



Posttraumatic stress symptoms, fear and avoidance of driving, and aberrant driving behaviors. The moderating role of gender

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ABSTRACT

Introduction: Previous literature supports the fact that posttraumatic stress disorder (PTSD) symptomatology, as well as fear and avoidance of driving are possible consequences of road traffic crashes (RTC). The aim of the present study is to assess the relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors, in a sample of Romanian drivers that were involved in an RTC in the last two years before conducting the study. Further, we wanted to identify the moderating role of gender in the relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors.

Method: A sample comprising 162 participants (62.3% were men, $Mage = 29.37$) was involved in the study.

Results: The results showed that PTSD symptoms and a composite score of fear and avoidance of driving were positively associated with slips and lapses on the road and with the number of reported errors while driving. The path analysis revealed non-significant relations between fear and avoidance of driving and driving behaviors. Furthermore, multi-group analysis showed that the relations between PTSD symptoms and aberrant driving behaviors are significant only for men.

Conclusions: The implications of the results for traffic safety are discussed.

1. Introduction

Many people lose their lives on the roads every day, and many more are left with long-lasting physical and psychological consequences (Heron-Delaney et al., 2013). A possible consequence is posttraumatic stress disorder (PTSD), characterized by intrusive thoughts, avoidance of stimuli associated with the trauma, alterations in mood and cognitions, and hyper arousal (American Psychiatric Association (2013)). Fear and avoidance of driving are also common at drivers involved in a road traffic crash (RTC) (Ehlers et al., 2007; Taylor and Deane, 2000). Previous studies offer some evidence for the associations of PTSD symptoms, fear and avoidance of driving, and driving behavior (e.g. e.g., Dula et al., 2010; Taylor and Koch, 1995). One of the most used taxonomies of driving behaviors distinguishes between four different classes of behaviors on the road: slips and lapses, errors, ordinary, and aggressive violations (Reason et al., 1990). Several studies found evidence for the fact that these traffic behaviors are positively correlated with traffic crashes (e.g. Özkan et al., 2006; Stanojevic et al., 2018; Winter and Dodou, 2010). Although previous studies confirmed the associations between anxious states and aberrant driving behaviors (Dula et al., 2010; Taylor and Koch, 1995), there is little evidence for the possible associations between PTSD symptoms, fear and avoidance of driving, and the four types of driving behaviors presented above. In this context, the aim of the present study is to assess the relations between PTSD symptoms, fear and avoidance of driving,

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and driving behaviors, in a sample of Romanian drivers who were involved in an RTC. The moderating role of gender was also explored given the documented gender differences both in terms of PTSD (e.g. Frank et al., 2018), but also in terms of driving behaviors (e.g. Stanojevic et al., 2018).

1.1. PTSD symptoms and driving behavior

After a transport related crash, 42–55% of people present mental health symptoms (e.g., anxiety, depression) that persist in the first two years following injury (Giummarra, Amoh-Gyimah, Saberi and Gabbe, 2019). Even in the cases of minor RTC-related injuries, studies documented poor recovery in the following two years after the RTC, particularly when the individuals also develop comorbid psychiatric disorders (e.g., PTSD) (Kenardy et al., 2015; Smits et al., 2019). The diagnostic of PTSD is not uncommon among victims of RTCs (Guest et al., 2016; Mayou et al., 2001), the prevalence being similar at different time points after the accident in the first two years following the accidents (e.g., 24%, 22%, and 25% at 6-, 12-, and 24-months, respectively, Kenardy et al., 2017; 26.1%, 24.7%, and 26.1% at 6-, 12-, and 24-months, respectively, Kenardy et al., 2018).

Previous studies claim that following an RTC, driver behavior can also be modified (e.g., decreased number of speeding violations) (Perez-Marín, Ayuso and Guillen, 2019). In the taxonomy of driving behaviors proposed by Reason et al. (1990), driving errors represent non-intentional failure of planned actions to achieve their goals (e.g., get into the wrong lane on approaching a roundabout), while deliberate violations are conscious, intentional, deviations from safety rules with a specific aggressive aim (aggressive violations; e.g., become impatient with a slow driver in the outer lane and overtake on the inside.) or without an aggressive aim (ordinary violations; e.g., excessive speed). Slips and lapses (e.g., misread the signs, attempt to drive away from traffic lights in third gear) were added later to this taxonomy, and focus on memory failures. Driving Behavior Questionnaire (DBQ) is a widely used instrument for measuring these driving behaviors. No previous study assessed the link between PTSD symptomatology and both nonintentional and intentional dangerous driving behaviors, although the potential relations between PTSD symptomatology and slips, lapses, errors, and violations on the road are supported by previous literature about: (1) the role of anxiety in traffic safety (e.g., Eysenck and Calvo, 1992; Lucidi et al., 2010; Olteidal and Rundmo, 2006), (2) the well-documented relation between PTSD symptomatology and difficulties in executive functions that are essential for avoiding unintentional aberrant driving behavior (i.e., errors, slips, lapses) (see Aupperle et al., 2012, for a review), (3) the relations between PTSD and different driving related behaviors and outcomes (e.g. Kuhn et al., 2010). These three lines of research that suggest a relation between PTSD symptomatology and aberrant driving behaviors will be presented below.

First, PTSD symptoms imply high levels of anxiety states (Cheng et al., 2015), and previous literature highlights the role of anxiety in traffic safety. Theoretical frameworks, like cognitive interference theory (Sarason, 1988) or processing efficiency theory (Eysenck and Calvo, 1992), sustain that trait anxiety determines disturbed attention to a specific task and impair performance on tasks that involve attentional or short-term memory demands. However, in relation to driving behaviors, the evidence for the implications of anxiety is mixed. Thus, some studies found that drivers with high and medium level of trait anxiety also reported higher scores on performance errors, lapses, and ordinary violations compared to drivers with low level of trait anxiety (e.g., Shahar, 2009). Other results sustain that trait anxiety is negatively related to driving violations and risky driving (e.g., speeding, rule violations) (Lucidi et al., 2010; Olteidal and Rundmo, 2006), and positively related to lapses, in samples of young drivers (Lucidi et al., 2010). However, trait anxiety was also found to be positively related to all aberrant driving behaviors measured by DBQ (i.e., errors, lapses, ordinary and aggressive violations) (Pourabdian and Azmoon, 2013). However, in a cluster analysis conducted with the scores provided by a sample of young drivers, low trait anxiety was a particularity of high-risk group of drivers (e.g., that reported speeding, rule violation) (Ulleberg, 2002). Similarly, in another study, lack of anxiety considered as a psychopathic personality trait was negatively related to driving violations on the road, measured with DBQ (Panayiotou, 2015). State anxiety was positively related to dangerous driving behaviors and aggressive driving in a sample of drivers with a mean of 0.53 crashes that occurred in the last 3 years before participating at the study (e.g., Dula et al., 2010). Finally, in another recent study, a distress composite score, consisting of symptoms commonly present in disorders such as PTSD (e.g., traumatic intrusions, insomnia, appetite loss, traumatic avoidance), was positively associated with DBQ errors and violations subscales, as well as with total DBQ score (Bernstein et al., 2019).

Second, in contrast to the deliberate driving violations that are governed by social norms and codes of rules, unintentional aberrant driving behaviors arise from deficiencies in cognitive processes involved in the selection of a goal and in the means to achieve it (Reason et al., 1990). It is well recognized that PTSD symptomatology is associated with difficulties in executive functions, including attention, memory, inhibition of automatic responses in order to achieve a goal, the ability to switch flexibly between two different tasks, and the ability to plan actions for obtaining a goal (see Aupperle et al., 2012, for a review). These executive functions are also required for avoiding unintentional aberrant driving behaviors (i.e., slips, lapses, and errors on the road) that represent memory and attention deficits or failure of planned actions (Reason et al., 1990). Results from the transportation psychology literature support the above mentioned literature, showing that individuals with PTSD subsequent to motor vehicle trauma evidenced greater performance deficits while driving (e.g., trouble finding the correct lane, pressing the wrong pedal) (Clapp et al., 2014). PTSD also generates difficulties with hypervigilance and affective dysregulation that may detract from driving attention and performance, leading to driving errors (Kraft et al., 2010; Lew et al., 2010).

Third, concerning the potential relation of PTSD with intentional violations of traffic rules, some previous studies found a positive relation between a specific measure of PTSD and aggressive driving (e.g. making verbal outbursts and angry hand gestures while driving, chasing, cutting off another driver) in a sample of veterans (e.g. Kuhn et al., 2010). In addition, PTSD was related to other traffic violation, which did not include an aggressive component, like tailgating (Kuhn et al., 2010). Because few studies assed the relation between PTSD symptomatology and both intentional and nonintentional aberrant driving behaviors, the aim of this study is to

assess, in a sample of Romanian drivers that were involved in an RTC, the relations between PTSD symptoms and aberrant driving behaviors, comprised in Reason et al.'s (1990) taxonomy. Based on previous findings, the hypothesis is that a high level of PTSD symptoms will be related to a high level of the four aberrant driving behaviors, although a stronger relation is expected with slips, lapses, and errors.

1.2. Fear and avoidance of driving, and driving behavior

After an RTC, many people develop fear of driving, associated with the tendency to avoid particular driving situations (Ehlers et al., 2007; Lucas, 2003; Taylor and Koch, 1995; Taylor and Deane, 2000). Findings from experimental studies also sustain that perceptions of fear increase when the levels of accident risk also increase (Barnard and Chapman, 2016). Studying the behaviors behind the wheel of persons who continue to drive despite their fear of driving received less attention, despite the potential danger associated with these behaviors, for drivers themselves and for other traffic participants. Furthermore, empirical evidences support the link between emotional distress and both driving errors and driving violations (Bernstein et al., 2019).

Some empirical evidence linked driving fear with a range of maladaptive behaviors in traffic like performance errors and attentional lapses (e.g. Taylor et al., 2007). In another study, conducted with drivers without a history of RTCs, travel avoidance (that also include driving avoidance) manifested positive associations with performance deficits and negative associations with perception of driving abilities in specific driving situations (Clapp et al., 2011). Moreover, driving related fears (i.e., panic-, accident-, and social-related driving fears) presented positive associations with performance deficits while driving (Clapp et al., 2011).

Concerning the relation between driving fear and avoidance and intentional violation of traffic norms, it was found that travel avoidance manifested positive associations with aggressive driving behaviors (Clapp et al., 2011). Moreover, accident-related fears were positively related to aggressive driving behaviors (Clapp et al., 2011). In another study, drivers who engage often in behaviors that deliberately violate the traffic rules are fearless (Panayiotou, 2015). In contrast, other results claim that fears composite score related to mood and anxiety disorders was positively associated with DBQ errors, DBQ violations, and DBQ total score, although this fears score did not predict DBQ errors, DBQ violations, and DBQ total score (Bernstein et al., 2019). The only previous study that focused on the relation between driving phobia, conceptualized as both driving fear and driving avoidance, and driving behavior found that drivers with high levels of driving phobia tend to be more cautious and to employ safer driving behaviors (e.g., Ehlers et al., 2007).

In order to advance the literature concerning the implications of fear and avoidance of driving for driving behavior, the second aim of the present study was to assess the relation between fear and avoidance of driving and slips, lapses, errors, ordinary, and aggressive violations. We anticipated that fear and avoidance of driving will be positively related to errors and lapses. However, given the tendency of drivers with fear and avoidance of driving to adopt safety behaviors (e.g., Ehlers et al., 2007), we anticipated that fear and avoidance of driving will be negatively related to both ordinary violations and aggressive violations in traffic.

1.3. The role of gender

Previous studies constantly sustained the fact that PTSD symptoms are more prevalent in women than in men, after different trauma life events (e.g. Frank et al., 2018; Olff, 2017). The same pattern of results was also obtained when the participants were victims of road traffic crashes (Chossegros et al., 2011; Fullerton et al., 2001; Kobayashi et al., 2018). Moreover, gender differences were documented in aberrant driving behaviors. Thus, some findings sustain that males commit more violations on the road, but fewer errors than females (Clapp et al., 2011; Moradia, Motevalian, Mirkoohi, McKay and Rahimi-Movaghar, 2013; Tabibi et al., 2015; Wickens et al., 2008). A study conducted with Romanian drivers also showed that being female is significantly negatively related to violations and significantly positively associated with errors (Stanojevic et al., 2018). However, according to our knowledge, no previous study analyzed gender differences in the relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors. For traffic safety, it is critical to understand what types of drivers are more prone to commit risky driving behaviors. Thus, the third aim of the present study is assessing the moderating role of gender in the relations between PTSD symptoms, fear and avoidance of driving, and the four types of aberrant drivers assessed in the present study – lapses and slips, errors, ordinary, and aggressive violations. Based on previous studies, we hypothesized that the relations between PTSD symptoms and driving phobia with ordinary and aggressive violation will be stronger for male participants, while the relations between PTSD symptoms and fear and avoidance of driving with errors, lapses, and slips will be stronger for female participants.

2. Method

2.1. Participants

The sample consisted of 162 participants (63% were men). The participants' mean age is 29.37 ($SD = 9.52$, range 19–57) and they had been driving for 8.34 years on average ($SD = 7.19$, years range 0–29). Most of the participants reported that they drive every day (62.3), 19.8% reported that they drive two or three times per week, 6.8% reported driving once per week, while 11.1% reported driving less than once per week. The number of months from the RTC to the moment when the study was conducted varied between 1 and 24, with a mean of 16.50 ($SD = 8.08$).

2.2. Instruments

2.2.1. Posttraumatic stress

PTSD Checklist for DSM-5 (PCL-5; Blevins et al., 2015) is a 20-item self-report scale that measures PTSD symptomatology presented in the past month. Participants were asked to think about the RTC in which they reported that they were involved. Then, they were asked to rate how much they were bothered by the presence of PTSD symptoms. Items are rated on a 5-point Likert scale from 1 (not at all) to 5 (extremely). Higher scores indicated higher levels of PTSD symptoms. In the present study, the total score was used, by averaging the items, and the Cronbach Alpha coefficient was 0.92.

2.2.2. Fear and avoidance of driving

The Travel Phobia Questionnaire (TPQ, Ehrling et al., 2006) comprises 12 items assessing the severity of travel fear and travel avoidance. Each item from fear subscale (e.g. *I always feel frightened when I have to drive*) was rated using a 5-point Likert scale from 1 (Not at all) to 5 (Very strongly), while the items from the avoidance subscale (e.g. *I avoid driving a car in bad weather conditions*) were rated using a 5-point Likert scale from 1 (Never) to 5 (Always). A total score, indicating driving phobia, can be computed by averaging scores of all 12 items. The participants could rate each item concerning one of the three situations: driving, travelling as a passenger, riding a bike. In the present study, the participants were instructed to rate each statement, by referring to driving. A single averaged score for the 12 items was used and the Cronbach Alpha was .83. The participants rated how much each statement was true for them in the past month.

2.2.3. Driving behavior

Driver Behaviour Questionnaire – Romanian version (Havârneanu et al., 2010), was used to assess self-reported slips and lapses, errors, ordinary, and aggressive violations on the road. 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 Cronbach Alpha coefficients were 0.85 for slips and lapses (13 items), 0.70 for errors (5 items), 0.84 for ordinary violations (9 items), and 0.82 for aggressive violations (7 items).

The demographic questionnaire asked the participants to report their age, gender, the number of years since obtaining the driving license, and the frequency of driving evaluated with the following question “How often do you drive in the present?”, evaluated on a 4-point scale: 1. daily, 2. two or three times per week, 3. about once a week, 4. less than once a week. Objective indicators of trauma caused by the RTC and collected in the present study are: the number of deaths caused by the RTC (open-ended question), the number of days of hospitalization for the participant (open-ended question), and the presence of physical wounds in the present (question with a dichotomous answer: yes/no), as a consequence of the RTC. The information about the time that has passed since the RTC took place and each participant’s position during the crash (driver vs. passenger) were also collected.

2.3. Procedure

The protocol for this study was approved by the Research Ethics Committee. We used a snowball sampling technique to recruit our sample, where students of the Faculty of Psychology were asked to identify drivers among personal acquaintances, from the general population. Students were instructed about the sample selection strategy. They presented the aims of the study to potential participants and applied the questionnaires in paper-pencil format, after signing the consent form. In exchange for this activity, the students received course credit. First, the student verbally addressed the following question “Have you been involved in the last two years in a serious motor vehicle crash in which one or more people were seriously injured or killed?”. The answer was also provided verbally and depending on it, the participants received a set of questionnaires. For the present study, the responses of drivers with an experience of traffic crashes (either as drivers or as passengers) were included. There were two inclusion criteria: 1) period of time between the RTC and the moment of completing the questionnaires longer than a month and shorter than two years; 2) having a valid driving license in the present. The participants were informed that their responses are anonymous and confidential, and they could discontinue participation in the study at any time. After signing the consent form, the participants completed instruments measuring driving behaviors, PTSD symptoms, and fear and avoidance of driving, as well as the demographic questionnaire.

For ethical consideration (i.e., all the students had a chance to obtain the course credits, even if they did not know persons involved in road accidents), an alternative set of questionnaires was prepared to be offered to potential participants that did not report the experience of an RTC in the last two years. This alternative set of questionnaires contains scales measuring several factors associated with driving behaviors in day to day driving situations (e.g., risk perception, driving stress, driving related cognitions).

2.4. Data analysis

First, we conducted preliminary analysis to examine the descriptive statistics and the associations for the variables analyzed in the present study. In order to estimate the direct relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors and also the moderating role of gender, we used a structural equation model framework in AMOS Graphics 22. For the evaluation of the overall model fit, four different fit indices were used: the chi-square statistic (χ^2), Normed Fit Index (NFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). A RMSEA < 0.05, χ^2/df < 3, NFI, and CFI > 0.90 indicated a very good model fit (Hu and Bentler, 1999). In order to test the moderation effect, we used multi-group analysis approach using critical ratios (z-scores) comparisons between groups on each specified path.

3. Results

3.1. Preliminary analysis

In the moment of the RTC, 73.5% of the participants were drivers in one of the cars involved in the crash, while 26.5% were passengers. When asked, “In the present, are there physical consequences of the RTC for you (e.g., wounds, scars)?”, 32.1% of the sample responded “Yes”, 66.7% said “No”, while 1.2% of the sample did not provide an answer.

The characteristics of the sample are provided in Table 1 and descriptive statistics for the main variables of the study are presented in Table 2. The participants' PTSD symptoms scores did not correlate with age, the number of years since obtaining the driving license, and the number of months since the RTC took place, all $r_s < 0.15$, all $p_s > .05$. From the objective indicators of RTC severity, only the number of days of hospitalization positively correlated with PTSD symptoms. The total score for fear and avoidance of driving was positively related with the number of days of hospitalization and the participants' age. There is also a positive significant correlation between PTSD symptoms and fear and avoidance of driving. These results are presented in Table 3.

There were no significant effects of the frequency of driving on all the aberrant driving behaviors, all $p_s > .05$, but the participants that drive daily have significant lower scores on PTSD symptoms ($M = 1.85$, $SD = 0.67$) and fear and avoidance of driving ($M = 1.99$, $SD = 0.75$) compared with the participants that drive two or three times per week ($M = 2.45$, $SD = 0.76$; $M = 2.42$, $SD = 0.75$ respectively).

3.2. The associations among the main study variables

Table 3 presents the Pearson correlations of all variables from the present study. The results showed that both PTSD symptoms and fear and avoidance of driving are positively associated with slips and lapses, and with errors. However, the relations between PTSD symptoms and fear and avoidance of driving with violations are non-significant. These relationships are medium (Cohen, 2013). The relations between different types of aberrant driving behaviors are strong, but do not exceed 0.80, suggesting no problems with multicollinearity (Tabachnick and Fidell, 2007).

3.3. Testing for direct effects and moderation

Finally, we simultaneously tested the direct relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors and also the moderated role of gender in these relations. The number of days of hospitalization, the number of deaths, frequency of driving in the present, being the driver vs. being the passenger in the moment of the RTC, as well as the participants' age were also introduced in the model, given their significant relations with one or more of the main study variables.

The fit for our overall model was very good: $\chi^2(32) = 37.67$, $p = .226$; NFI = 0.93; CFI = 0.98; RMSEA = 0.03, 90% CI [0.000; 0.070]. As assumed, PTSD symptoms significantly predicted slips and lapses ($\beta = 0.21$, $p = .017$) and errors ($\beta = 0.26$, $p = .003$) on the road. Thus, a high level of PTSD symptomatology is associated with a high level of slips, lapses, and errors on the road. However, PTSD symptoms did not predict ordinary and aggressive violations ($\beta = 0.01$, $p = .883$; $\beta = 0.02$, $p = .866$ respectively). Further, fear and avoidance of driving manifested a non-significant relation with all types of driving behaviors (all $p > .05$) (see Fig. 1).

Further, we tested whether the links between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors differ in strength when conditioned by gender. Comparing the regression weights for the path between PTSD symptoms and aberrant driving behaviors, the results indicated that men presented stronger relations between PTSD symptoms and slips and lapses ($b = 0.44$, $p < .001$, $z = 3.71$, $p < .01$), and errors ($b = 0.44$, $p < .001$, $z = 2.26$, $p < .05$), comparing with women. Moreover, only for men, PTSD symptoms are significantly related with ordinary violations ($b = 0.26$, $p = .045$). However, the results revealed non-significant differences between men and women, concerning the relation between fear and avoidance of driving and aberrant driving behaviors. The pattern of results for the multi-group comparisons is presented in Table 4.

Table 1
Sample characteristics. N = 162.

Variables	N	%	Mean	SD
Age			29.37	9.52
Gender (male)	102	63%		
Driving experience (years)	<1-29		8.34	7.19
Months since accident	>1-24		16.50	8.08
Frequency of driving				
Daily	101	62.30%		
Two or three time per week	32	19.80%		
Once per week	11	6.80%		
Less than once per week	18	11.10%		
Education				
Secondary degree	1	0.60%		
High school	54	33.30%		
College degree	107	66%		

Table 2

Means, standard deviations, minimum and maximum values of the main study variables. N = 162.

Variables	Mean	SD	Minimum	Maximum
Posttraumatic stress symptoms	2.13	0.79	1.00	4.10
Fear and avoidance of driving	2.05	0.75	1.00	4.50
Slips and lapses	1.09	0.67	0.00	3.46
Errors	1.51	0.77	0.00	3.80
Ordinary violations	1.49	0.87	0.00	5.00
Aggressive violation	1.30	0.89	0.00	4.43
Number of deaths	0.15	0.76	0.00	9.00
Time since RTA	16.50	8.08	1.00	24.00
Driving experience	8.34	7.19	<1 year	29.00
Hospitalization	2.66	13.28	0.00	150

Table 3

Pearson correlations between the study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. PTSD symptoms	–												
2. FAD	.53***												
3. Slips and lapses	.29***	.26**											
4. Errors	.31***	.27***	.76***										
5. Ordinary violation	-.001	-.01	.59***	.46***									
6. Aggressive violation	.02	.02	.63***	.51***	.78***								
7. Number of deaths	.14	.09	-.08	-.15*	-.10	-.09							
8. Time since RTA	.12	.15	.09	.001	-.05	-.01	-.06						
9. Driving experience	.007	.10	.08	.04	-.06	.06	.14	.13					
10. Hospitalization	.17*	.22***	.07	-.02	.03	-.07	.03	.05	-.009				
11. Physical wounds	-.08	-.04	-.05	-.04	-.01	-.02	.02	-.11	.12	.21**			
12. Driver vs. passenger	.03	.00	-.13	-.09	-.20**	-.19*	.02	.15	-.08	-.09	.05		
13. Gender	.31***	.13	-.16**	-.06	-.34***	-.35***	-.00	-.03	-.04	-.01	-.08	.20**	
14. Age	.09	.16*	.05	.01	-.17*	-.06	.11	.17*	.86***	.02	.13	-.06	.04

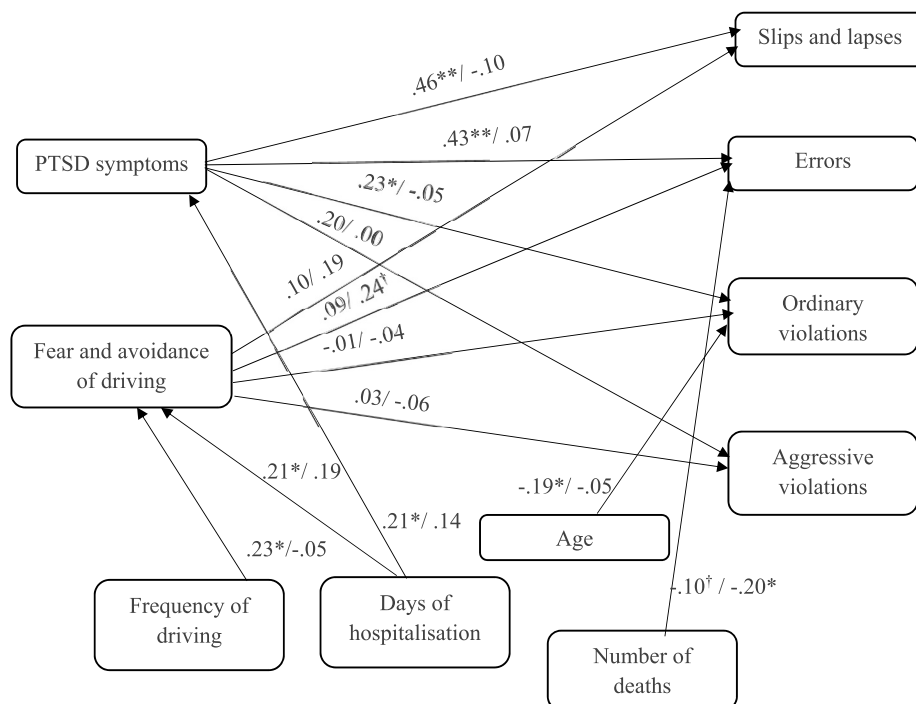
Note. FAD - Fear and avoidance of driving, * $p < .05$, ** $p < .01$, *** $p < .001$; N = 162.**Fig. 1.** The pattern of relations between PTSD symptoms, fear and avoidance of driving, and driving behaviors. From left to right, the standardized regression weights are for men and for women. For easy of reading, only the significant paths between the control variables and the main study variables are presented in the figure. † $p = .077$ (fear and avoidance of driving – errors), † $p = .069$ (number of deaths – errors), * $p < .05$, ** $p < .001$.

Table 4
Critical ratios comparisons for multi-group analysis.

	Women		Men		Z score
	Estimate	<i>p</i>	Estimate	<i>p</i>	
<i>PTSD symptoms as predictor variable</i>					
1. Slips and lapses	−0.07	.471	0.44	<.001	3.71***
3. Errors	0.07	.471	0.44	<.001	2.26**
4. Ordinary violations	−0.05	.680	0.26	.045	1.70*
5. Aggressive violation	−0.001	.994	0.26	.060	1.40
<i>Fear and avoidance of driving as predictor variable</i>					
1. Slips and lapses	0.14	.160	0.08	.378	−0.394
2. Errors	0.21	.103	0.09	.400	−0.685
3. Ordinary violations	−0.02	.841	−0.05	.694	−0.132
4. Aggressive violation	−0.05	.679	0.00	.998	0.281

Note. *** $p < .01$; ** $p < .05$; * $p < .10$.

4. Discussion

The major aim of the present study was to assess the associations between PTSD symptoms, fear and avoidance of driving, and driving behaviors that are closely related to traffic safety, in a sample of RTC victims, and also to identify gender differences in these relations.

First, our results showed positive associations between PTSD symptoms and slips, errors, and lapses in traffic, while the relations with ordinary and aggressive violations are non-significant. Thus, as the present results suggest, even without a full diagnosis of PTSD, the presence of posttraumatic stress symptoms may be related to dangerous driving behaviors, most of them nonintentional. These results should raise concerns about the fitness of driving after involvement in an RTC, even in the absence of severe bodily injuries. These results may be explained by the well-known fact that PTSD is associated with difficulties of attention and memory, low flexibility, and difficulties of planning actions (Aupperle et al., 2012). These executive impairments may detract from driving attention and performance. We should also notice that, in the present study, PTSD symptoms are not related to ordinary and aggressive violations. Future studies should aim to investigate the mechanisms that may link PTSD symptoms with these types of driving behaviors. Although the present study did not provide an answer to the question about what factors explain the relation between PTSD symptoms and driving slips, lapses, and errors, it extends previous findings by highlighting the relation of PTSD symptoms to dangerous behaviors in traffic. Thus, PTSD symptomatology developed after an RTC is associated with dangerous driving behaviors that put the driver in danger for another RTC. In order to avoid this vicious circle, psychological states and disorders, following an RTC, should receive at least the same attention as physical wounds. Furthermore, the factors that may moderate the relation between PTSD symptoms and aberrant driving behaviors, like emotional regulation strategies (e.g., expressive suppression of emotions, cognitive reappraisal) deserve further attention from researchers interested in understanding and preventing dangerous driving. Previous studies offer evidence for the fact that cognitive reappraisal moderates the relation between PTSD symptoms and health destructive behaviors (e.g., alcohol use) (Aase et al., 2018). The potential moderating role of reappraisal in the relation between PTSD symptoms and dangerous driving could also be explored, because it may help us to understand the relations of PTSD symptoms with different aberrant driving behaviors.

Another result of the present study consists on the fact that fear and avoidance of driving is associated with slips, lapses and errors, but not with simple and aggressive violations. Thus, a similar pattern of results is observed, as in the case of PTSD symptoms. As previous studies showed, these results can be explained through the fact that anxiety consumes cognitive resources and impairs performance, being associated with heightened distractibility and attention deficit, and consequently with dangerous behaviors in different domains, including driving (Olteidal and Rundmo, 2006; Eysenck and Calvo, 1992; Sarason, 1988). Thus, although the total score for fear and avoidance of driving is not related with the intention to violate traffic rules, it is associated with the tendency to commit more errors due to inattention resulted from cognitive overload (Eysenck and Calvo, 1992; Sarason, 1988). However, in the path analysis, when the frequency of driving in the present is controlled, the relations between fear and avoidance of driving and driving behaviors are non-significant. A similar result was also reported in a previous study, where a fear composite score correlated with DBQ errors, DBQ violations, and DBQ total score, although this fears score did not predict any DBQ score (Bernstein et al., 2019). Given the driving avoidance component of the total score, it is possible that the exposure of these drivers to driving situations is limited. As a consequence, the probability of engaging in different driving behaviors is low. Furthermore, as in the case of the relation between PTSD symptoms and driving behavior, the relation between fear of driving and driving behavior may be moderated by the strategies that drivers use to regulate their emotions. For example, in a previous study, expressive suppression was positively related with driving fear and driving avoidance (Măirean, 2018). However, the supposition that expressive suppression or another emotional regulation strategy moderate the relation between fear of driving and driving behaviors requires further studies.

When exploring the role of gender, the results showed that PTSD symptoms are positively associated with slips, lapses, and errors only for men. These results are counterintuitive, given the fact that women have a higher tendency to adopt these types of aberrant driving behavior (e.g., Stanojevic et al., 2018), and also a high probability to develop PTSD (Chossegras et al., 2011; Kobayashi et al., 2018). An explanation for the non-significant relations between PTSD symptoms and aberrant driving behaviors among women could rely on the fact that women could use avoidance coping to a higher degree; thus, they may be less exposed to traffic situations. Another

explanation may be related to the frequency of involvement in these types of driving behaviors before the RTC, in the current sample. A previous recent study showed that changes in driving behaviors after an RTC (i.e., reduction in speeding violations) were more specific to men who committed more frequent speed violations prior to the RTC (Pérez-Marín et al., 2019).

Although the analysis for the entire sample did not reveal significant associations between PTSD and ordinary violations of traffic rules, the multi group analysis showed that these relations are significant for men, and not for women. Previous studies also sustain that men engage more often in traffic violation (e.g. Tabibi et al., 2015; Wickens et al., 2008). Thus, the present study has confirmed previous results, but also has extended them, by showing that men with high level of PTSD symptoms could also be prone to traffic errors. An interesting result is the fact that PTSD symptoms manifested a positive relation only with ordinary violation, and not also with aggressive violations, among men. Some previous studies sustain that fact that men manifest more aggressive driving behaviors (e.g. Deffenbacher et al., 1996), although this result was not confirmed in other studies (e.g. Clapp et al., 2014). Thus, gender differences in aggressive driving, and specifically in the relation between PTSD symptoms and aggressive driving behaviors need further research.

Several limitations of this study should be mentioned. First, our convenience sample of Romanian RTC victims may not be necessarily representative of all Romanian RTC victims. This is the first study of this type with a Romanian sample and it requires replication in future studies. Second, the retrospective reports of driving behaviors did not allow us to establish causal relation between the determinant and the outcome variables. We cannot exclude the possibility of PTSD severity inflating the reporting of aberrant driving behaviors. Future longitudinal studies could help in clarifying the relations between PTSD, driving phobia, and driving behaviors that may constitute a danger for traffic safety. Third, our data rely solely on self-reports, which increase the possibility of collecting distorted data due to social desirability, given the fact that the participants were asked to report their errors in traffic and violations of traffic rules. However, several studies sustain the fact that DBQ has good construct validity, being a proper scale to measure the self-reported aberrant behaviors, and that the bias caused by socially desirable answers was very small in the DBQ responses (Sullman and Taylor, 2010; Winter and Dodou, 2010). Moreover, the fact that data collection was anonymous diminishes the impact of social desirability. For increasing the external validity of the present results, future studies can complete self-report measures with other measures, such as a driving simulator, which allow for the measurement of cognitive and affective responses, as well as of specific driving behaviors.

Despite these limitations, a major strength of the present study is the fact that it explored psychological consequences of motor vehicle crashes, both in terms of posttraumatic reactions and in terms of safety driving, which is an insufficiently explored field. By providing some evidence for the relations between PTSD symptoms, fear and avoidance of driving, and driving behaviors, this study presents theoretical and practical implications. First, by using the DBQ typology of aberrant driving behaviors, the results highlighted the fact that PTSD symptoms, after a traffic crash, are associated with the drivers' tendency to engage in some forms of driving behaviors that put them in a continuous risk of further fatalities on the road. Moreover, these results suggest that PTSD after motor vehicle crashes present different associations with driving behavior among men and women. Thus, the results permit us to differentiate between factors that lead to mistakes due to misjudgments or deficits of information processing (i.e. errors and lapses) from those associated with deliberate deviations from safe driving practices (i.e. violations). From a practical point of view, understanding the factors associated with dangerous driving behavior following an RTC may assist practitioners to propose interventions in order to increase traffic safety. Another practical implication of the present results consists of the increased necessity to screen the drivers for PTSD symptomatology, after an RTC, and to orient these drivers through specialized treatment, before they drive again. Recommendation regarding driving could also be provided for drivers with fear and avoidance of driving, given the association of these manifestations with nonintentional aberrant driving behaviors. Moreover, training programs may be designed to help drivers to identify and anticipate situations that determine fear within the driving environment, with the aim of delineating which situations are more likely to interfere with secure driving behavior and to facilitate habituation with anxiogenic stimuli. Moreover, given the fact that PTSD is related to dangerous driving behaviors that implies performance deficits (e.g. errors), it is important to assess not only posttraumatic disorders, but also driving abilities after an RTC, in order to identify those driving skills affected by trauma.

As a conclusion, the present study supports the positive associations between PTSD symptomatology after an RTC and error, slips and lapses on the road. The multi-group comparisons revealed the fact that these relations are stronger for men. Moreover, PTSD symptoms are significantly related with ordinary violations, only for men. Fear and avoidance of driving positively correlated with error, slips and lapses on the road, but did not predict any type of aberrant driving behaviors. Future studies should be conducted in order to explore the factors that may moderate or mediate the relations between PTSD symptoms, fear and avoidance of driving, and aberrant driving behaviors.

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CRediT authorship contribution statement

Cornelia Măirean: Formal analysis, Writing - original draft.

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