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Traffic locus of control scale – Romanian version: Psychometric properties and relations to the driver's personality, risk perception, and driving behavior

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ABSTRACT

The first aim of this research was to develop a valid and reliable tool for measuring traffic locus of control among Romanian drivers (T-LOC-RO). Second, we also wanted to assess the construct validity of the scale, as well as the relation with personality variables (honesty-humility, emotionality, extraversion, agreeableness, openness, conscientiousness), with specific traffic variables (personal driving style, sensation seeking in traffic situations, risk perception, risky behavior) and with two traffic outcomes (number of offences and produced accidents). Third, we proposed to identify subtypes of drivers based on their locus of control and the above mentioned variables. Two studies were conducted. In study 1, we assessed the factorial adequacy of the T-LOC-RO, as well as the relations with socio-demographic variables, in two different samples ($N = 1140$, $N = 1139$, respectively). Study 2 ($N = 1907$) tested the last two objectives. The results of the two studies supported the validity and reliability of this culture-specific version of the T-LOC-RO. In comparison to a previous version, the T-LOC-RO version addresses a supplementary dimension concerning religiosity as an external attribution that God can convey protection against accidents. Moreover, based on a cluster analysis, we identified high risk categories of drivers, corresponding to individuals with a medium and high external locus of control, as well as with a low level of internal locus of control. The results are discussed from the perspective of their implications for traffic behavior and accident involvement.

1. Introduction

In 2013 there were 1861 reported road traffic fatalities in Romania which translates into an 8.7 estimated death rate per 100,000 population (World Health Organization, 2015). With 91 dead per million inhabitants, Romania ranks among the European countries with the highest road fatality rate, and had the second highest fatality rate among the EU-28 member states in 2014 (European Commission, 2015). The high rate of accident involvement persists in spite of the strictness of Romania's road legislative enforcement. Since the human factor accounts for approximately 90% of accidents (Rumar, 1985), studying it can help practitioners to develop effective road safety interventions. Previous studies showed that traffic locus of control (T-LOC), representing the attributions that drivers make for the outcomes of the situations that they

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experience in traffic, is a key human factor that influences safe driving behavior (Holland, Geraghty, & Shah, 2010; Lheureux, Charlois, Auzoult, & Minary, 2015; Sarma, Carey, Kervick, & Bimpeh, 2013; Özmen & Sümer, 2011). However, the role of locus of control (LOC) was not explored among Romanian drivers. This research was designed to develop an effective tool for measuring T-LOC for Romanian drivers and to assess the relation between this construct and other relevant driving variables and outcomes, like driving style, driving behavior, accident involvement, and traffic offences.

1.1. Locus of control

The concept *locus of control (LOC)* was proposed by Rotter (1954) in social learning theory. The individuals with external LOC tend to consider other people or circumstances responsible for the occurrence of positive or negative life events, while the individuals with internal LOC take own responsibility and often choose to rely on their personal abilities in a variety of situations (Hennessy, 2011; Rotter, 1954). Since Rotter first proposed this concept, it has been widely used in a variety of domains, such as: personality psychology (e.g. Judge, Erez, Bono, & Thoresen, 2002), health psychology (e.g. Chaplin et al., 2001; Luszczynska & Schwarzer, 2005), aging research (e.g. Lachman, 1986), risky behavior of adolescents and young adults (e.g. Wilkinson, 2007; Özmen & Sümer, 2011) or driving behavior (e.g. Özkan & Lajunen, 2005).

Several changes can be identified about the way researchers measure this concept. First, according to the initial unidimensional approach of the construct, internal and external LOC exist on opposite ends of a continuum and a person holds either internal or external LOC (Rotter, 1966, 1975). Subsequent research showed that this conceptualization is too simple to explain people's attributions in a variety of settings. For example, external LOC is composed of several dimensions like chance or luck and other people (Wilkinson, 2007). Second, LOC began to be treated as a domain-specific construct (Lachman, 1986; Lefcourt, 1991), and consequently different LOC scales have been developed within specific domains, such as health, safety, work, career development, and driving (Huang & Ford, 2012; Özkan & Lajunen, 2005). Concerning the situational vs. dispositional nature of LOC, researchers began to sustain its situational character (Luszczynska & Schwarzer, 2005).

1.2. Traffic locus of control, risk perception, and driving behavior

Based on Rotter's (1966) scale of Internality-Externality (I-E), Montag and Comrey (1987) developed the first instrument with two separate scales for measuring driving internality (DI) and driving externality (DE). Almost two decades later, Özkan and Lajunen (2005) developed a 16-item traffic locus of control (T-LOC) scale, with four dimensions: self (equivalent to internal LOC), other drivers, vehicle/environment, and fate. The last three dimensions represent the external T-LOC. They argued that individuals with internal T-LOC often choose to rely on their personal abilities rather than on a safe environment or technological device when driving. In contrast, individuals with external T-LOC tend to perceive driving outcomes as the result of external factors, such as other drivers, luck, fate, and vehicle (Özkan & Lajunen, 2005). T-LOC is a malleable factor, which can be changed through education (Huang & Ford, 2012) and may therefore have important implications for driver training (Stanton, Walker, Young, Kazi, & Salmon, 2007). Two studies have shown that an advanced driver coaching system based on a model of response to hazards is able to improve the drivers' situation awareness, driving skills, to reduce attributions of external locus of control and to increase the internality (Huang & Ford, 2012; Stanton et al., 2007).

Previous studies have shown that T-LOC predicts which drivers will adopt risky behaviors and will be involved in traffic accidents (Gidron, Gal, & Desevilya, 2003; Huang & Ford, 2012). One line of research on the relation between T-LOC and traffic outcomes suggested that externally oriented people are more prone to adopt risky behaviors and to cause motor vehicle accidents (Montag & Comrey, 1987). A possible explanation is that these individuals are less careful and take less precautions to prevent traffic accidents (Knapper & Crowley, 1978; Montag & Comrey, 1987). In addition, internal T-LOC was associated with the tendency to take precautionary measures, to be alert and careful, to perceive risks, and to be involved in less traffic accidents (Lajunen & Summala, 1995; Rudin-Brown & Parker, 2004).

Conflicting results have also been reported: on the one hand, some studies show a positive association between external T-LOC and risk perception, and a negative association between external T-LOC and risky driving behavior (Alper & Özkan, 2015; Carpentier et al., 2014; Warner, Özkan, & Lajunen, 2010). On the other hand, internal T-LOC was positively associated with risky driving and accident involvement (Arthur & Doverspike, 1992; Warner et al., 2010; Özkan & Lajunen, 2005). These results can be explained by the fact that drivers with an internal T-LOC have a greater confidence in their own ability to avoid an accident and can even overestimate their own driving skills (Arthur & Doverspike, 1992). Other studies did not find any significant association between T-LOC and risky driving behavior (Iversen & Rundmo, 2002), suggesting that the relation between T-LOC and driving behavior is not always clear and the evidence on the relation between T-LOC, risk perception, and risky behavior is somewhat mixed. Therefore, the question about the role of LOC in risky driving behavior is still open.

1.3. Locus of control and its relation with personality and personal driving style

Previous studies on the topic LOC and personality showed that internality is positively related with conscientiousness, extraversion, openness, but negatively related with stress (Judge et al., 2002). With respect to T-LOC, driving internality was negatively associated with driving anger, anxiety, aggression, and sensation seeking, whereas driving externality was positive associated with these variables (Lucidi et al., 2010). Moreover, previous studies found that higher levels of external

T-LOC (other drivers and environment) were associated with lower levels of normlessness (Sarma et al., 2013) and altruism (Marengo, Settanni, & Vidotto, 2012), whereas higher levels of internal T-LOC were associated with higher levels of excitement, anger, normlessness, impulsiveness, and well as with lower levels of extraversion (Sarma et al., 2013).

Studies on the relationship between LOC and driving styles have reported mixed findings. Several researchers have suggested that an external LOC is related to a lack of caution and failure to take precautionary actions to avoid the occurrence of unfavorable outcomes, showing that driving internality was linked to careful driving, whereas driving externality was positively associated with involvement in fatal accidents (Montag & Comrey, 1987). Other researchers suggested that due to drivers' beliefs in their own ability to avoid an accident, increased internal LOC has been associated with risky driving style (Holland et al., 2010). Moreover, drivers' with external LOC scored higher on dissociative, anxious and distress-reduction styles (Holland et al., 2010) suggesting the fact that those with more external LOC may experience greater accident risk (Taubman-Ben-Ari, Mikulincer, & Gillath, 2004).

1.4. Aims of the present research

The present research has three objectives. The first one is to develop and assess the psychometric properties (reliability and factorial structure) of a Romanian version of the traffic locus of control scale (T-LOC-RO). Our second objective is to assess the construct validity of the scale and its associations with risk perception and risky driving behavior. We evaluated the construct validity of the scale through its associations with a set of personality traits which have already been found to be related to LOC in other cultural contexts, namely extraversion, conscientiousness, agreeability, emotionality, openness, as well as with personal driving style (e.g. Judge et al., 2002; Lucidi et al., 2010; Sarma et al., 2013). The third objective is to provide a typology of Romanian drivers, based on their T-LOC and the presence of other personality variables and traffic related variables.

In order to assess these objectives, two studies were conducted. The first study was designed to develop a Romanian version of the T-LOC and to examine its factorial structure, reliability, gender differences, and associations with sociodemographic variables. The second study addressed the last two objectives.

2. Study 1

The aim of Study 1 was to build an adapted version of the Traffic Locus of Control scale for use in the Romanian population (T-LOC-RO) and to investigate its reliability and factorial structure. This objective relies on several reasons. First, previous studies conducted in other areas have shown that, when studying LOC, the most accurate results can be achieved by tailoring the construct more specifically to the targeted behaviors rather than by using general measures (Lefcourt, 1991). Second, only one scale measures LOC in traffic (Özkan & Lajunen, 2005). As the authors said, the sample used to develop and assess the psychometric properties of that scale is comprised by young drivers with relatively short driving history, is relatively male-dominant and all respondents were university students. Hence, the sample of their study might not represent the driver population in terms of T-LOC orientation (Özkan & Lajunen, 2005). Third, the existing T-LOC scale could be incomplete in the Romanian driving context because driving-related behaviors have been shown to vary across countries (Nordfjærn & Rundmo, 2009; Şimşekoğlu et al., 2013). Concerning culture-specific conditions, previous research on Romanian samples suggested that certain religious beliefs and practices popular in the Romanian Christian-Orthodox culture (e.g. having a holy object in the vehicle, performing a short symbolic religious ritual before starting a long journey) are thought to confer divine protection against accidents (e.g. God takes care of me and protects me from road accidents) (Havârneanu, 2011; Havârneanu, 2012). Özkan and Lajunen (2005) did not include a measure of religiosity, but suggest that religiosity is a component part of Fate dimension. We disagree with this assumption and consider that by taking into account the socio-cultural driving context and by including some items that measure religiosity, we will enhance the content validity of the scale and will develop a valuable tool to assess T-LOC among Romanian drivers.

Our hypothesis was that the factorial structure that would emerge would be similar to the one identified by Özkan and Lajunen (2005), but with a culture specific addition in terms of the religiosity. This type of T-LOC constitutes a distinct Romanian T-LOC dimension, besides those addressed in the original T-LOC scale. We also considered that Fate and Luck represent two separate factors. The former refers to predetermined causes related to one's destiny, while the latter to occasional hazards such as the bad luck that may cause an accident, as well as the good luck that may prevent one from injury. The second aim of Study 1 was to test the factorial structure that emerged from the previous study through confirmatory factor analysis. We also studied the relation between T-LOC-RO factors and sociodemographic variables, namely gender, age, number of years since obtaining the driving license, the overall number of kilometers, and the number of kilometers from the last year.

2.1. Method

2.1.1. Participants and sampling

We developed a sampling scheme based on gender and age in order to cover balanced numbers of men, women, young, adult, and old drivers. To increase the validity of the study, we used two different samples: one for the exploratory factor analysis (EFA) and one for the confirmatory factor analysis (CFA). Field operators were instructed to identify among personal

acquaintances at least 12 drivers that would each correspond to a combination of age and gender criteria. The field operators contacted the potential participants at their homes, informed them about the scope of the study, and then asked for their consent to participate in the study. From the initial sample of 1218 Romanian drivers, 78 people (6.34%) declined their participation after being presented the questionnaire or provided incomplete data. The remaining sample consisted of 1140 participants who completed the T-LOC-RO (*Mage* = 36.98; *SD* = 14.97; 53.2% women). The participants had been driving for 12.16 years on average (*SD* = 10.58 years) and they reported that they had been involved in .36 active accidents (range 0–12, SD = .93), and in .80 passive accidents (range 0–24, SD = 1.85) on average in a lifetime period.

To assess the factorial structure through confirmatory factor analysis, 1202 participants were included, but 63 refused to complete the task. The final sample consisted of 1139 participants, all of them drivers with a mean of 12.27 years since obtaining the driving license (*SD* = 10.86). The age ranged from 18 to 82, with a mean age of 37.79 (*SD* = 13.99), and 51.4% were men. The participants reported that they had been involved in .45 active accidents (range 0–10, *SD* = 1.03) and in .79 passive accidents (range 0–30, *SD* = 1.94) on average in a lifetime period. In both samples of Study 1 there was a high heterogeneity concerning the participants' occupation.

2.1.2. Measures

The *Traffic Locus of control scale – Romanian version* (T-LOC-RO) was developed from two existing instruments for measuring LOC. First, we included the four factors from the *Multidimensional Traffic Locus of Control Scale* (T-LOC) (Özkan & Lajunen, 2005): "Self" (i.e. causes of accidents attributed to oneself; 5 items), "Other Drivers" (i.e. causes of accidents attributed to other drivers; 6 items), "Vehicle and Environment" (i.e. causes of accidents attributed to external factors; 3 items), and "Fate" (i.e. causes of accidents attributed to fate or bad luck; 2 items). Since the original T-LOC has a relatively low number of items per scale, we also adapted and included relevant items from the *Army Locus of Control Scale* (Army-LOC) developed for army aviators (Hunter & Stewart, 2012). In this process we separated "Fate" (e.g. If an accident is to happen we cannot do anything to prevent it) from "Luck" (e.g. Successful driving is partly a matter of good luck). Furthermore, we added a subscale named "Religiosity" (i.e. the external attribution that God can convey protection against accidents), based on two exploratory studies previously conducted on Romanian drivers (Havârneanu, 2011; Havârneanu, 2012). Finally, the T-LOC-RO included a group of additional items aiming to indicate honest responses (e.g. I always stick to the speed limits; When the traffic lights change from green to yellow I always slow down and stop, etc.). The items adapted from T-LOC and Army-LOC were translated from English into Romanian using the back-translation method. Two researchers independently reviewed all the draft items and assigned them to one of the seven scales: Self, Other drivers, Vehicle and environment, Fate, Luck, Religiosity, and Honesty. The items that created disagreements between the two reviewers were either rephrased or eliminated. The final T-LOC-RO Scale included 83 items.

2.1.3. Procedure

The study was approved by the Research Ethics Committee of Al. I. Cuza University. The potential participants were contacted at their homes and were informed about the scope of the study and the confidentiality of the responses, and then asked for their consent to participate in the research. An informed consent was obtained from all participants. The average time for completing the scale was 30 min. At the end, a demographic questionnaire, assessing age, gender, number of accidents (passive and active) involvement, and total mileage was completed.

2.2. Results

2.2.1. Exploratory factor analysis

We submitted our extended set of 83 T-LOC-RO items to an exploratory factor analysis, using primary axis (PA) extraction and Oblium Rotation. Factor loadings higher than .40 were used as item selection criterion.

Parallel analysis informed us that six factors surpassed the PA criterion, which explained 43.6% of the total variance. We analyzed both the structure matrix and the pattern matrix coefficients, in order to select the items for their factorial assignment. Both analyses yielded the same results in terms of the higher factor coefficient for each of the items selected. The loadings of the 41 remaining items on each of these factors are presented in Table 1. In addition, 9 items measured the tendency to give desirable answers. This subscale was proposed as an additional tool to help researchers identify (and eventually exclude from the study sample) those respondents who show a high tendency to give socially desirable answers.

The first factor explains 14.08% of the total variance and consists of 16 items measuring *luck/ fate*. The second factor includes eight items and explains 11.98% of the variance. We labeled this factor as *religiosity,* since all its items denote a person's tendency to believe that God may protect the driver from harmful traffic situations. The third factor explains 7.54% of the variance and consists of six items describing the tendency to attribute the responsibility for what is happening in traffic to *other drivers*. The fourth factor explains 5.18% of the variance and has five items, all measuring an *internal locus of control*. The fifth factor explains 4.82% of the variance and includes six items, representing the tendency to attribute the cause of accidents to the *vehicle and environment*.

2.2.2. Reliability analyses and inter-correlations between factors

Reliability estimates are presented in Table 2. The α-values obtained on the present sample ranged in the following interval [.62, .92], indicating good to excellent internal consistency. Skewness [−.93, −.03] and kurtosis [−.90, .97] estimates for

Table 1
Exploratory factor analysis of the traffic locus of control – Romanian version.

Items	Factor loading						M	SD	Item test
	1	2	3	4	5	6			
Destiny/luck									
1 (40). Avoiding a road accident depends on my luck	.742						2.26	1.18	.58
2 (24). Being injured in crash is a matter of destiny	.737						2.39	1.22	.57
3 (31). One's destiny decides who will be involved in an accident	.730						2.20	1.18	.57
4 (68). Each driver is more or less lucky and this can make the driver more accident prone	.720						2.34	1.20	.56
5 (19). Luck has an important role in deciding whether I am involved in an accident	.720						2.28	1.17	.54
6 (52). One will become the victim of a traffic accident only if this is the forecasted destiny	.715						2.10	1.17	.56
7 (33). My involvement in a traffic accident depends on my bad luck	.714						2.19	1.19	.57
8 (66). Every driver has his own destiny which includes more or less accidents	.708						2.43	1.29	.56
9 (47). Should I have a traffic accident, it would occur only if I was stuck by bad luck	.703						2.16	1.15	.51
10 (10). The destiny decides whether some people experience traffic accidents and others not	.685						2.34	1.24	.50
11 (45). During a risky traffic situation, I trust that the chance is on my side	.649						2.54	1.24	.50
12 (38). If an accident is to happen, we cannot do anything to stop it	.602						2.55	1.32	.42
13 (17). I will not experience any accidents unless it is "written in the stars"	.598						2.14	1.24	.42
14 (12). Suffering injuries during a car crash is determined by chance	.598						2.76	1.27	.37
15 (5). Avoiding a road accident is largely a matter of luck	.573						2.08	1.15	.33
16 (3). Being "in the wrong place at the wrong moment" decides whether a driver produces an accident or not	.515						2.06	1.17	.29
Religious beliefs									
17 (7). The holy tokens in my car protect me from accidents		.741					2.54	1.32	.65
18 (14). A "holy" car (blessed by a priest) keeps you away from unwanted events in traffic		.739					2.63	1.34	.67
19 (21). Having a small cross or icon in my car protects me while driving		.738					2.60	1.31	.71
20 (63). People who have a cross or icon in their car experience less severe accidents		.725					2.44	1.26	.66
21 (56). Drivers who had their car blessed by a priest experience less severe accidents		.714					2.53	1.29	.65
22 (28). Before I leave on a journey, I make the cross sign with my fingers		.701					3.09	1.49	.59
23 (35). Before I leave on a long journey I say "God help me!" in order to be protected		.683					3.23	1.45	.57
24 (49). I feel that God cares for me and protects me from traffic accidents		.636					3.40	1.35	.52
Desirability									
25 (18). I have always respected the rules imposed by the Traffic Code			.778				3.00	1.33	.61
26 (11). I have never broken the traffic rules			.750				2.55	1.34	.57
27 (25). I have never driven over a continuous line marking the middle axis of the road			.693				2.63	1.44	.48
28 (4). I always stick to the speed limits			.680				3.61	1.15	.47
29 (46). I always brake down and stop when I see a traffic light changing from green to yellow			.561				3.82	1.17	.35
30 (53). I always use the directional blinking light to signal that I want to change the driving direction			.499				4.28	1.02	.29
31 (39). I have never got mad at another road user			.496				2.00	1.27	.27
32 (32). In traffic I am always polite even with the persons who do not deserve it			.454				3,45	1.14	.27
33 (67). I always recall very well the last traffic sign that I saw			.449				3.45	1.20	.30
Other drivers									
34 (73). Road accidents could be avoided especially if the other road users behaved safer				.699			4.35	.77	.50
35 (74). Traffic accidents are caused by the other drivers' lack of responsibility				.678			4.32	.81	.48
36 (71). Road accidents result from the other drivers' mistakes				.659			3.87	.92	.45
37 (72). The other road users would avoid causing accidents if they paid more attention to the potential hazards				.657			4.37	.74	.47
38 (62). Traffic crashes occur because the other drivers do not care about road safety				.610			4.00	.96	.42
39 (55). Most accidents are caused by the carelessness of other drivers				.607			4.09	.90	.39
Internality (Myself)									
40 (23). My own risky driving behavior could cause an accident					.789		4.00	1.20	.63
41 (9). The high speed I drive at can be the cause of a car accident					.747		4.13	1.10	.57
42 (30). My lack of driving skills could produce an accident					.730		3.75	1.31	.56
43 (2). The risky overtaking maneuvers that I initiate may lead to accidents					.711		4.46	.96	.51
44 (51). Traffic accidents can result from my own driving errors					.555		3.67	1.17	.35

(*continued on next page*)

Table 1 (*continued*)

Items	Factor loading						M	SD	Item test
	1	2	3	4	5	6			
Vehicle and environment									
45 (57). The underdeveloped road infrastructure is an important cause of traffic accidents						.697	4.23	.92	.52
46 (50). The presence of carriages and other unmarked vehicles is an important cause of accidents						.662	4.31	.92	.46
47 (43). The presence of animals (dogs, sheep, horses, cows etc.) on the roadway is an important cause of accidents						.626	4.22	.93	.42
48 (22). If the public roads were of a better quality, there would be less traffic accidents						.597	4.37	.89	.37
49 (29). Traffic accidents are usually caused by unsafe or poorly maintained cars						.490	3.61	1.10	.31
50 (64). There would be fewer accidents if the road signage was better						.482	4.13	.90	.34

Table 2
Summary statistics for the Traffic Locus of Control – RO factors.

T-LOC-RO factors	Number of items	Cronbach's	Min	Max	Mean	SD	Skewness	Kurtosis
Destiny-Luck	16	.927	1	5	2.31	.83	.27	−.75
Religiosity	8	.913	1	5	2.81	1.07	−.03	−.90
Desirability	9	.786	1	5	3.20	.75	−.04	−.60
Other drivers	6	.762	1	5	4.17	.57	−.70	.71
Internal locus of control	5	.627	1	5	4.01	.72	−.93	.51
Vehicle and environment	6	.703	1	5	4.15	.60	−.83	.97

Table 3
Correlation matrix for the Traffic Locus of Control – RO.

	Religiosity	Desirability	Others	Internal locus of control	Vehicle and environment
Destiny-Luck	.62**	.10*	.09**	−.07*	.09*
Religiosity		.15**	.11**	.01	−.19**
Desirability			.21**	.14**	.18**
Other drivers				.24**	.41**
Internal locus of control					.27**

Note:
** $p < .01$.
* $p < .05$.

the five factors allowed the use of parametrical correlational analyses. As can be seen in Table 3, the correlations between factors ranged from .01 to .62, most of them being statistically significant ($p < .001$).

2.2.3. Confirmatory factor analysis

In order to test the factorial structure of the T-LOC-RO, the 41-item version of T-LOC-RO obtained after exploratory factor analysis was administered to a different sample of participants. The average response time was 20 min.

We employed an order confirmatory factor analysis using maximum likelihood estimation via AMOS 22.0. In each factor, one of the target loadings was fixed to 1, while the others were freely estimated, as were the factor variance and covariance, and the error terms. All other parameters were fixed to 0. Estimates were derived using maximum likelihood estimations and an overall model fit was assessed with the normative fit index (NFI), goodness of fit (GFI), the comparative fit index (CFI) and the root mean square residual (RMSEA). Acceptable model fit indices were indicated by a $\chi^2/df < 3$, a GFI, NFI, and CFI > .90, and a RMSEA < .08 (Hu & Bentler, 1999). We also analyzed the squared multiple correlations of each item and the model misspecification indexes – the covariance and the modification indexes.

The model fit of the data analysis were $\chi 2\ (725) = 1906.917$, $\chi^2/df = 2.63$, $p < .01$; NFI = 0.903, CFI = .937, GFI = .920, AGFI = .910, RMSEA = .038, 90% CI [.036, .040]. These values are in line with the joint fit criteria (Hu & Bentler, 1999), therefore we considered this model to fit the data adequately. The squared multiple correlations varied between .207 and .751. The estimated factor loadings and factor correlations were similar to the results of the primary axis extraction performed in the first study.

2.2.4. T-LOC-RO 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 ($F\ [1, 1138] = 12.39$, $p < .001$, $\eta_p^2 = .21$) or to the vehicle and environment ($F\ [1, 1138] = 6.98$,

Table 4
Traffic locus of control – RO scales by gender.

MDSI-RO factors	Gender	N	Mean	SD	F(1, 1138)	Cohen's d
Destiny-Luck	Women	534	2.36	0.85	4.62**	.13
	Men	606	2.26	0.82		
Religiosity	Women	534	2.86	1.04	2.02	.08
	Men	606	2.77	1.94		
Desirability	Women	534	3.31	.75	19,63***	.26
	Men	606	3.11	.75		
Other drivers	Women	534	4.11	.60	12.39***	−.21
	Men	606	4.23	.55		
Internal locus of control	Women	534	3.98	.74	1.70	−.08
	Men	606	4.03	.71		
Vehicle and Environment	Women	534	4.10	.59	6.98***	−.16
	Men	606	4.19	.60		

Note:
*** $p < .001$.
** $p < .05$.

$p < .001$, $\eta_p^2 = .16$), while women believed more in fate and luck (F [1, 1138] = 4.62, $p < 0.001$, $\eta_p^2 = .13$). Considering religiosity and internal locus of control, the results did not reveal significant differences between men and women. These results are presented in Table 4.

We also examined the relations between T-LOC-RO and age, number of years since obtaining the driving license, the overall number of kilometers, and the number of kilometers from the last year. Pearson correlations revealed that *fate* is positively associated with age ($r = .14$, $p < .001$) and number of years since obtaining the driving license ($r = .10$, $p < .001$). *Religiosity* is also positively associated with age ($r = .12$, $p < .001$) and number of years since obtaining the driving license ($r = .11$, $p < .001$), as well as with the number of kilometers from the last year ($r = .08$, $p = .003$). *Other drivers* and *self* are positively associated with age ($r = .06$, $p = .042$; $r = .13$, $p < .001$) and number of years since obtaining the driving license ($r = .06$, $p = .036$; $r = .11$, $p < .001$). Finally, *vehicle/ environment* is positively related with all the variables included in the analysis: age ($r = .20$, $p < .001$), number of years since obtaining the driving license ($r = .21$, $p < .001$), the overall number of kilometers ($r = .09$, $p = .001$), and the number of kilometers from the last year ($r = .12$, $p < .001$). Based on Cohen's (2013) criteria for magnitude of effect sizes, the results revealed small to medium effect sizes.

2.3. Discussion

Our findings indicate that the T-LOC-RO has adequate psychometric properties, revealing good to excellent reliabilities. In general, the factorial structure of the T-LOC-RO is comparable to the original version (Özkan & Lajunen, 2005), revealing all the four dimensions: internal locus of control, others, fate/ luck, and vehicle/ environment.

As in T-LOC (Warner et al., 2010; Özkan & Lajunen, 2005) and contrary to our expectations, the items from *luck* and *destiny* dimensions formed a single factor. In addition to the four dimensions, our factorial solution includes one more factor: religiosity. Therefore, T-LOC-RO comprises five dimensions measuring internal and external traffic LOC. The correlations between internal and external T-LOC factors were low to moderate, as in previous studies on T-LOC scales development (Montag & Comrey, 1987; Özkan & Lajunen, 2005). The religiosity factor is consistent with the findings from two previous pilot studies conducted on Romanian drivers (Havârneanu, 2011, 2012) who were questioned about their religious practices in traffic: 78.7% of the respondents reported that they make a cross sign before they leave for a long journey, 76.4% that they have a religious object in their car (crosses, icons, etc.), and 48.1% have taken their car to the church in order to turn it 'holy'. Surprisingly, only 8.3% of the responding drivers had of a non-religious protective object in their cars, such as talismans or amulets, considered to have protective power. These preliminary results suggested a high preference for religious practices as means of protection against accidents. Its multidimensional structure is statistically supported by satisfactory fit indices. Overall, although the T-LOC-RO presents some variations from the previous scale in the item content and in the factorial structure, as our study highlights the presence of the religiosity dimension, the factorial solution of the T-LOC-RO matches the meaning of the four broad facets of T-LOC scale originally proposed by Özkan and Lajunen (2005).

Our results showed that men reported a higher tendency to attribute the responsibility for different driving situations to the other drivers or to the vehicle and environment, while women believe more in fate and luck. In Özkan and Lajunen (2005), women scored higher than men on all the T-LOC factors. Considering religiosity and internal LOC, our results did not reveal significant differences between men and women. Concerning religiosity, a culture specific factor, these results may suggest that it is equally important for both female and male Romanian drivers. In addition, this scale has one of the highest internal consistencies, which justifies psychometrically its inclusion in the instrument. A previous study about health locus of control also showed that religiosity is considered an important source of influence in one's life (Chaplin et al., 2001). The predictive validity of this scale should be further assessed in studies focused on its relation with traffic outcomes.

Our results also showed that Romanian drivers make more attributions for car accidents, both internal and external, when their age and mileage are higher. These results can be explained by the fact that with an increased age and driving experience, the driving situations encountered are more various and this can help drivers to make more attributions for accidents involvement. Moreover, it is possible that drivers with a higher experience (and implicitly higher exposure) have a greater history of car accidents and respond to T-LOC-RO based on their life experiences that allowed them to make more attributions for causes of personal crash involvement. A previous study found that past exposure to road risks situations affects the explanations drivers give to traffic accidents. Specifically, professional drivers with high driving experience have a higher tendency to ascribe accidents to external factors (Kouabenan, 2002). The distinction between minor and major accidents may be useful in future studies. It is possible that more external causal attributions are made for major accidents in order to maintain self-esteem, while more internal attributions are made for minor accidents (Kouabenan, 1985; Montag & Comrey, 1987). Moreover, the driver's blame (active vs. passive accidents) may be responsible for different type of attributions. In a previous study, involvement in active accidents was associated with internality (Özkan & Lajunen, 2005). These factors should be considered in future studies, in order to understand what factors actually moderate the relation between T-LOC and the driver's age or mileage.

Since the results of the first study supported the factorial structure of the T-LOC-RO, a second study was conducted in order to examine the construct and external validity, by investigating the relationships between its subscales and relevant personality and traffic variables.

3. Study 2

The aim of this study was threefold. First, we aimed to assess the convergent and discriminant validities of the T-LOC-RO by analyzing the relation between its dimension and a set of relevant variables: honesty-humility, emotionality, extraversion, agreeableness, openness, conscientiousness, personal driving style, and sensation seeking in traffic situations. Personal driving style is defined as the way the driver chooses to drive habitually (Taubman-Ben-Ari & Skvirsky, 2016) and traffic sensation seeking refers to driver's tendency to obtain enjoyment through risk-taking driving behaviors (Matthews, Desmond, Joyner, Carcary, & Gilliland, 1996). Second, we wanted to assess the relation between T-LOC dimensions and specific driving behaviors and outcomes (offences and active accidents), as well as risk perception, in order to test whether T-LOC can explain specific behaviors and outcomes in traffic. In our study, risky behaviors refer to: speeding, drunk-driving, not wearing seat belts, reckless driving, and general violation of other traffic rules. Additionally, risk perception was defined as the subjective evaluation of the probability that a specific event with negative consequences will occur in a traffic situation (Rosenbloom, Shahar, Elharar, & Danino, 2008). Third, we wanted to identify subtypes of drivers based on their T-LOC and the above mentioned variables. We decided to create separate clusters for men and women for three main reasons: (1) gender differences on T-LOC factors were revealed by Özkan and Lajunen (2005) and also by our first study; (2) as suggested by Ulleberg (2002), the inclusion of both males and females in a cluster analysis would make it inevitable to ask if the differences between clusters would be attributed to gender differences; and (3) previous traffic studies that attempted to create driver clusters based on various traffic variables obtained different percentages of males and females within clusters (Lucidi et al., 2010; Marengo et al., 2012).

3.1. Method

3.1.1. Participants

The sampling strategy is identical with that used in the first study. A number of 2002 participants were included, but 95 refused to complete the task. The final sample consisted of 1907 participants (*M*age = 37.68, *SD* = 13.78, 49.2% men). The participants reported that they had been involved in .37 active accidents (range 0–11, *SD* = .86), and .79 passive accidents (range 0–24, *SD* = 1.50) on average in a lifetime period. There was a high heterogeneity concerning the participants' occupation.

3.1.2. Measures

Locus of control scale – Romanian version with 41 items described in Study 1 was used.

Multidimensional Driving Style Inventory – Romanian version (Holman & Havârneanu, 2015), was used to assess the self-reported driving style. The instrument consists of 41 items assessing 7 driving styles: irrationality of norms (6 items), anxious (4 items), careful (7 items), risky (6 items), furious (8 items), stress reduction (4 items), and distract driving style (6 items). In our sample, Alpha Cronbach coefficients ranged from .64 to .79 for the seven dimensions. Answers were recorded on a 6-point scale ranging from 0 (never) to 5 (always).

Risk Perception Inventory (Rosenbloom et al., 2008) was used to assess the degree of risk perceived in different driving situations. The scale consists of 35 items forming a single total score. The participants rated the items on a 5-point scale ranging from 1 (not risky at all) to 5 (very risky). An average score was computed in our sample. Alpha Cronbach coefficient was .88.

Two scales aimed at measuring self-reported *risky driving behavior* were included (Iversen, 2004; Ulleberg & Rundmo, 2003). From the two scales, 18 items were selected, measuring five classes of risky behaviors: speeding, drunk-driving, not wearing seat belts, reckless driving, and violation of different traffic rules. We selected the items referring to the most

risky behaviors relevant for the Romanian context, and excluded safe behaviors (e.g. Drive below a speed limit of 30 mph). We also excluded the items describing behaviors which do not depend directly on the driver (e.g. Ride with a person you know has been drinking too much alcohol). The participants rated the frequencies of manifesting different behaviors, using a 6-point scale from 0 (never) to 5 (very often). A total score was computed with high scores indicating a high level of risky behavior. In our sample, the Alpha Cronbach coefficient was .84.

Driver Behavior Questionnaire – Romanian version (Havârneanu, Gheorghiu, & Hohn, 2010), was used to assess self-reported violations on the road (16 items), both aggressive and simple violations. Answers were made on a 6-point scale ranging from 0 (never) to 5 (nearly all the time) and an average score was computed. The internal reliability of the aggressive violations subscale was.79, whereas for the simple violations subscale .83.

The HEXACO Personality Inventory (Lee & Ashton, 2004) was used to assess the following personality dimensions: honesty – humility, emotionality, extraversion, agreeability, conscientiousness, and openness. The short form with 60 items was used (10 items for each factor). For the six factors computed in our sample, the Alpha Cronbach coefficients ranged from .66 to .70.

Traffic sensation seeking was assessed through the 8-item tool developed by Matthews et al. (1996). Participants rated their agreement with each item on a 6-point scale, ranging from "totally disagree" (1) to "totally agree" (6). Higher average scores indicate higher impulsive sensation seeking, defined as the willingness to seek excitement through risky behaviors. Alpha Cronbach in our sample was .91.

The *demographic questionnaire* asked participants to report their age, gender, their total mileage, the number of accidents they produced (i.e. active accidents) and the number of offences since they obtained the driving license.

3.1.3. Procedure

The participants were informed about the scope of the study, that their participation is voluntary and that the information is confidential. After signing the informed consent form they completed the self-report questionnaire. Only people with a valid driving license were included in the study. There was no other exclusion criteria or restrictions based on demographic variables. The average time to complete all the questionnaire was about 60 min.

3.2. Results

3.2.1. Traffic locus of control in relation to personality and driving style

To assess the relations between the study variables, Pearson correlations were computed. We also computed partial correlations between all the variables, controlling for age, gender, educational level, and years of driving. The significant correlations are discussed below.

Concerning the relations with Hexaco personality factors, the results showed that *destiny/luck* is positively associated with emotionality and negatively associated with openness. *Religiosity* is positively associated with emotionality, and negatively associated with honesty-humility and conscientiousness, but the correlations are very low. Further, *other drivers* is the dimension of external T-LOC that negatively correlated with honesty-humility and emotionality, and positively correlated with extraversion, agreeableness, and conscientiousness. *Vehicle/environment* is positively associated with emotionality and negatively associated with openness. The total score at external T-LOC correlates positively with emotionality and extraversion, and negatively with openness. *Internal T-LOC* is positively associated with emotionality and negatively associated with conscientiousness and openness. We can observe that all the correlations are low. Table 5 displays the pattern of correlations between the variables.

Concerning the driving styles, despite the small relations the results showed that external T-LOC is positively associated with the careful, risky, and angry driving style, while internal T-LOC is positively associated with the patient, angry, and dissociative driving style (see Table 6).

3.2.2. Traffic locus of control in relation to driving behavior, risk perception and traffic sensation seeking

The relations between the dimensions of T-LOC, driving behavior, risk perception, and sensation seeking are presented in Table 7. External T-LOC is positively associated with risk perception, and negatively with risky behavior. Internal T-LOC is also positively associated with risk perception, and negatively with risky behavior and sensation seeking in traffic.

3.2.3. Traffic locus of control, involvement in traffic crashes and offenses

Next, we examined the relation between T-LOC-RO factors and: (a) the number of traffic crashes caused by the participant; (b) the overall number of traffic offenses; and (c) the number of traffic offenses during the last year. Pearson correlation (see Table 8) showed that *religiosity* is positively related with the number of traffic offenses from the last year ($r = .04$, $p = .042$), although the relation is very low. *Other drivers* is also positively related with both the overall measure of traffic offenses ($r = .11$, $p < .001$) and with the number of traffic offenses from the last year ($r = .10$, $p < .001$). Therefore, the higher the tendency of a driver to consider other drivers responsible for producing a car accident, the higher the number of traffic offences. The other correlations are not significant.

3.2.4. Hierarchical regression analysis

Five separate hierarchical regression analyses were performed on the following outcome variables: risky behavior, risk perception, the total number of produced accidents, the total number of offences, and the number of the offences from

Table 5
Pearson and partial correlations between Traffic Locus of Control – RO and HEXACO personality factors scores.

	Honesty humility	Emotionality	Extraversion	Agreeableness	Conscientiousness	Openness
Destiny-Luck	−.009	.182**	−.011	.033	−.039	−.084**
	−.039	.189**	−.009	.012	−.061**	−.085**
Religiosity	−.075**	.146**	.025	−.016	−.050*	−.043
	−.090**	.156**	.024	−.029	−.062**	−.041
Other drivers	−.093**	−.176**	.192**	.047*	.074**	.015
	−.069**	−.121**	.192**	.052*	.086**	.033
Vehicle and environment	.042	.217**	−.021	.037	−.013	−.150**
	.003	.210**	−.015	.015	−.038	−.154**
Externality total score	.034	.128**	.054*	.035	−.007	−.094**
	.056*	.147	.057*	.018	−.023	−.089**
Self	.025	.156**	−.025	−.005	−.061**	−.071**
	.001	.159**	−.025	−.024	−.080**	−.075**
Desirability	−.021	.141**	.010	.004	−.024	−.121**
	−.049*	.151**	.013	−.016	−.046*	−.122**

Note. Pearson correlations on the first row and partial correlations (controlling for age, gender, educational level and years of driving) on the second row.
** $p < 0.01$.
* $p < 0.05$.

Table 6
Pearson and partial correlations between Traffic Locus of Control – RO and MDSI-RO factors.

	Irrational norms violation style	Anxious	Patient and careful	Risky	Angry	Distress-reduction	Dissociative
Destiny-Luck	−.056*	.034	.120**	.025	.082**	−.020	−.070**
	−.022	.045	.086**	.065**	.114**	.033	.081**
Religiosity	.033	.019	.050*	.085**	.145**	.036	.065**
	.050*	.026	.027	.107**	164**	.071**	.075**
Other drivers	.069**	−.139**	.084**	.193**	.150**	.056*	−.216**
	.048*	−.115**	.090**	.174**	.134**	.071**	−.189**
Vehicle and Environment	−.097**	.042	.118**	−.014	.032	−.033	.061**
	.048*	−.115**	.090**	.174**	.134**	.071**	−.189**
Externality total score	−.026	−.011	.122**	.086**	.123**	.007	−.004
	−.003	.005	.091**	.118**	.148**	.057**	.012
Self	−.040	.014	.126**	.014	.049*	.009	.062**
	−.012	.023	.099**	.045*	.075**	.049**	.069**
Desirability	−.035	.005	.099**	.036	.094**	−.014	.027
	−.003	.018	.065**	.073**	.123**	.038	.039

Note. Pearson correlations on the first row and partial correlations (controlling for age, gender, educational level and years of driving) on the second row.
** $p < 0.01$.
* $p < 0.05$.

Table 7
Pearson and partial correlations between Traffic Locus of Control – RO, DBQ, risk perception, risk behavior and seeking sensations.

	Inattention	Lapse	Mistake	Simple violation	Aggressive violation	Risk perception	Risk behavior	Sensations seeking
Destiny-luck	−.013	.054**	−.037	.007	.001	.183**	−.094**	−.073**
	.018	.068**	.014	.025	.009	.158**	−.055**	−.010
Religiosity	.015	.059**	.003	.050*	.013	.113**	−.029	.022
	.032	.060**	.012	.065**	.016	.095**	−.008	.064
Other drivers	−.117**	.078**	.019	.053**	−.102**	−.037	−.013	.200**
	−.109**	−.081**	−.007	.032	−.104**	−.015	−.047*	.174
Vehicle and environment	−.020	.061**	−.036	−.023	.006	.136**	−.114**	−.134**
	.004	.069**	−.008	.010	.015	.101**	−.067**	−.060
Externality	−.044	.034	−.017	.018	−.025	.128**	−.087**	−.009
	−.018	.039	−.006	.039	.019	.108**	−.060**	.044
Self	−.008	.012	−.044	−.014	.001	.207**	−.098**	−.060**
	.017	.019	−.024	.007	.007	.190**	−.069	−.009
Desirability	−.014	.049*	−.020	.012	.005	.150**	−.078**	−.063**
	.016	.060**	.001	.042	.012	.123**	−.041	−.003

Note. Pearson correlations in the first row and partial correlations (controlling for age, gender, educational level and years of driving) in the second row.
** $p < 0.01$.
* $p < 0.05$.

Table 8
Pearson and partial correlations between Traffic Locus of Control – RO, traffic crashes caused by the participant, an overall measure of traffic offenses, and traffic offenses from the last year.

	Traffic crashes	Traffic offenses (overall)	Traffic offenses (last year)
Destiny-luck	.022	.017	.011
	.009	−.012	.014
Religiosity	.044*	.035	.047*
	.033	.015	.045*
Other drivers	.037	.112***	.102***
	−.003	.069**	.068**
Vehicle and Environment	−.004	−.026	−.027
	−.004	−.041	−.017
Self	.020	.007	.028
	.012	−.014	.031
Desirability	.034	.025	.009
	.019	−.007	.011

Note. Pearson correlations in the first row and partial correlations (controlling for age, gender, educational level and years of driving) in the second row.
*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

the last year. In each analysis, the age, last year mileage, number of years since obtaining the driving license, and sex were introduced into the model in the first step as controlled variables. The five subscales of T-LOC (Destiny-Luck, Religiosity, Other Drivers, Vehicle–Environment, and Self) were entered in the second step. Only the significant predictions are mentioned below.

After controlling for age, last year mileage, number of years since obtaining the driving license, and sex, the results showed that *Destiny-Luck* predicted risk perception ($\beta = .13$, $p = .003$). *Religiosity* predicted risky behavior ($\beta = .12$, $p < .001$), risk perception ($\beta = -.09$, $p = .012$), the total number of produced accidents ($\beta = .07$, $p = .050$), and the number of the offences from the last year ($\beta = .07$, $p = .037$). Further, *other drivers* predicted risk perception ($\beta = -.05$, $p = .034$), the total number of offences ($\beta = .06$, $p = .004$), and the number of the offences from the last year ($\beta = .06$, $p = .014$). *Vehicle-environment* predicted risky behavior ($\beta = -.11$, $p < .001$), the total number of offences ($\beta = -.09$, $p = .005$), and the number of the offences from the last year ($\beta = -.07$, $p = .027$). Finally, *self* scale predicted risky behavior ($\beta = -.07$, $p = .012$) and risk perception ($\beta = .16$, $p < .001$).

3.2.5. Cluster analysis to identify subtypes of drivers

A two-step cluster analysis (SPSS 22) was computed to identify sub-types of Romanian drivers. The analysis was based on scores from all the above presented variables, using the squared log-likelihood distance measure. The analysis identified three clusters for external T-LOC and three clusters for internal T-LOC (for low, medium, and high levels of T-LOC), separately for men and women, as the 'best' fit for the data based on Schwarz's Bayesian Criterion score and the largest ratio of log-likelihood distance measures (below 2). A multivariate factorial analysis of covariance (MANCOVA), controlling for age, last year mileage, and number of years since obtaining the driving license, was applied to examine whether the clusters differed on the number of produced accidents and offences (overall and during the last year). The clusters were then described using only those variables which scored high or low.

3.2.5.1. Cluster analysis for men. Concerning external T-LOC, the largest cluster is comprised by the men with a low level of external T-LOC (Cluster 1 – 42.6%). These participants can be described as having a low level of risky, angry, irrational, stress reduction, and anxious driving style, as well as a low level of risky behavior and traffic sensation seeking. They also can be described as having a high level of careful driving style, honesty-humility, conscientiousness, and risk perception. The clusters composed by the men with a medium (Cluster 2 – 28.1%) and with a high level of external LOC (Cluster 3 – 29.3%) are presented in Table 9.

The MANCOVA indicated significant differences between the three clusters concerning the number of contraventions from the last year ($F[2; 923] = 6.97$; $p < .001$) and the overall number of contraventions ($F[2; 923] = 4.57$; $p = .011$). The differences between the clusters concerning the number of active accidents is marginally significant ($F[2; 923] = 2.95$; $p = .053$]. The contrast results showed that individuals in Cluster 2 had significantly more offences (both the total number and the number from the last year) (total offences: $M = 5.42$, $SE = .53$; last year: $M = .51$, $SE = .04$) than the individuals in Cluster 1 (total offences: $M = 3.52$, $SE = .42$; last year: $M = .27$, $SE = .03$) and Cluster 3 (total offences: $M = 3.44$, $SE = .52$; last year: $M = .34$, $SE = .04$). There were no significant differences between Clusters 1 and 3 concerning the number of contraventions. Further, the results showed that individuals in Cluster 2 ($M = .66$, $SE = .06$) reported a higher number of active accidents than the individuals in Cluster 1 ($M = .45$, $SE = .05$).

The men with medium internal LOC (Cluster 2 – 43.5%) are characterized by a low level of risky driving, traffic sensation seeking, risky, irrational, angry, stress reduction, and anxious driving style. They also have a high level of honesty, agreeableness, conscientiousness, risk perception, and careful driving style. The clusters comprised by men with a low level (Cluster 1 – 28.1%) and men with a high level of internal LOC (Cluster 3 – 28.4%) are presented in Table 9.

Table 9
External LOC cluster differences on driving style, risk perception, risky driving, driver behavior, and personality.

	Men driver clusters (N = 929)			F (η^2)	Women driver clusters (N = 939)			F (η^2)
	1 (n = 261)	2 (n = 396)	3 (n = 272)		1 (n = 284)	2 (n = 450)	3 (n = 205)	
Driving style								
Irrationality of norm	3.92 (.84)	2.53 (.85)	2.66 (.95)	216.99** (.31)	2.62 (.97)	2.43 (.87)	3.72 (.88)	147.77** (.23)
Anxious	2.49 (.76)	2.03 (.71)	2.23 (.67)	32.34** (.06)	2.33 (.71)	2.34 (.77)	2.66 (1.18)	11.13** (.02)
Careful	4.50 (.63)	5.25 (.58)	5.39 (.47)	195.11** (.29)	5.29 (.53)	5.36 (.49)	4.37 (.76)	221.24** (.32)
Risky	3.57 (.77)	2.13 (.62)	2.46 (.76)	332.59** (.41)	2.18 (.72)	2.04 (.60)	3.33 (.96)	230.92** (.33)
Furious	3.74 (.71)	2.44 (.66)	2.70 (.73)	282.89** (.37)	2.53 (.78)	2.45 (.85)	3.46 (.76)	115.56** (.32)
Stress reduction	4.16 (.96)	3.47 (1.03)	3.55 (1.12)	38.66** (.07)	3.77 (1.06)	3.63 (1.09)	4.14 (.87)	16.88** (.19)
Distract	1.97 (.74)	1.55 (.51)	1.59 (.50)	41.18** (.08)	1.79 (.53)	1.76 (.54)	2.30 (.86)	56.83** (.03)
Risk perception	2.89 (.44)	3.20 (.45)	3.24 (.49)	46.14** (.09)	3.29 (.45)	3.35 (.47)	2.95 (.45)	53.92** (.10)
Risky driving behavior	1.90 (.54)	1.00 (.47)	1.03 (.46)	304.04** (.39)	.98 (.42)	.84 (.42)	1.75 (.59)	273.80** (.36)
Driver behavior								
Simple violations	2.28 (.70)	1.17 (.57)	1.27 (.62)	270.26** (.36)	1.20 (.61)	1.05 (.59)	2.06 (.73)	184.34** (.28)
Aggressive violations	1.05 (.67)	.41 (.40)	.51 (.43)	137.61** (.22)	.36 (.35)	.32 (.36)	.99 (.80)	141.48** (.23)
Personality factors								
Honesty – Humility	2.96 (.57)	3.57 (.56)	3.41 (.53)	96.06** (.17)	3.55 (.59)	3.64 (.57)	3.07 (.59)	68.49** (.12)
Emotionality	2.84 (.48)	2.98 (.51)	3.07 (.50)	14.07** (.02)	3.32 (.48)	3.33 (.50)	3.19 (.57)	5.73** (.01)
Extraversion	3.47 (.45)	3.46 (.51)	3.47 (.43)	.026 (.00)	3.43 (.50)	3.42 (.49)	3.47 (.51)	.756 (.00)
Agreeableness	2.95 (.54)	3.30 (.47)	3.29 (.49)	44.82** (.08)	3.25 (.49)	3.30 (.48)	2.93 (.50)	42.45** (.08)
Conscientiousness	3.27 (.50)	3.57 (.49	3.54 (.47)	32.53** (.06)	3.58 (.48)	3.59 (.51)	3.30 (.50)	26.81** (.05)
Openness	3.33 (.56)	3.50 (.50)	3.35 (.54)	10.88** (.02)	3.50 (.51	3.52 (.54)	3.46 (.62)	.957 (.00)
Traffic sensation seeking	6.06 (1.84)	2.81 (1.81)	3.11 (2.18)	246.31** (.34)	2.36 (1.94)	1.97 (1.70)	4.90 (2.09	181.38** (.27)

Note.
** $p < 0.01$.

The MANCOVA indicated significant differences between the three clusters concerning all the three dependent variables: the number of active accidents (F[2; 925] = 3.21; p = .041), the number of total contraventions (F[2; 925] = 3.69; p = .025), the number of contraventions from the last year (F[2; 925] = 6.61; p = .001). Specifically, the individuals in Cluster 1 had significantly more offences (total offences: M = 5.26, SE = .53; offences from the last year: M = .48, SE = .04) and active accidents (M = .64, SE = .06) than the individuals in Cluster 2 (total offences: M = 3.40, SE = .42; offences from the last year: M = .26, SE = .03; active accidents M = .43, SE = .05). There were no significant differences between Clusters 2 and 3.

3.2.5.2. Cluster analysis for women. The women with a low level of external LOC (Cluster 1 – 31.0%) have a low level of risky, safe, and stress reduction driving style, as well as lower levels of risk perception. They also have low levels of agreeability, and emotionality, whereas they manifest a higher level of risky behavior. The women with a medium level of external LOC (Cluster 2 – 32.9%) are characterized by a low level of risk perception and extraversion and by a high level of risky behavior, sensation-seeking, risky driving style, and conscientiousness. The women with a high level of external LOC (Cluster 3 – 36.1%) present lower levels of risky behavior and distract diving style. Moreover, they have high levels of angry, prudent, risky, and irrationality of norm driving style as well as high levels of risky perception, sensation seeking, and emotionality. These results are presented in Table 10.

The MANCOVA revealed significant differences between the three clusters concerning all the three dependent variables: the number of active accidents (F[2; 933] = 6.11; p = .002), the number of total contraventions (F[2; 933] = 9.64; p < .001) and the number of contraventions from the last year (F[2; 933] = 3.41; p = .033). Specifically, women in Cluster 3 had significantly more accidents (M = .33, SE = .04) than women in Cluster 1 (M = .18; SE = .03) or women in Cluster 2 (M = .17; SE = .02). Furthermore, women in Cluster 3 had significantly more contraventions, both overall (M = 1.72; SE = .16) and from the last year (M = .21; SE = .02) than women in Cluster 1 (overall contraventions: M = .99; SE = .13; last year contraventions: M = .11; SE = .02) or Cluster 2 (overall contraventions: M = .85; SE = .11; last year contraventions: M = .13; SE = .02). There were no significant differences between Clusters 2 and 3.

The women with a low level of internal LOC (Cluster 1 – 30.9%) have low levels of prudent, distract, and stress reduction driving styles as well as low levels of risk perception and sensation seeking. Moreover, they present high levels of risky driving, humility, and conscientiousness. The women with a medium level of internal LOC (Cluster 2 – 38.9%) are characterized by low levels of prudent driving style, risk perception humility, and agreeability. Moreover, they have high levels of risky, angry, and irrationality of norms driving style as well as high levels of risky behavior and sensation seeking. Finally, the women with a high level of internal LOC (Cluster 3 – 30.2%) have low levels of risky behavior, sensation seeking, and extraversion. Moreover, they present high levels of prudent driving style, risk perception, emotionality, and humility. These results are presented in Table 10.

The MANCOVA indicated no significant differences between the three clusters concerning the number of accidents (F[2; 934] = 2.61; p = .074), the overall number of offences (F[2; 934] = .967; p = .381) or the number of contraventions committed during the last year (F [2; 934] = .65; p = .522).

Table 10
Internal LOC Cluster differences on driving style, risk perception, risky driving, driver behavior, and personality.

	Men driver clusters ($N = 931$)			F (η^2)	Women driver clusters ($N = 940$)			F (η^2)
	1 ($n = 262$)	2 ($n = 264$)	3 ($n = 405$)		1 ($n = 287$)	2 ($n = 352$)	3 ($n = 301$)	
Driving style								
Irrationality of norm	3.93 (.86)	2.67 (.94)	2.51 (.83)	229.28** (.33)	2.73 (1.05)	2.87 (1.03)	2.69 (1.01)	2.90 * (.00)
Anxious	2.44 (.74)	2.20 (.67)	2.08 (.74)	20.31** (.04)	2.32 (.73)	2.49 (1.03)	2.38 (.78)	3.23 * (.00)
Careful	4.50 (.65)	5.31 (.53)	5.30 (.55)	181.13** (.28)	5.09 (.65)	5.06 (.76)	5.22 (.64)	5.13** (.01)
Risky	3.56 (.79)	2.47 (.73)	2.14 (.64)	322.55** (.41)	2.25 (.83)	2.51 (1.02)	2.32 (.76)	7.43** (.01)
Furious	3.67 (.72)	2.76 (.82)	2.45 (.66)	227.33** (.32)	2.58 (.83)	2.78 (.96)	2.70 (.89)	4.13 * (.00)
Stress reduction	4.16 (.98)	3.55 (1.09)	3.48 (1.05)	35.13** (.07)	3.74 (1.04)	3.82 (1.06)	3.78 (1.07)	.52 (.00)
Distract	1.91 (.74)	1.67 (.55)	1.53 (.50)	28.86** (.05)	1.75 (.58)	1.97 (.71)	1.92 (.64)	9.33** (.01)
Risk perception	2.88 (.42)	3.29 (.47)	3.18 (.46)	58.24** (.11)	3.18 (.48)	3.22 (.49)	3.34 (.47)	8.87** (.01)
Risky driving behavior	1.91 (.52)	1.06 (.49)	.97 (.44)	335.36** (.41)	1.10 (.60)	1.13 (.62)	1.00 (.51)	4.15 * (.00)
Driver behavior								
Simple violations	2.31 (.67)	1.29 (.62)	1.14 (.55)	315.66** (.40)	1.26 (.71)	1.38 (.79)	1.28 (.71)	2.33 (.00)
Aggressive violations	1.07 (.67)	.48 (.44)	.41 (.38)	155.39** (.25)	.44 (.53)	.56 (.64)	.42 (.46)	5.78** (.01)
Personality factors								
Honesty – Humility	2.90 (.55)	3.43 (.54)	3.59 (.53)	131.40** (.22)	3.51 (.61)	3.42 (.64)	3.54 (.61)	3.52* (.00)
Emotionality	2.79 (.48)	3.11 (.51)	2.99 (.48)	27.11** (.05)	3.22 (.52)	3.29 (.51)	3.37 (.50)	6.11** (.01)
Extraversion	3.46 (.47)	3.45 (.45)	3.48 (.48)	.452 (.00)	3.46 (.54)	3.44 (.47)	3.41 (.48)	.98 (.00)
Agreeableness	2.97 (.56)	3.25 (.51)	3.32 (.45)	38.86** (.07)	3.22 (.52)	3.18 (.51)	3.22 (.49)	.64 (.00)
Conscientiousness	3.32 (.53)	3.47 (.45)	3.58 (.49)	23.34** (.04)	3.59 (.51)	3.49 (.50)	3.51 (.52)	3.28 * (.00)
Openness	3.31 (.58)	3.35 (.52)	3.52 (.50)	15.23** (.03)	3.55 (.54)	3.49 (.56)	3.46 (.53)	1.96 (.00)
Traffic sensation seeking	6.10 (1.86)	3.13 (2.05)	2.79 (1.87)	258.81** (.35)	2.70 (2.26)	2.78 (2.27)	2.68 (2.04)	.17 (.00)

Note.
** $p < 0.01$.
* $p < 0.05$.

3.3. Discussion

The present study explored the associations between T-LOC-RO and the six Hexaco personality factors and the seven driving styles of MDSI-RO. We also investigated the relation between T-LOC-RO and specific driving variables – traffic sensation seeking, risk perception, and risky behavior.

The results revealed that internal T-LOC is negatively related to both conscientiousness and openness. Sarma et al. (2013) investigated the psychological factors associated with indices of risky driving and within their results, they reported a negative association between LOC – fate and extraversion, but our study did not find a significant association. The divergent analyses in relation to the personality factors and driving styles provided support for the instrument's construct validity. Overall, the data revealed that personality factors and driving style have a small contribution to understanding traffic LOC. These findings led us to argue that T-LOC is weakly influenced by personality and driving style and, in turn, may have weak chances to influence one's driving style. These results can be explained by the fact that T-LOC is rather situational than dispositional, being a malleable factor, influenced more by particular circumstances (Luszczynska & Schwarzer, 2005). Further, our results showed that internal T-LOC is positively associated with risk perception, and negatively associated with sensation seeking in traffic and risky behavior. An interesting result is that the same pattern of results emerge when analyzing external T-LOC dimensions. Therefore, the tendency of Romanian drivers is to perceive risk in traffic, although this perception does not protect them from being involved in traffic accidents. We should also notice that the relation between both types of T-LOC and risky behavior is weak, whereas the relation between risk perception and internal T-LOC is stronger than the relation between risk perception and external T-LOC. Probably the relation between LOC and risk perception is more complex and future studies should analyze the variables that moderate or mediate the link between the two variables. Some individuals may perceive the risks in a traffic situation, but may continue to adopt a risky behavior because they do not consider the risk as being sufficiently threatening. As Hunter (2006) mentioned, these individuals can be described as having a greater tolerance or acceptance of risks.

Concerning the relation of the T-LOC-RO factors with accident involvement (active accidents) and traffic offences, the results only highlighted a positive relation between the dimensions of external T-LOC scale (religiosity, other drivers, vehicle-environment) and the number of traffic offenses. Drivers who find more external causes of accidents seem to have more traffic offences, which might be explained by the fact that these individuals are less careful and take less actions to prevent traffic incidences and accidents (Knapper & Crowley, 1978; Montag & Comrey, 1987). However, the respondents with a high number of traffic offences may avoid to present themselves as responsible for traffic incidents and accidents involvement, which may have led them to attribute road traffic accidents to external causes when responding to the T-LOC-RO scales (Holland et al., 2010; Özkan & Lajunen, 2005). The results showing the lack of associations between T-LOC-RO factors, excepting religiosity, and accident involvement are highly similar with those obtained by Özkan and

Lajunen (2005). They only found a small positive relation between *self* and accident involvement, while offences were negatively related with the *vehicle and environment* dimension. Since causing vehicle accidents is associated with personal guilt, it is possible that our participants did not correctly report the real number of active accidents in order to avoid the personal guilt, social shame or other negative emotional states created by this recall. Desirability cannot explain the results because there is not a significant relation between the *desirability* subscale and the number of active accidents. Moreover, traffic accidents are less frequent than traffic offences (Warner et al., 2010), which may justify that only offences manifest a significant relation with a T-LOC-RO factor.

We also identified three clusters for external and internal T-LOC separately for men and women. Based on the differences between clusters, we can identify two high risk clusters for men, corresponding to individuals with a medium external T-LOC and a low level of internal T-LOC, and a high risk clusters for women, corresponding to individuals with a high level of external T-LOC. We can observe that both groups of men drivers are described through low levels of: careful driving style, risk perception, honesty-humility, agreeability, conscientiousness, emotionality, and openness. They also present a high level of risky behavior, sensation seeking, as well as a risky, angry, irrational, distract, and stress reduction driving style. A previous study also found that sensation seeking and risky driving style are part of a high-risk group comprised mostly by men (Ulleberg, 2002). Furthermore, higher reckless and angry styles and lower careful style have been associated with previous involvement in car accidents (Poó, Taubman-Ben-Ari, Ledesma, & Díaz-Lázaro, 2013; Taubman-Ben-Ari & Skvirsky, 2016). This combination of characteristics predisposes men to commit more offences. Women with high levels of external T-LOC have an angrier and irrationality of norm driving style, being predisposed to more offences and accidents. We can observe that angry driving style and irrationality of norms are risk factors for both men and women. However, while these risk factors are specific to men with a medium level of external T-LOC and a low level of internal T-LOC, they are also present in women with high levels of external T-LOC. These results suggest that interventions designed to change the drivers' LOC in order to improve their driving behavior (Huang & Ford, 2012) should be implemented differently for men and women. A previous study also showed that driving styles are differently associated with accident involvement according to gender, further suggesting that planning driver training schedules should be customized for men and women (Holland et al., 2010). Future research is needed to clearly establish the differences between men and women based on their T-LOC and related variables.

4. Summary and conclusions

The present research included two complementary studies driven by three main objectives: (1) developing the T-LOC-RO and testing its psychometric properties, (2) testing the construct validity of the T-LOC-RO and extending prior knowledge on traffic locus of control by exploring its correlations with personality factors, driving styles, risk perception, risky behavior, and traffic outcomes (accidents and offences), and (3) offering a typology of Romanian drivers based on their traffic locus of control and the above presented variables.

Based on the results of Study 1 we can state that the T-LOC-RO has similar psychometric properties to the original version (Özkan & Lajunen, 2005), revealing good to excellent reliabilities and a satisfactory factor solution, validated through confirmatory factor analysis. By revising and expanding the original content of the T-LOC, we developed the Romanian version (T-LOC-RO) with a structure that corresponds to the four broad driving domains of the original instrument (self, others, fate, vehicle/environment), while also addressing a supplementary dimension, namely *Religiosity*. In addition, T-LOC-RO includes a short and effective *desirability* subscale aiming to overcome some limits of self-report responses.

The main results of Study 2 provided evidence for the construct validity of our instrument. Although personality factors seem to have a small contribution in explaining drivers' locus of control, together with the driving style they provided a unique attempt to describe a typology of Romanian drivers according to their type of traffic locus of control (internal/external) and its intensity (low, medium, high). This study allowed the identification of three important high-risk groups of drivers: two for men and one for women.

The small relations found between T-LOC scales and traffic outcomes may be explained in several ways. First, it is possible that these relations to be moderated by others variables. For example, cognitive biases, as illusion of control or optimism bias, should be considered in future studies, as moderators of the relation between T-LOC and driving outcomes. If self-confident drivers consider that the likelihood of being involved in a traffic crash depends on their own behavior and skills (Özkan & Lajunen, 2005), then we expect that the relation between internal T-LOC and risky driving to be stronger for the participants with a high level of confidence in personal driving abilities. Second, self-report measures of offences and crashes could imply forgetting or differences in self-disclosure, as sources of error for the responses we collect. It is possible that, as in the case of other psychological variables, the associations between T-LOC scales and previous experiences to not be reliable estimates of the associations between T-LOC and future events (Hunter, 2001). Giving the fact that T-LOC is a malleable factor, which can be changed through education (Huang & Ford, 2012), drivers should be educated to adopt a secure T-LOC, in order to prevent the future negative traffic outcomes. Third, we also suggest that future studies should use a multidimensional measure of driving behavior, when analyzing the relation between T-LOC and risky driving. A previous study showed that T-LOC scales manifest different patterns of correlations with different types of risky driving behaviors (Sarma et al., 2013). As a conclusion, the weak relations found between T-LOC and driving outcomes suggest the necessity of future research in order to clarify the predictive role of T-LOC in traffic, for different categories of drivers.

Several limitations of the present research should be noted. First, it relied on self-report measures of all studied variables, including the number of accidents and offences. Although most of the previous studies on this topic include self-report measures some sources of error like forgetting and under-reporting can account for the responses we collected. However, the desirability cannot explain the results, because it does not have significant relationships with the study variables. Second, we used convenience samples in our studies, therefore the results may not be generalized to the entire population of Romanian drivers. Further studies are needed in order to increase the external validity of these results. However, we aimed to get representative samples, including drivers varying as much as possible in gender, age, driving experience, education level, and occupation. Third, locus of control might be related to drivers' confidence in their driving skills and optimism bias (Özkan & Lajunen, 2005). In forthcoming studies about traffic locus of control and safety, these measures and other driving biases should be included. Future studies should also assess if changes in driving locus of control are associated with changes in subsequent driving behaviors and outcomes.

Intervention programs in other areas of applied psychology have been shown to effectively influence individuals' domain-specific locus of control. Different therapeutic approaches, like attributional retraining, based on reinstating perceived control over outcome, has been found to induce a more internal locus of control (Menec et al., 1994). The question about the effectiveness of intervention programs in Romanian drivers should be addressed in future research. A first important step in implementing these interventions consists in identifying the locus of control among Romanian drivers. In this regard, the current study has a contribution by developing a reliable and valid tool. Moreover, our findings may provide guidance on measures that could be developed in order to reduce the accident risk, such as informing further training for new drivers once licensed about the necessity to adopt an internal locus of control for different traffic outcomes. Finally, our research contributes to the literature by highlighting the nature of relations between driving locus of control perceptions and a wide range of individual variables in the road traffic context which is still understudied.

The new T-LOC-RO is a reliable and valid instrument in the Romanian driving context, and includes the general psychological structure of the previously developed version, as well as cultural specificities. We consider this measure as a valuable tool for both practitioners interested in reducing accident risk and increase road safety, as well as for researchers interested in this topic. Although this scale was designed to measure traffic locus of control among Romanian drivers, it may also be useful in other countries with a Christian-Orthodox religion or close traffic culture. Future studies in different cultural contexts are needed in order to increase the external validity of this scale.

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