.

Conclusion: The Arabic-version T-LOC-A exhibited good psychometric properties. In the Lebanese driving environment and cultural specificities, it is found to be a valid and reliable instrument, supporting the three factorial structures of the original T-LOC.

Introduction

Road traffic crashes (RTCs) have been a leading cause of injury-related deaths worldwide. Since the human factor is one of the RTCs determinants [1], studying it can help decision-makers to spot and design effective road safety interventions. Thus, identifying and designing methods to boost the safe operation of motor vehicles can lead to substantial societal and organizational impact.

Traffic safety researchers have recognized the locus of control (LOC) as a personality attribute revealing how a person generally perceives events to be under his/her control (internal LOC) or the control of others or outside forces (external LOC) [2]. Hence, this variable played an important role in predicting safe driving behaviors and determining drivers' dangerous behaviors and crash involvement [3–6]. The LOC assumed the presence of individual discrepancies in perceptions of the causation link between individuals' acts and resulting outcomes [7]. Since the concept was suggested, LOC has been widely used in a variety of research domains, such as health psychology and traffic safety. Perception of outcomes as the result of external, uncontrollable influences, such as luck, fate, and powerful others was referred to as external-LOC personalities, whereas internal-LOC personalities tend to consider outcomes depending on their behavior. Hence, drivers attributing driving outcomes to internal and controllable factors [8] are more willing to take precautionary measures [9, 10]. This has been acknowledged by several empirical findings that reported regular seatbelt use [10, 11], alertness while driving [12], and applying brakes quickly when perceiving potential danger on a driving track among individuals showing a high internal locus of control score.

Given the importance of T-LOC in traffic safety, its relationship with driving behaviors has been the focus of several papers [13–15]. Drivers who assigned the cause of RTCs to external LOC factors were more prone to adopt risky driving behaviors as reported by Montag and Comrey (1987) [6]. Conversely, the safe-driving behavior increased with the intensified internal LOC attribution because these individuals were more likely to adopt defensive driving and precautionary measures [16, 17].

The multidimensional Traffic Locus of Control scale (T-LOC), developed by Özkan & Lajunen (2005) [14] is used to measure the LOC of drivers. It includes 15 items focusing on all possible traffic accident causes structured in four factors, namely, "self", "other drivers", "vehicle/environment", and "fate". "Self" represents drivers' internal beliefs, and the other three factors represent external factors [14]. Since its development, the T-LOC has been used and translated by many researchers. The Swedish [15] and Romanian [13] versions did not conserve the same factorial structure, therefore suggesting that the factorial structure of the T-LOC must be adapted for use in other cultural contexts and driving environments. Hence, a further component was added to the original T-LOC in both of the mentioned versions. In regard to the Swedish version, it comprises 17 items, and the component called "self" in the original version T-LOC was split into two factors known as "own skills" and "own behavior" [15]. In the Romanian version, religiosity was added as a new component and the scale was extended to include 41 items [13]. Despite the modifications between versions, the principal four factors in the original T-LOC were kept. This highlights the importance of adaptation of the instrument according to the culture.

In Lebanon, RTCs are a major community health threat and their resulting injuries lay an additional burden on an already crushed health sector. The dearth of data and the limited analysis of factors leading to road traffic injuries (RTIs), including human, vehicle, and environment and their interaction, restrains the ability to implement oriented interventions. Since one of these factors was the driver behavior, hence exploring the driver's personality traits that could trigger RTCs is considered one of the keys for successful carrying out oriented human behavior intervention.

Since several previous studies have shown that T-LOC predicts which drivers will adopt risk-taking behaviors and will be involved in traffic accidents [20, 21] and that externally-oriented people are more prone to adopt risky behaviors [6], it is of great interest to explore this attribute among Lebanese drivers using a recognized scale. To the best of our knowledge, the role of LOC has not been previously explored among Lebanese drivers due to the absence of a valid instrument to assess drivers' LOC. This study aimed to assess the psychometric properties of the Arabic (Lebanon) version of T-LOC (T-LOC-A) among Lebanese drivers and to test its internal and external reliability as well as its content and construct validity. In addition, it aims to examine convergent and discriminant validity by testing gender difference and correlation with driver behavior.

Methods

Translation and cross-cultural adaptation process

Permission was obtained from the corresponding author [14] to translate the original T-LOC questionnaire into the Arabic language. The translation and cross-cultural adaptation of the T-LOC-A scale were performed according to the steps proposed by Beaton et al. [22].

The 16-items version of T-LOC was translated from English to the Arabic language by two independent bilingual native-Arabic translators. Inconsistencies found between the two translators were discussed until consensus was reached. Then, it was back-translated by two independent native-English translators. A committee of experts which included a road safety specialist, a psychologist, and three drivers from different age groups reviewed the new version to verify linguistic, problematic items, and discrepancies in terms of wording, ambiguity, and specific features of the Lebanese context. A consensus was reached on keeping all the T-LOC items leading to the pre-final version of the translated T-LOC-A, which was piloted on a small convenience sample of 35 drivers from all the Lebanese governorates.

Study design and participants

This cross-sectional study was carried out between October and December 2019, among Lebanese drivers from all Lebanese governorates. Data was collected through a convenience sampling method. Then, the collected data were weighted according to gender, age, and dwelling region, to ensure that the age, location, and gender distributions of respondents were representative of the Lebanese population. This procedure involved setting predetermined target figures across gender and age for each Lebanese governorate (Bekaa, Baalbeck-Hermel, Mount-Lebanon, Beirut, North, Akkar, South, and Nabatyeh), based on figures from the Central Administration of Statistics [24]. Since no updated official list of drivers is available, potential respondents were recruited from public places such as shopping areas and parking stations. All Lebanese active drivers having 18 years or over, having a driver's license, driving regularly, and agreeing to participate were eligible to be part of this study. This study excluded drivers who were currently not practicing driving activities, illiterate drivers who could not understand the questions, and non-Lebanese drivers.

Ethical considerations

Written informed consent was obtained for each participant. They were reassured that their participation was voluntary and that they were free to withdraw at any time. In addition, all information was gathered anonymously and handled confidentially. This study was conducted following the Declaration of Helsinki. The protocol of the study was reviewed and approved by IPNET. The study design assured adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial.

Data collection

A standardized questionnaire was developed in Arabic, the native language of Lebanon, and took around 10 minutes to be filled. The first page of the questionnaire included a brief introduction to the background and the objective of the survey, in addition to some instructions for filling the questionnaire, including three sections:

The first section included questions assessing socio-demographic characteristics of the study participants, such as age, gender, education level, marital status, and working status.

The second section included exposure variables such as driving experience and annual mileage and risk involvement (being involved in RTCs or receiving traffic offenses during the previous three years).

The third section included 2 scales:

T-LOC consists of 16 items of which 5 items target self (e.g. own risk-taking), 6 items target other drivers (e.g. other driver's risk-taking), 3 items target vehicle/environment (e.g. mechanical failure in the car), and 2 items target fate (e.g. bad luck). For each item, participants were asked to rank the possibility that each of these 16 reasons could be the cause of RTCs on a five-point scale (1 = not at all possible; 5 = highly possible) [14].

Driver behavior questionnaire (DBQ) is one of the most widely used instruments in traffic psychology developed by Reason [25]. The DBQ assessed aberrant driver behavior by asking how often they experience specific types of aberrant driving behaviors on a six-point scale (1 = never; 2 = hardly ever; 3 = occasionally; 4 = quite often; 5 = frequently; 6 = nearly all the time) across different driver situations. The DBQ questionnaire has four components; ordinary violations, aggressive violations, errors, and lapses. The Arabic version of the DBQ was previously validated by Youssef et al. among Lebanese drivers (Submitted). In our study, the internal reliability of the aggressive violations subscale was 0.89, whereas for the simple violations subscale 0.85.

Procedure

After receiving the signed informed consent, eligible respondents were asked to complete a questionnaire via a face-to-face approach. Two trained data collectors who were students in the traffic major at the

Lebanese Higher Technical School were responsible for the dissemination of questionnaires. Before participation, study objectives and general instructions were delivered for the participants orally by data collectors. Drivers were free to participate in the study and they didn't receive any financial compensation for their participation. For the test-retest reliability, 40 subjects were asked to fill out the questionnaire for the second time after almost 8 weeks.

Statistical analysis

The collected data was entered and analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 24.0. Sample size guidance indicated that 300 or 5–10 participants per scale item would be adequate for establishing sufficient evidence of scale validity and reliability [23]. Thus, considering that the T-LOC has 16 items, the number of participants required would be at least 80–160. To reduce the sampling error and increase the study power, a rough estimation was made by multiplying the calculated sample size by 3.5, leading to a final sample size of 560 participants. The person who performed data entry was not involved in the data collection process. Given that missing values constituted < 10% of the total data, they were not substituted. Descriptive analyses were performed using frequency and percentage for categorical variables and mean and standard deviation for continuous variables.

A bivariate analysis was conducted using the Chi-square test to check for associations between categorical variables and the ANOVA test to compare means of LOC subscales and the categorical variables. Pearson correlation was used for linear correlation between continuous variables. All variables that showed a $p < 0.2$ in the bivariate analysis were included in the model as independent variables. Finally, logistic regression analyses were performed to determine the effects of T-LOC scores on risk involvement and driver behavior.

Internal consistency was estimated using Cronbach's alpha. A value ≥ 0.70 was considered satisfactory [26]. The test-retest reliability was assessed by calculating the intra-class correlation coefficient (ICC). ICC values between 0.40 and 0.59 are considered fair, values between 0.60 and 0.74 good and between 0.75 and 1.0 excellent [27].

Content validity: Based on the review of the scale items by the panel of experts, the content validity ratio (CVR) for each item is calculated using the following formula: $CVR = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$, where "Ne" is the number of experts who rated an item as "necessary" and N is the total number of experts [28]. Thus, according to criterion values provided by Lawshe, CVR must be equal to or larger than 0.49 for each item [28]. to be included in the initial form. The Content Validity Index (CVI) which is the mean score of those retained items having CVR≥0.49 was calculated [28, 29].

Kaiser-Meyer-Olkin (KMO) and Bartlett tests were performed before factor analysis to evaluate the adequacy of data for factor analysis. To examine the appropriateness of the factor structure and to increase the validity, we split our data into two random samples using SPSS split function, one for the

exploratory factor analysis (EFA) and one for the confirmatory factor analysis (CFA). For the first sample, we performed factor analysis using the principal axis factoring (PAF) method with Varimax rotation on retained items from the T-LOC to identify T-LOC-A dimensions. Based on Eigenvalues > 1 and scree plot, it was decided on the number of factors. Then, we performed a parallel bootstrapping analysis (PA) to derive simulated eigenvalues from random samples for comparing with the observed data and to determine the number of components or factors to retain from factor analysis.

Confirmatory Factor Analyses (CFA)

The factorial structure of the 16-item version of T-LOC-A was subjected to confirmatory analysis using SPSS Amos to examine the good fit of the model to the Lebanese drivers. Confirmatory factor analyses (CFA) were used to compare item organization of two models: (a) exploratory factor model, and (b) the Lebanese adapted model. To identify the best fitting model, the following goodness-of-fit statistics indicated the best fit to the data were calculated using IBM AMOS 24.0. Estimates were derived using maximum likelihood estimations and an overall model fit was assessed with the normative fit index (NFI), the goodness of fit (GFI), the comparative fit index (CFI), and the root mean square residual (RMSEA). The structural models were considered as a good fit to the data when $\chi 2/df < 5$, the GFI, NFI and CFI > 0.9, and the Standardized Root Mean Square Residual SRMSR < 0.08 [30], and the RMSEA < 0.08 [31]. In case of a poor fit, modification indexes were observed to identify additional parameters that improved the goodness of fit of the models [31].

Results

1. Translation and content validity

After reviewing the translation and back-translation of the T-LOC-A, and testing the pre-final version on 35 drivers, minor modifications including replacement of some ambiguous words were implemented to obtain the final Arabic version. The back-translated version was very similar to the original. Two experts considered the instrument appropriate to measure the driver's LOC and judged that the questionnaire had good content and face validity. All items obtained a CVR of more than 0.75. Thus, all these items were retained. Moreover, the overall Content Validation Index (CVI) of TLOC is 0.88.

2. Socio-demographic characteristics of the study participants:

Of the 568 drivers who participated (Table 1), the majority were male (69%) and aged between 30- and 49-years old (42.1%). More than half of the participants (52.6%) were married and 62.1% were living in urban areas; 58% of the drivers held a university degree or above. Out of the total, 41.0% of surveyed drivers were involved in RTCs in the previous three years and half of them (50.4%) had received at least one ticket in the previous three years.

Table 1: Socio-demographics characteristics of the study sample (N = 568)	n	%
Gender		
Male	392	69.0
Female	176	31.0
Age groups (years)		
Less than 29	250	44
30–49	239	42.1
50 and above	79	13.9
Marital status		
Single	239	42.1
Married	299	52.6
Other (Widowed, Separated...)	30	5.2
Education level		
Secondary or less	238	41.9
University or above	330	58.1
Occupation		
Non-professional driver	508	88.7
Professional driver (taxi)	64	11.3
Annual mileage		
< 6 000Km	278	48.9
≥ 6000 Km	290	51.1
Road traffic crashes in the previous 3 years (mean ± SD)	0.87 ± 1.47	
Fines last three years (mean ± SD)	0.46 ± 0.498	
N: Frequency, %: Percentage, SD: Standard deviation		

3. Factor structure of T-LOC scale

3.1 Exploratory factor analysis

The exploratory factor analysis of the T-LOC scale showed a KMO measure of 0.837 indicating adequate sampling adequacy. In addition, Bartlett's Test of sphericity was highly significant ($p < 0.001$). The scree plot of the Eigenvalues revealed a four-factor structure of the T-LOC scale. Random eigenvalues derived

from the bootstrapping procedure showed that 4 factors that had eigenvalues over 1 would have been selected (eigenvalues of 6.244 and 1.407). The four-factor structure explained 78% of the total variance. The first factor explained 39.0% of the total variance and consisted of 6 items measuring other drivers-based causes (items 3, 4, 8, 10, 14, 15, Table 2). Since these items described the tendency to attribute the responsibility for what is happening in traffic to other drivers, this factor was named “other drivers”. The second factor included five items that tapped drivers’ self-based causes and accounted for 15.7% of the variance. We labeled this factor as “self” since all its items denote personal skills and behavior. The third factor included three items about the vehicle and environmental-based causes and accounted for 14.5% of the variance and was named as “vehicle and environment”. The fourth factor included two items that tapped fate and chance-based causes. This factor accounted for 8.8% of the variance and was named “fate”.

Table 2
Exploratory factor analysis of the TLOC scale among Lebanese drivers

	TLOC scale items	TLOC components			
Item	Other Drivers	Self	Vehicle& Environment	Fate	
LOC15	Other drivers' dangerous overtaking	0.957			
LOC14	Other drivers driving under influence of alcohol	0.945			
LOC8	Other drivers drive often with too high speed	0.944			
LOC4	Other drivers' risk-taking while driving	0.912			
LOC10	Other drivers drive too close to my car	0.902			
LOC3	Shortcomings in other drivers' driving skills	0.842			
LOC1	Shortcomings in my driving skills		0.887		
LOC16	My own dangerous overtaking		0.886		
LOC2	My risk-taking while driving		0.809		
LOC9	If I drive too close to the car in front		0.770		
LOC7	If I drive often with too high speed		0.593		
LOC12	Bad weather or lighting conditions			0.897	
LOC6	Dangerous roads			0.885	
LOC13	Mechanical failure in the car			0.870	
LOC11	Fate				0.836
LOC5	Bad luck				0.831
E	Eigenvalue	6.244	2.515	2.316	1.407
A	Chronbach alpha	0.907	0.883	0.859	0.657
V	Variance	39.024	15.718	14.473	8.797

3.2 Confirmatory factor analysis

A Confirmatory factor analysis was performed to determine the multidimensionality model of the TLOC scale. A priori hypothesized model, that is the 20 items of the instrument load in four factors as suggested by the EFA displayed an unsatisfactory fit ($\chi 2/df = 7.226$; NFI, CFI and GFI < 0.9, SRMR = 0.05, RMSEA = 0.146). The modification indices inspection suggested adding error covariance between e2 and

e1, e3 and e4, e1 and e5. These modifications resulted in a significant improvement of the fit indices as follow $\chi 2/df = 2.302 < 5$; NFI = 0.953, CFI = 0.973, GFI = 0.917, AGFI = 0.902, RMSEA = 0.038 and SRMR = 0.042 < 0.05, therefore confirming the adequacy of the model (Fig. 1).

4. Reliability of the T-LOC-A scale

The overall reliability of the T-LOC-A scale was good (α = 0.85). Alpha reliabilities for these subscales ranged from 0.66 to 0.91. Skewness (-0.82 to 0.0.4] and kurtosis (-0.28 to 0.67] estimates for the four factors allowed the use of parametrical correlational analyses (Table 3).

Table 3
Mean scores, Cronbach's alpha coefficient, skewness, and Kurtosis of the T-LOC-A scale

	All drivers (N = 568)						
	Scale Mean	**S.D**	**Min**	**Max**	**Alpha α**	**Skewness**	**Kurtosis**
Self-related	17.08	3.79	7	25	0.88	-0.50	0.28
Other drivers	22.74	5.31	7	30	0.91	-0.82	0.61
Fate	5.87	1.98	2	10	0.66	-0.40	-0.55
Vehicle/ Env.	10.29	2.04	3	15	0.86	-0.69	1.67
T-LOC-A scale	56.21	8.42	28	71	0.85	-0.57	0.47

5. Correlation between the traffic locus of control dimensions and the DBQ subscales

The correlations between T-LOC-A factors ranged from 0.11 to 0.40, most of them being statistically significant ($p < 0.05$) with a low to very low correlation (Table 4). Other drivers' dimension of T-LOC-A was positively correlated with aggressive violation ($r = 0.387$, $p < 0.05$, Table 4). Notably, internal T-LOC-A represented by self-dimension was positively correlated to aggressive violations ($r = 0.155$, $p < 0.05$). The fate dimension was positively correlated to aggressive violation ($r = 0.11$, $p < 0.001$) and lapses ($r = 0.217$, $p < 0.05$). In addition, the other drivers subscale was positively correlated to errors ($r = 0.320$, $p < 0.05$). Vehicle and environment subscale was found to be correlated with lapses ($r = 0.131$, $p < 0.05$) (Table 4).

Table 4
Correlation between the traffic locus of control dimensions and the DBQ subscales

	Self-related	Other drivers	Vehicle and environment	Fate
Self-related	1	– .401**	0.13*	-0.11*
Other drivers	– .401**	1	0.01	-0.06
Vehicle and environment	0.13*	0.01	1	-0.02
Fate	-0.11*	0.06	-0.02	1
Aggressive violation	0.155*	.387*	0.057	.110**
Ordinary violation	-0.019	-0.012	-0.09	0.047
Errors	0.037	0.320*	0.038	0.006
Lapses	0.009	-0.026	0.031*	0.217*
Note: * Correlation is significant $p < 0.05$, ** Correlation is significant at the 0.001 level ($p < 0.001$)				

Association between T-LOC-A and socio-demographic variables

Gender differences revealed that men reported a higher tendency to attribute the responsibility for different driving situations to the other drivers (Mean 22.69 (SD = 4.95) for men versus (Mean 23.45 (SD = 5.19 for women, $p = 0.024$, Cohen's $d = 0.21$) while women believed more in fate and luck (Mean 5.84 (SD = 2.06) for men versus (Mean 6.24, (SD = 1.81) for women, $p = 0.012$, Cohen's $d = 0.30$). The "self" and "vehicle and environment" subscales measured were not significantly different between men and women (Table 5).

Fate was negatively correlated with age ($r=-0.149$, $p < 0.001$) and with the years of experience ($r=-0.198$, $p < 0.001$). It was also associated with annual mileage ($p < 0.001$). "Other drivers" scale was positively correlated with all variables included in the analysis: age ($r = 0.098$, $p < 0.05$), years of experience ($r = 0.128$, $p < 0.001$), and annual mileage ($p = 0.007$). Finally, vehicle/environment was positively related with all the variables included in the analysis: annual mileage ($p = 0.029$).

Table 5
Arabic Traffic locus of control by gender

	Gender	N	Mean	Std. Deviation	P-value	Cohen's d
Self	Men	392	17.25	3.74	0.26	-0.20
	Women	176	16.70	3.90		
Other drivers	Men	392	22.69	4.95	0.024	0.21
	Women	176	23.45	5.19		
Vehicle and Environment	Men	392	10.30	2.16	0.13	-0.02
	Women	176	10.28	1.76		
Fate	Men	392	5.84	2.06	0.012	-0.30
	Women	176	6.24	1.81		

Discussion

This research was designed to adapt an effective tool for measuring T-LOC among Lebanese drivers. Our findings indicate that the T-LOC-A has adequate psychometric properties revealing good to excellent reliabilities. The results from the exploratory factor analysis showed that the factorial structure of the T-LOC-A was similar to that of the original version [14] revealing the same multidimensional structure with 4 subscales namely internal locus of control called “self”, “others drivers”, “fate”, and “vehicle/environment”. All four factors had acceptable reliability. Its multidimensional structure is statistically supported by satisfactory fit indices. The factorial solution of the T-LOC-A also matches the meaning of the four broad facets of the Chinese [32], Swedish [15], and Romanian [13] versions, where the 4 components were retained despite variation in terms of factorial structure and the content revealed by the number of items [13]. In addition, the peculiarity between external and internal beliefs is consistent with previous studies [3, 6, 14, 18, 19, 33]. Our study revealed that the correlations between internal and external T-LOC factors were low to moderate, which is in line with the findings of previous studies on T-LOC scales development [6, 13, 14].

The pattern of correlations between the T-LOC-A factors was for the most part similar to the findings of previous studies [15, 16]. Other drivers and fate were negatively correlated with self [13]. Conversely, self was positively correlated to vehicle/environment dimension. Our results are in line with previous studies that also found self-scale to be positively correlated with vehicle/environment [13–15]. However, the absence of correlation between external dimensions is inconsistent with previously studies that found that other driver's dimensions were positively correlated with fate and vehicle/environment and that fate was positively correlated with vehicle/environment [13]. Further studies are necessary to explain these particular findings of the Lebanese drivers.

There were gender differences in the attribution of responsibility of the RTC to the internal or the external factors. Men reported a higher tendency to attribute the responsibility for different driving situations and RTCs to the other drivers. However, women believed more in fate and bad luck as a contributor to RTCs. Our results are similar to the findings of a study conducted among Romanian drivers, that revealed the same pattern of responsibility attributions between men and women [6]. Considering self and vehicle-environment scales, the results did not reveal significant differences between men and women. Of note, the present study revealed that Lebanese female drivers had the highest scores in all the T-LOC-A factors compared to male drivers. These results were also in line with previous studies [4, 14] and for some cases, similar to the findings in other fields, such as health psychology [34].

Remarkably, the present study found that “self” was positively correlated to the aggressive violation. This indicated that Lebanese drivers who tended to attribute the causes of traffic accidents to themselves might have a greater likelihood to adopt aggressive violations when driving. Consistently with the findings of previous studies that suggested that increased internal LOC results in risky driving behaviors, was in part related to drivers’ idealistic beliefs or overconfidence in their aptitude to evade crashes [3, 4].

In addition, our study found that drivers who tended to attribute the causes of RTCs to “other drivers” were more willing to adopt a dangerous behavior revealed by the aggressive violation. This might be explained by the fact that drivers who tended to be nervous and concerned about other drivers' performances while driving were more likely to react negatively and adopt risky behavior revealed by aggressive violations. Interestingly, the fate dimension was also correlated to the aggressive violation. Drivers who blamed destiny or luck to be the causes of RTCs didn’t consider themselves accountable for such incidents and involved themselves more in dangerous driving behavior. The presence of very low correlation or even its absence between T-LOC subscales and lapses explains the reason behind the omission of lapses when studying the correlation between aberrant behavior and T-LOC.

Strengths

To the best of our knowledge, our study is the first national study that aims to assess traffic locus of control among Lebanese drivers. Since the main purpose of the present study is, not to describe the Lebanese driver, but to test the T-LOC scale in a sample different from which it was first developed, the study sample of Lebanese drivers is considered certainly sufficient as the participants live in different geographical areas and drive in a different traffic environment compared to the Turkish drivers in the original study [14] and allows a close approximation of the findings to the general driver population, especially since no such studies, taking into consideration a representative sample from all regions, were previously conducted in Lebanon. This study would enable traffic safety researchers in the Arabic countries to conduct further studies in other work settings to ensure objective assessment of traffic locus of control.

Limitations

First, the study cross-sectional design in nature does not allow deriving causal relationships of the main associations. Despite weighing over gender, age, and geographical regions, selection bias might be present given the use of the convenience sampling technique. Secondly, it relied on self-report measures of all studied variables. Although most of the previous studies on this topic include self-report measures, the responses may bear recall and information bias. However, the desirability cannot explain the results, because it does not have significant relationships with the study variables. Finally, since the locus of control might be related to drivers' confidence [14], their forthcoming studies about T-LOC and safety should include driving skills, confidence, and optimism bias.

Implications

The current study contributes to literature since studies assessing traffic locus of control are scarce. The first important step in implementing interventions targeting traffic psychology consists in identifying the locus of control among Lebanese drivers. Hence, our study aimed to adapt and validate a tool for LOC assessment among Lebanese drivers that could be used by both practitioners interested in reducing accident risk and increasing road safety, as well as for researchers interested in this topic. Further training sessions for new drivers about the necessity to adopt an internal locus of control for different traffic outcomes are recommended. Finally, our research contributes to the literature by highlighting the nature of relations between driving locus of control perceptions and a wide range of demographic variables and behavior in the road traffic context.

Conclusion

The Arabic version of T-LOC (T-LOC-A) is a valid and reliable instrument in the Lebanese driving context and cultural specificities. It supports the same factorial structure of the original T-LOC. This tool might support the development of interventions for drivers who are prone to RTC in Lebanon. Forthcoming studies exploring the association between T-LOC and involvement in RTCs are recommended.

Abbreviations

T-LOC-A: Traffic locus of control scale – Arabic version

RTCs: Road traffic crashes

T-LOC: The Traffic Locus of Control scale

P: P-value

SD: Standard deviation

SPSS: Statistical Package for Social Sciences

CFA: Confirmatory factor analysis

EFA: Exploratory factor analysis

KMO: Kaiser–Meyer–Olkin

CVI: Content Validity Index

CVR: Content validity ratio

RMSEA: Root mean square error of approximation

SRMR: Standardized root mean square residual

GFI: Goodness-of-Fit Index

CFI: Comparative Fit Index

NFI: Normed Fit Index

DBQ: Driver behavior questionnaire

α :Cronbach's alpha

r: coefficient de correlation r

d: Cohen' d

IPNET: Lebanese Higher Institute of Technical & Professional

Declarations

Ethical considerations

Written informed consent was obtained for each participant. They were reassured that their participation is voluntary and that they were free to withdraw at any time. In addition, all information were gathered anonymously and handled confidentially. The study design assured adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial.

Funding

No funding was received.

Availability of data and materials

Data are available from the corresponding authors upon reasonable request.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Acknowledgments

The authors acknowledge all drivers who participated in this study and the students of traffic major in IPNET Lebanese Higher Institute of Technical & Professional, Bir Hassan who helped us in the data collection.

Availability of data and materials:

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Conception and design: D.Y

Analysis and interpretation of the data: D.Y, P.S, L.A.A. and LR.S

Drafting of the article: D.Y

Critical revision of the article for important intellectual content: D.Y, P.S, and LR.S

Final approval of the article: D.Y, P.S, L.A.A and L.R.S

Authors information

- Dalal Youssef, MSc, MPH, RSM, Ph.D. student, Research Center Bordeaux Population Health, Institut de santé publique, d'épidémiologie et de développement (ISPED), Bordeaux University, France & Clinical trial Program, Ministry of Public Health, Beirut, Lebanon & Lebanese Higher Institute of Technical & Professional, Bir Hassan, Ministry of Education, Lebanon ORCID IDs: https://orcid.org/0000-0003-3085-6849 Email: dyoussef@moph.gov.lb; dalalyoussef.esu@gmail.com; Phone number: +96171239633

- Pascale Salameh, PharmD, PhD, INSPECT-LB (Institut National de Santé Publique, d'Épidémiologie Clinique et de Toxicologie-Liban), Beirut, Lebanon. &Faculty of Pharmacy, Lebanese University, Beirut, Lebanon &University of Nicosia Medical School, Nicosia, Cyprus.

- Linda Abou Abbas, MPH, Ph.D., Neuroscience Research Center, Lebanese University, Faculty of Medical Sciences, Lebanon.

- Louis-Rachid Salmi, MD, Ph.D., Emeritus Professor, INSERM U-1219, Bordeaux Population Health (Injury Epidemiology, Transportation, Occupation team), Institut de santé publique, d'épidémiologie et de

développement (ISPED), Bordeaux University, France

References

1. Rumar, K., *Driver requirements and road traffic informatics*. Transportation, 1990. **17**(3): p. 215–229.
2. Rotter, J.B., *Generalized expectancies for internal versus external control of reinforcement*. Psychological Monographs: General and Applied, 1966. **80**(1): p. 1–28.
3. Arthur, W. and D. Doverspike, *Locus of control and auditory selective attention as predictors of driving accident involvement: A comparative longitudinal investigation*. Journal of Safety Research, 1992. **23**(2): p. 73–80.
4. Holland, C., J. Geraghty, and K. Shah, *Differential moderating effect of locus of control on effect of driving experience in young male and female drivers*. Personality and Individual Differences, 2010. **48**: p. 821–826.
5. Özmen, O. and Z.H. Sümer, *Predictors of risk-taking behaviors among Turkish adolescents*. Personality and Individual Differences, 2011. **50**: p. 4–9.
6. Montag, I. and A.L. Comrey, *Internality and externality as correlates of involvement in fatal driving accidents*. Journal of Applied Psychology, 1987. **72**(3): p. 339–343.
7. Rotter, J.B., *Some problems and misconceptions related to the construct of internal versus external control of reinforcement*. Journal of Consulting and Clinical Psychology, 1975. **43**(1): p. 56–67.
8. Phares, E.J. and K.G. Wilson, *Responsibility attribution: role of outcome severity, situational ambiguity, and internal-external control*. J Pers, 1972. **40**(3): p. 392–406.
9. Peterson, C. and A.J. Stunkard, *Cognates of personal control: Locus of control, self-efficacy, and explanatory style*. Applied and Preventive Psychology, 1992. **1**(2): p. 111–117.
10. Strickland, B.R., *Delay of gratification and internal locus of control in children*. J Consult Clin Psychol, 1973. **40**(2): p. 338.
11. Hoyt, M.F., *Internal-External Control and beliefs about automobile travel*. Journal of Research in Personality, 1973. **7**(3): p. 288–293.
12. Lajunen, T. and H. Summala, *Driving experience, personality, and skill and safety-motive dimensions in drivers' self-assessments*. Personality and Individual Differences, 1995. **19**(3): p. 307–318.
13. Mairean, C., et al., *Traffic locus of control scale – Romanian version: Psychometric properties and relations to the driver's personality, risk perception, and driving behavior*. Transportation Research Part F Traffic Psychology and Behaviour, 2017. **45**: p. 131–146.
14. Özkan, T. and T. Lajunen, *Multidimensional Traffic Locus of Control Scale (T-LOC): Factor structure and relationship to risky driving*. Personality and Individual Differences, 2005. **38**: p. 533–545.
15. Warner, H.W., T. Ozkan, and T. Lajunen, *Can the traffic locus of control (T-LOC) scale be successfully used to predict Swedish drivers' speeding behaviour?* Accid Anal Prev, 2010. **42**(4): p. 1113–7.
16. Alper, S. and T. Özkan, *Do internals speed less and externals speed more to cope with the death anxiety?* Transportation Research Part F: Traffic Psychology and Behaviour, 2015. **32**: p. 68–77.

17. Huang, J. and J. Ford, *Driving locus of control and driving behavior: Inducing change through driver training*. Transportation Research Part F Traffic Psychology and Behaviour, 2012. **15**: p. 358–368.
18. Iversen, H. and T. Rundmo, *Personality, Risky Driving and Accident Involvement Among Norwegian Drivers*. Personality and Individual Differences, 2002. **33**: p. 1251–1263.
19. Guastello, S.J. and D.D. Guastello, *The relation between the locus of control construct and involvement in traffic accidents*. The Journal of Psychology: Interdisciplinary and Applied, 1986. **120**(3): p. 293–297.
20. Gidron, Y., R. Gal, and H.S. Desevilya, *Internal locus of control moderates the effects of road-hostility on recalled driving behavior*. Transportation Research Part F: Traffic Psychology and Behaviour, 2003. **6**(2): p. 109–116.
21. Huang, J.L. and J.K. Ford, *Driving locus of control and driving behaviors: Inducing change through driver training*. Transportation Research Part F: Traffic Psychology and Behaviour, 2012. **15**(3): p. 358–368.
22. Beaton, D.E., et al., *Guidelines for the process of cross-cultural adaptation of self-report measures*. Spine, 1976. **25**(24): p. 3186–91.
23. Comrey, A.L. and H.B. Lee, *A first course in factor analysis, 2nd ed*. A first course in factor analysis, 2nd ed. 1992, Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc. xii, 430-xii, 430.
24. Khobi, J.A., J.S. Mtebe, and J.T. Mbelwa, *Factors influencing District Health Information System usage in Sierra Leone: A study using the Technology-Organization-Environment Framework*. The Electronic Journal of Information Systems in Developing Countries, 2020. **86**(6): p. e12140.
25. Reason, J., et al., *Errors and violations on the roads: a real distinction?* Ergonomics, 1990. **33**(10–11): p. 1315–32.
26. Tavakol, M. and R. Dennick, *Making sense of Cronbach's alpha*. International journal of medical education, 2011. **2**: p. 53.
27. Cicchetti, D., *Guidelines, Criteria, and Rules of Thumb for Evaluating Normed and Standardized Assessment Instrument in Psychology*. Psychological Assessment, 1994. **6**: p. 284–290.
28. LAWSHE, C.H., *A QUANTITATIVE APPROACH TO CONTENT VALIDITY1.* Personnel Psychology, 1975. **28**(4): p. 563–575.
29. DeVon, H.A., et al., *A psychometric toolbox for testing validity and reliability*. J Nurs Scholarsh, 2007. **39**(2): p. 155–64.
30. MacCallum, R., M. Browne, and H.M. Sugawara, *Power analysis and determination of sample size for covariance structure modeling*. Psychological Methods, 1996. **1**: p. 130–149.
31. Byrne, B.M., *Structural equation modeling with EQS: Basic concepts, applications, and programming, 2nd ed*, in *Structural equation modeling with EQS: Basic concepts, applications, and programming, 2nd ed.* 2006, Lawrence Erlbaum Associates Publishers: Mahwah, NJ, US. p. xii, 440-xii, 440.
32. Sun, L., Y. Ma, and L. Hua, *Adaptation and validity of the traffic locus of control scale in Chinese drivers*. Personality and Individual Differences, 2020. **159**: p. 109886.

33. Levenson, H., *Differentiating among internality, powerful others, and chance*. Research with the locus of control construct, 1981. **1**: p. 15–63.
34. Luszczynska, A. and R. Schwarzer, *The Role of Self-Efficacy in Health Self-Regulation*, in *The adaptive self: Personal continuity and intentional self-development*. 2005, Hogrefe & Huber Publishers: Ashland, OH, US. p. 137–152.

Figures

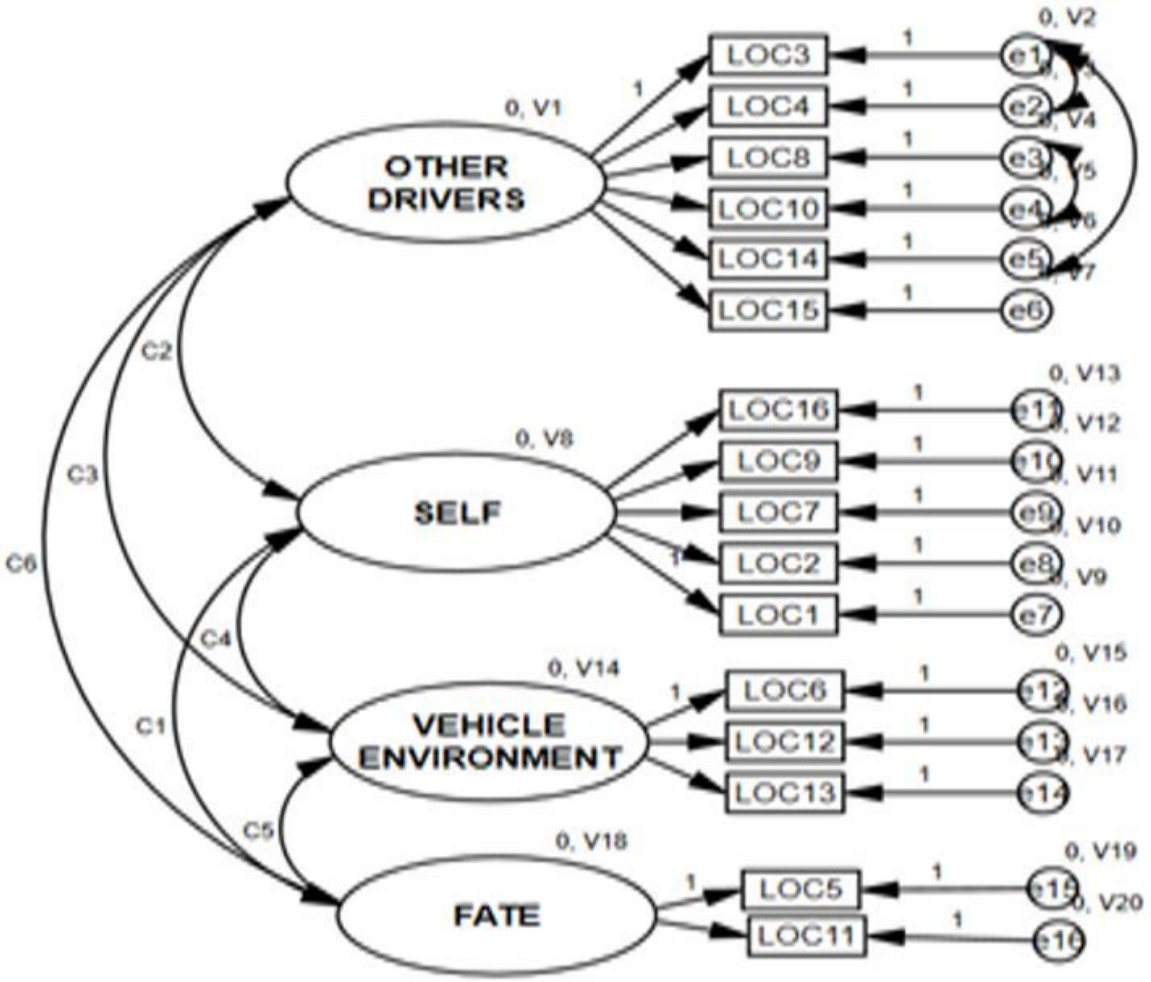

Figure 1

Multidimensional factor structure of the Arabic version of the Traffic Locus of Control (TLOC) scale