



French drivers' behavior: Do psychological resources and vulnerabilities matter?

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ABSTRACT

Introduction: Driving is a risky activity, and road users' behavior is one of the many factors that participate in increasing the risk of road-traffic crashes. Drivers must constantly adapt their behavior to the environment and control their vehicles, and must also anticipate the behavior of others, which may pose a threat to their own safety. Interactions between road users can therefore be stressful and elicit strong negative emotions. Psychological resources and vulnerabilities may be important in understanding how drivers perceive and respond to these driving interactions. The aim of this study was to investigate the role of empathy, self-compassion, personal distress, and alexithymia in both dangerous and prosocial driving behaviors. **Method:** Our sample ($N = 550$) of French drivers was recruited via snowball sampling. The drivers filled in paper-and-pencil questionnaires including the Driver Behavior Questionnaire (DBQ), the French adaptation of the Toronto Empathy Questionnaire (Short-FTEQ), the Interpersonal Reactivity Index (IRI), the Self-Compassion Scale – Short Form (SCS-SF), and the Toronto Alexithymia Scale (TAS-20). **Results:** After controlling for gender and age, regression analyses revealed that road traffic violations were positively predicted by alexithymia and negatively predicted by cognitive empathy; errors were positively predicted by alexithymia and personal distress, and prosocial driving was positively predicted by emotional and cognitive empathy. A two-step cluster analysis identified three groups of drivers: unsafe and psychologically vulnerable ($n = 176$), self-focused and less prosocial ($n = 151$), and safe and resourceful ($n = 223$). **Conclusions:** Empathy seems to promote safe driving behaviors. Moreover, cognitive empathy appears to safeguard drivers against deliberate violations, whereas psychological vulnerabilities seem to increase the probability of engaging in dangerous behaviors. **Practical Applications:** These results could open new research avenues for the prevention of dangerous driving behaviors and the promotion of road safety.

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1. Introduction

Road-traffic crashes are the first cause of unnatural death in the world, with approximately 1.35 million people dying each year (World Health Organization [WHO], 2020). Dangerous driving behaviors such as errors and violations have been highlighted as important predictors of these tragic events (de Winter et al., 2015; de Winter & Dodou, 2010). Errors can be defined as unintentional behaviors that reflect limitations in drivers, such as attention deficit, lack of driving experience, or difficulty processing information; while violations are voluntary deviations from the highway code that can be described as part of the individual's driving style

or habits. Compared to errors, violations are more dependent on the driving context (density of traffic, road conditions, types of infrastructure, etc.) and the driver's motivations (regarding the purpose of car travel, time constraints, etc.; Lajunen et al., 2004; Reason et al., 1990). Moreover, a driver's personality traits such as neuroticism or impulsiveness (Bıçaksız & Özkan, 2016; Monteiro et al., 2018), and maladaptive expressions of anger (Delhomme & Villieux, 2005) have been found to increase dangerous driving behaviors. However, it is not clear how drivers' psychological resources and personal vulnerabilities jointly influence these behaviors. Finally, road safety research should also consider how these dispositions might promote prosocial driving behaviors (i.e., behaviors that aim to facilitate traffic fluidity and promote safety for all road users; Özkan & Lajunen, 2005).

The risk of injury or death is high on the road, and drivers constantly need to both adapt their behavior to the environment and

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control their vehicle. Moreover, they must anticipate the behavior of other road users, which can threaten their own safety. In social interactions in general, recognizing the intentions of others is crucial in anticipating their behaviors. However, in the traffic environment, drivers have only few clues available to infer the intentions and motivations of other road users (Mundutéguy & Darses, 2007; Vallières et al., 2014). Traffic interactions are therefore open to misinterpretation and can give rise to strong negative emotions such as stress, anxiety, or anger. In turn, these emotions can lead to risky behaviors (Bowen et al., 2020). It can be assumed that psychological resources and vulnerabilities that have an impact on social interactions in general might also play a role in how drivers analyze and handle the specific traffic interactions.

Psychological resources, especially empathy and self-compassion have scarcely been studied in the context of traffic safety. Empathy is a disposition that enables individuals to perceive, understand, and respond to other people's emotional experiences. It refers to the emotional capacity to share others' emotions (emotional empathy), and the cognitive ability to understand what they are feeling and experiencing (cognitive empathy; Batson, 2011; Decety & Ickes, 2011; Spreng et al., 2009). Self-compassion is a form of compassion directed toward oneself. Self-compassionate people view their failures, pains, or weaknesses with a sense of kindness, connectedness, and balanced awareness, and they try not to judge themselves severely (Neff, 2003). Both of these dispositions have been found to promote prosocial behaviors (Guo et al., 2019; Habashi et al., 2016; Lockwood et al., 2014; Welp & Brown, 2013), that is, intentional behaviors aimed at benefiting and helping others (Eisenberg et al., 2010). Positive associations have also been found between self-compassion and perspective taking, a measure of cognitive empathy (Fuochi et al., 2018; Neff & Pommier, 2013).

Perspective taking is the empathy component that relates most strongly to transgressions in general (robbery, burglary, assault, etc.). A meta-analysis on the links between empathy and transgressions indicated a negative association between perspective taking and offenses, with a mean effect size of 0.39 (Cohen's *d*) (van Langen et al., 2014). Furthermore, empathy seems to have an inhibiting effect on aggression (Song et al., 2018). To date, only two published studies have investigated the role of empathy in violations, errors, and road-traffic crashes, one in older drivers (Owsley et al., 2003) and the other in urban Turkish drivers (Nordfjærn & Şimşekoğlu, 2014). However, there are few studies on the impact of psychological resources, particularly empathy, in the field of transportation.

Both alexithymia and personal distress play a role in the way people perceive, process, and respond to emotions (Di Tella et al., 2020; Nam et al., 2020). Personal distress has often been considered as a component of emotional empathy (Davis, 1983; Spreng et al., 2009). However, an increasing number of studies point out fundamental differences between the two concepts. Where empathy can be described as "other-oriented," comprising feelings of warmth and sympathy that drive individuals to approach interactions, personal distress is "self-oriented" and comprises feelings of discomfort and anxiety in the face of another in need (Decety & Lamm, 2009). Moreover, personal distress has been found to be positively correlated with neuroticism, depression, and self-criticism (Kim & Han, 2018); difficulties in emotion regulation (Grynberg & López-Pérez, 2018); and alexithymia (Di Tella et al., 2020), which is characterized by externally oriented thinking and difficulty in identifying and verbalizing one's own emotions (Loas et al., 2001). This definition of alexithymia has gradually extended to the interpersonal domain. Alexithymic individuals not only tend to have trouble reading others' emotions, intentions, and desires, but also their own (Grynberg et al., 2010; Lyvers et al., 2017; Nam et al., 2020). This deficit in emotion processing has been

linked to aggressivity (Velotti et al., 2016) and a tendency to exhibit a hostile attribution bias (i.e., to interpret the behaviors of others as intentional, hostile, and threatening; Li et al., 2020). In the context of road safety, positive associations have been found between alexithymia and perceived stress in public transportation drivers from the Czech Republic (Winklerová & Paráková, 2013), and in France researchers have shown that drivers with higher levels of alexithymia tend to take more risks but only when they have low levels of private self-consciousness (Lheureux et al., 2018).

The aim of the present study was to investigate the role of psychological resources and vulnerabilities in driving violations, errors, and prosocial behaviors. It is the first study to examine the specific impact of empathy as well as self-compassion on both dangerous and prosocial driving behaviors. These resources have been found to facilitate social interactions and promote prosocial behaviors in general. We therefore hypothesized that they would predict more prosocial driving behaviors and fewer deliberate dangerous behaviors such as violations. Our second hypothesis was that drivers with higher alexithymia and personal distress would engage in more dangerous driving behaviors such as violations and errors.

2. Method

This study was conducted in compliance with the ethical standards of the French Society of Psychology and was systematically monitored for compliance with the ethical guidelines of Paris Nanterre University.

2.1. Participants

Initial eligibility for participation was determined using the following inclusion criteria: (a) having a valid driver's license, (b) being at least 18 years of age, (c) speaking French, and (d) driving at least 100 km per year. The participants were 620 French drivers from six different geographical areas. They were recruited using the snowball sampling method between April and June 2018. Recruitment took place in various contexts such as workplaces (hospitals, law offices, notarial offices, computer companies, schools) or associations (drama clubs, choirs, neighborhood associations). Young drivers were approached in education centers, through their former driving schools, or during their summer jobs. Thirty-one drivers were recruited when they were in driving rehabilitation programs (5.6%).

2.2. Procedure

Before filling in a paper-and-pencil questionnaire, all participants received a complete description of the study and were informed of its purpose (i.e., to assess psychological factors that could impact driving behaviors). Participation was voluntary and confidential, and participants did not receive any compensation. Forty-two drivers refused to participate and 28 were excluded due to insufficient information (age, driving experience, etc.), or because they failed to answer at least 50% of the questionnaire's items. The final sample consisted of 550 drivers (52.7% female) ranging in age from 18 to 88 ($M = 40.27$, $SD = 15.51$).

In the final sample of recruited drivers, 25.3% had been involved in at least one car crash in the last three years and 45.5% reported having been given at least one demerit point on their driver's license during that same period. They had had their driver's license for 20.56 years on average ($SD = 15.34$), had driven a car for an annual average of 17,006 kilometers ($SD = 16,222$), and had gotten an average of 1.42 ($SD = 2.46$) demerit points on their license.

Males indicated having more demerit points and driving more than females (see Table 1).

Most of the participants had at least two years of higher education (67.8%); the others declared having obtained a high school degree (14.2%) or reported not having completed high school (17.4%). Most of the drivers (52.6%) indicated working at full-time jobs, 18.9% were students, 10.2% were retired, 7.5% were self-employed professionals, 6.7% had part-time jobs, and 4.2% were unemployed. Finally, most participants were married or living maritally (64.2%).

2.3. Measures

Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009). The TEQ is a unidimensional scale composed of 16 items first designed to assess empathy as a general factor (Cronbach's $\alpha = 0.87$). For the present study, the short-FTEQ (Short-French Toronto Empathy Questionnaire), which is the French adaptation of the TEQ, was used (Karras et al., 2020). Its 16 original items were translated independently by two French psychology students and the best translation for each item was selected. A back-translation was then performed by a native English speaker and any difficulty regarding culture or understanding was discussed with the author. An exploratory factor analysis revealed that the French adaptation of the TEQ had four factors instead of the expected single one. Moreover, three of these factors failed to reach acceptable internal consistency and the factor loadings of six items were below the acceptable threshold of 0.40. The decision was made to keep only the first factor (composed of six items) and a confirmatory factor analysis showed a good fit to the model (Karras et al., 2020). The short-FTEQ is a short and reliable (Cronbach's $\alpha = 0.77$) measure of dispositional empathy rated on a Likert scale ranging from 1 (*never*) to 5 (*always*).

Interpersonal Reactivity Index (IRI, Davis, 1983). The French version of the IRI (Gilet et al., 2013) was used primarily to assess cognitive empathy (perspective taking) and personal distress. This self-report scale includes 28 items measuring four dimensions of empathy and rated on a 7-point Likert scale ranging from 1 (*this statement does not describe me at all*) to 7 (*this statement describes me perfectly*). The four dimensions are Fantasy (FS), Perspective Taking (PT), Empathic Concern (EC), and Personal Distress (PD). Each of these dimensions is measured by seven items. Internal consistency was acceptable for all four subscales: Cronbach's alphas were 0.71, 0.79, 0.67, and 0.79 for EC, PD, PT, and FS, respectively. In the original French validation study, Cronbach's alphas were 0.70, 0.78, 0.71, and 0.81.

Toronto Alexithymia Scale (TAS-20; Bagby, Parker, et al., 1994; Bagby, Taylor, et al., 1994). The TAS-20 was used to assess alexithymia. It is composed of 20 items measuring three facets: DIF, difficulty identifying feelings in oneself (e.g., "I have feelings that I can't quite identify"); DDF, difficulty describing one's feelings to others (e.g., "It is difficult for me to find the right words for my

feelings"); and EOT, externally oriented thinking (e.g., "I prefer talking to people about their daily activities rather than their feelings"). Participants were asked to indicate their agreement with each statement using a 5-point Likert scale ranging from 1 (*I strongly disagree*) to 5 (*I strongly agree*). In the current study, only the total alexithymia score of the scale was used and its internal consistency was good ($\alpha = 0.83$). In the French validation study on non-clinical adults by Loas et al. (2001), Cronbach's alpha was 0.78.

Driving Behaviour Questionnaire (DBQ; Reason et al., 1990). The French adaptation of the DBQ (Guého et al., 2014) has 23 items and was used to measure aberrant behaviors on the road as well as prosocial behaviors. Participants were asked to indicate on a 6-point Likert scale how often they had been involved in each type of self-reported behavior over a one-year period. The scale ranged from 1 (*never*) to 6 (*very often*). Six types of behaviors were measured: ordinary violations (4 items), aggressive violations (3 items), dangerous errors (4 items), inattention errors (4 items), inexperience errors (4 items), and prosocial behaviors (4 items). Because the internal consistency of each of the violation and error subscales was not satisfactory, we chose to retain only the total 7-item violation score ($\alpha = 0.72$) and the total 12-item error score ($\alpha = 0.73$) for further analyses. The internal consistency of the positive behaviors subscale was questionable ($\alpha = 0.61$).

Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011). The SCS-SF is a unidimensional brief self-assessment measure of self-compassion (12 items) that uses a 5-point Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). It has recently been translated into French (Karras et al., 2019) and exhibits a stable factorial structure and satisfactory internal consistency ($\alpha = 0.76$). Participants were asked to indicate how they typically act towards themselves in difficult times.

Sociodemographic characteristics. The sociodemographic characteristics were age, gender, education, marital status, annual kilometers, years since the driver's license was obtained, number of car crashes, and demerit points within the last three years.

2.4. Data analyses

The data were analyzed using SPSS 23.0 software. We carried out hierarchical multiple regression analyses to determine the contribution of psychological resources and vulnerabilities to violations, errors, and prosocial driving behaviors, while controlling for the driver's gender and age. A cluster analysis was also performed to identify specific patterns of psychological resources, vulnerabilities, and driving behaviors. The IRI fantasy scale was excluded from analyses because it measures an individual's ability to project him/herself onto the feelings and emotions of imaginary characters, which does not apply to the driving activity. The correlation between the short-FTEQ and the IRI's empathic concern was high (0.70), to avoid collinearity only the short-FTEQ was used as a measure of emotional empathy.

3. Results

3.1. Descriptive statistics

Internal consistency coefficients, means, and standard deviations for all study variables are reported in Table 2. The normality assumption was checked for all variables: the skewness and kurtosis coefficients were within the recommended interval of $[-2; +2]$ (Gravetter et al., 2020). Before comparing men's and women's scores, we performed Levene's homogeneity of variance tests. Levene's tests were significant for the DBQ-violation subscale, the TAS-20, and the SCS-SF, indicating that the null hypothesis of

Table 1

Means for driving experience, annual kilometers, demerit points, and road crashes [SD in brackets]

	N = 550	Male (n = 260)	Female (n = 290)
Experience (years)	20.56 [15.34]	21.10 [16.01]	20.08 [14.73]
Kilometers/year*	17,005 [16,222]	21,434 [17,980]	13,036 [13,294]
Demerit points*	1.42 [2.46]	1.92 [2.95]	0.98 [1.80]
Crashes	0.31 [0.58]	0.32 [0.58]	0.29 [0.56]

SD: standard deviation.

*Significant differences between men and women (Welch's *t*-test for unequal variances, $p < 0.001$).

Table 2

Mean scores and differences between men and women on the study variables [SD in brackets]

	N = 550	Male n = 260	Female n = 290	Cronbach's α	Cohen's <i>d</i>
Short-FTEQ*	23.82 [3.24]	23.04 [3.32]	24.51 [3.01]	0.77	0.45
IRI-Personal Distress*	23.80 [7.40]	22.32 [6.84]	25.13 [7.65]	0.79	0.38
IRI-Perspective Taking	32.05 [6.06]	31.92 [5.96]	32.16 [6.16]	0.67	-
Self-compassion*	36.16 [6.73]	36.99 [6.14]	35.41 [7.14]	0.76	0.24
TAS-20*	50.21 [10.99]	51.49 [9.97]	49.07 [11.72]	0.83	0.22
DBQ-Violations*	14.41 [5.50]	15.73 [5.81]	13.23 [4.92]	0.72	0.46
DBQ-Errors*	24.75 [6.92]	23.65 [6.49]	25.73 [7.14]	0.73	0.30
DBQ-Prosocial Behaviors	17.58 [3.84]	17.67 [3.66]	17.50 [4.01]	0.61	-

* $p < 0.01$.

SD: standard deviation.

(Short-FTEQ: French Toronto Empathy Questionnaire-Short Form; IRI: Interpersonal Reactivity Index; TAS-20: Toronto Alexithymia Scale-20 items; DBQ: Driving Behaviour Questionnaire).

homogeneity had to be rejected. We thus used Welch's *t*-test to compare violations, alexithymia, and self-compassion scores across genders, whereas we used Student's *t*-test for the other scales.

3.2. Correlation analyses

Pearson's correlations between study variables are presented in Table 3. Negative correlations were observed between violations and the three psychological resources, and a positive correlation was found with alexithymia. Errors were associated positively with psychological vulnerabilities and negatively with self-compassion. Finally, cognitive and emotional empathy were positively associated with prosocial driving behaviors, while alexithymia was negatively correlated with these positive behaviors.

3.3. Hierarchical regression analyses

Three hierarchical regression analyses were performed with violations, errors, and prosocial behaviors as dependent variables. For each analysis, the driver's gender and age were entered in Step 1 and psychological variables, in Step 2 (see Table 4).

The driver's gender and age were significant predictors of driving violations to the extent that females and older drivers reported lower frequencies of these risky behaviors than males and younger drivers. As expected, perspective taking ($\beta = -0.14$, $p < 0.01$) and alexithymia ($\beta = 0.10$, $p < 0.001$) also significantly predicted violations. Personal distress ($\beta = 0.25$, $p < 0.001$), alexithymia ($\beta = 0.19$, $p < 0.001$), and gender (declared female gender, $\beta = 0.11$, $p < 0.01$) were positive predictors of driving errors. The two psychological vulnerabilities alone explained 12.7% of the variance in the DBQ-errors. Finally, the predictors of prosocial driving behaviors were emotional empathy ($\beta = 0.21$, $p < 0.001$) and perspective taking

($\beta = 0.22$, $p < 0.001$): 12.8% of the variance in the DBQ-prosocial behaviors was explained by these variables.

3.4. Cluster analysis

The Two-step cluster analysis method was employed to examine profiles, created empirically by grouping drivers based on the three driving behavior variables (violations, errors, and prosocial behaviors). All criterion variables were standardized, and z-scores were used. A Two-step cluster analysis is a reliable clustering method when used on quantitative variables (Bacher et al., 2004). We identified three clusters. One-way ANOVAs followed by Scheffe post-hoc tests were then performed on all study variables to compare mean scores within groups (see Table 5).

The first cluster consisted of 176 drivers (32% of the total sample) that we labeled "unsafe and psychologically vulnerable" because they reported the highest frequencies of violations and errors, and the highest level of alexithymia among the three clusters. These drivers also had significantly more demerit points on their driver's license in the three years prior to the study. The second group was labeled "self-focused and less prosocial" since it consisted of 151 drivers (27.5% of the total sample) who reported engaging in prosocial driving behaviors significantly less often than the other two groups and obtained the lowest emotional empathy score. Finally, the third group was labeled "safe and resourceful;" it consisted of 223 drivers (40.5% of the sample) who reported the highest frequency of prosocial behaviors and the highest level of perspective taking. They also indicated engaging in violations less often than the other two groups, and had been involved in significantly fewer car crashes in the three years prior to the study. Interestingly, "safe and resourceful" drivers reported significantly lower levels of personal distress, and higher levels of self-compassion than "unsafe and psychologically vulnerable" drivers. They were also older and more experienced.

Table 3

Pearson's correlations between the study variables.

	IRI-PT	SCS SF	IRI-PD	TAS-20	DBQ-Violations	DBQ-Errors	DBQ-Prosocial
Short-FTEQ	0.33***	-0.04	0.13**	-0.13**	-0.14**	0.10	0.27***
IRI-PT		0.25***	-0.01	-0.30***	-0.18***	-0.01	0.30***
SCS-SF			-0.35***	-0.32***	-0.12**	-0.17***	0.10
IRI-PD				0.32***	-0.05	0.34***	0.03
TAS-20					0.20***	0.25***	-0.12**
DBQ-Violations						0.18***	-0.15**
DBQ-Errors							-0.07

** $p < 0.01$, *** $p < 0.001$.

(Short-FTEQ: French Toronto Empathy Questionnaire-Short Form; IRI-PT: Interpersonal Reactivity Index-Perspective Taking; SCS-SF: Self-Compassion Scale-Short Form; IRI-PD: Interpersonal Reactivity Index-Personal Distress; TAS-20: Toronto Alexithymia Scale-20 items; DBQ: Driving Behaviour Questionnaire).

Table 4
Hierarchical regression results for driving violations, errors, and prosocial behaviors.

	Step 1				Step 2			
	B	SE B	β	t	B	SE B	β	t
DBQ-violations								
(Intercept)	18.04	0.67		26.83	21.72	2.82		7.71
Gender	−2.51	0.45	−0.23***	−5.55	−2.37	0.46	−0.22***	−5.14
Age	−0.06	0.02	−0.16***	−3.94	−0.05	0.02	−0.15***	−3.55
Short-FTEQ					−0.04	0.08	−0.02	−0.54
IRI-PT					−0.12	0.04	−0.14**	−3.00
TAS-20					0.05	0.02	0.10*	2.27
SCS-SF					−0.04	0.04	−0.05	−1.17
	$R^2 = 0.078F = 23.07^{***}$				$R^2 = 0.127F = 13.20^{***}$			
DBQ-Errors								
(Intercept)	24.79	0.87		28.53	10.27	3.43		3.00
Gender	2.08	0.58	0.15***	3.56	1.52	0.58	0.11**	2.63
Age	−0.03	0.02	−0.06	−1.51	−0.01	0.02	−0.03	−0.65
Short-FTEQ					0.12	0.09	0.06	1.40
TAS-20					0.12	0.03	0.19***	4.19
SCS-SF					−0.004	0.05	−0.004	−0.10
IRI-PD					0.23	0.04	0.25***	5.53
	$R^2 = 0.027F = 7.51^{**}$				$R^2 = 0.154F = 16.50^{***}$			
DBQ-Prosocial Behaviors								
(Intercept)	16.81	0.49		34.48	6.57	1.96		3.35
Gender	−0.17	0.33	−0.02	−0.52	−0.56	0.32	−0.07	−1.75
Age	0.02	0.01	0.09	2.03	0.02	0.01	0.07	−1.79
Short-FTEQ					0.25	0.05	0.21***	4.71
IRI-PT					0.14	0.03	0.22***	4.93
TAS-20					−0.01	0.02	−0.02	−0.41
	$R^2 = 0.008, F = 2.20$				$R^2 = 0.136, F = 14.19^{***}$			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Gender: 0 = man, 1 = woman.

(Short-FTEQ: French Toronto Empathy Questionnaire-Short Form; IRI-PT: Interpersonal Reactivity Index-Perspective Taking; SCS-SF: Self-Compassion Scale-Short Form; IRI-PD: Interpersonal Reactivity Index-Personal Distress; TAS-20: Toronto Alexithymia Scale-20 items; DBQ: Driving Behaviour Questionnaire).

Table 5
Means, standard deviations and one-way ANOVAs on behavioral variables, psychological variables, and driving outcomes.

	Cluster 1 (n = 176)		Cluster 2 (n = 151)		Cluster 3 (n = 223)		$F(2, 547)$	p	Partial η^2
	M	SD	M	SD	M	SD			
Prosocial D.B.	17.91 ^a	3.20	13.23 ^b	2.34	20.26 ^c	2.14	336.59	0.000	0.552
Violations	20.09 ^a	5.22	13.14 ^b	3.25	10.78 ^c	2.49	313.12	0.000	0.534
Errors	28.70 ^a	8.27	23.34 ^b	5.32	22.58 ^b	5.17	50.62	0.000	0.156
Emotional empathy	23.84 ^a	3.14	22.74 ^b	3.35	24.53 ^a	3.06	14.53	0.000	0.050
Perspective taking	31.68 ^a	5.98	30.28 ^a	5.93	33.53 ^b	5.87	14.10	0.000	0.049
Self-compassion	34.96 ^a	6.55	35.88 ^{a b}	6.30	37.29 ^b	6.99	6.17	0.002	0.022
Alexithymia	53.84 ^a	10.61	49.96 ^b	9.81	47.44 ^b	11.14	17.89	0.000	0.061
Personal distress	25.07 ^a	7.81	23.38 ^{a b}	6.54	23.09 ^b	7.54	3.89	0.021	0.014
Age	37.94 ^a	15.65	39.49 ^{a b}	14.81	42.63 ^b	15.61	4.82	0.008	0.017
Km/year	18,850	17,154	17,333	16,310	15,329	15,281	2.37	0.094	0.009
Lost points	2.10 ^a	3.16	1.38 ^b	2.27	0.92 ^b	1.73	11.73	0.000	0.041
Car crashes	0.40 ^a	0.65	0.35 ^a	0.58	0.19 ^b	0.46	8.09	0.000	0.029

Prosocial D.B.: prosocial driving behaviors.

^{abc}Different initials show significant differences between clusters (Scheffe post-hoc test, $p < 0.05$).

Chi-square tests were performed to compare groups in terms of gender, getting at least one demerit point in the three years preceding the research, and involvement in at least one car crash during the same period. There were more females among the “safe and resourceful” drivers (57.8%) than among the “unsafe and psychologically vulnerable” drivers (44.3%): $\chi^2(2) = 7.64$, $p = 0.022$, Cramer’s $V = 0.118$. Only 35.9% of the “safe and resourceful” drivers had gotten any demerit points on their driver’s license within the last three years, which is significantly lower than the other groups (48.3% of the “self-focused and less prosocial” drivers and 55.1% of the “unsafe and psychologically vulnerable” drivers): $\chi^2(2) = 15.39$, $p < 0.001$, Cramer’s $V = 0.167$. Finally, only 26.6% of these drivers had been involved in a car crash (32.4% and 41% for the other two groups, respectively): $\chi^2(2) = 15.25$, $p < 0.001$, Cramer’s

$V = 0.167$. Notably, the three clusters did not differ in the number of kilometers driven each year.

4. Discussion

The aim of this study was to investigate the role of psychological resources and vulnerabilities in driving violations, driving errors, and prosocial driving behaviors. Firstly, we expected empathy and self-compassion to play a protective role in driving by reducing violations and promoting prosocial driving (Hypothesis 1). Secondly, we expected alexithymia and personal distress to predict more driving violations and errors (Hypothesis 2).

Our first hypothesis was partially validated. A hierarchical regression analysis showed that, after controlling for gender and age, only perspective taking, a measure of cognitive empathy,

was a significant negative predictor of violations. This is in line with the results of the meta-analysis performed by Van Langen et al. (2014), which found that offenders involved in transgressions in general (robberies, assaults, etc.) had lower levels of perspective taking than non-offenders. Moreover Llorca-Mestre et al. (2017) found that young offenders scored lower on the Interpersonal Reactivity Index's perspective-taking scale than non-offenders and that it also predicted fewer aggressive behaviors. Both components of empathy were significant positive predictors of prosocial driving behaviors. As expected, being able to understand another's perspective, as well as being sensitive to other people's emotions and well-being, seem to foster cooperation with other road users. This result is consistent with studies that have found empathy, both emotional and cognitive, to be a strong predictor of prosocial behaviors. For example, Welp and Brown (2013) showed that, compared to non-empathic drivers, empathic adults driving past a man with a flat tire on the side of the road reported more intentions to stop and lend their cell phone or their spare tire, or to give the man a ride. Moreover, Gülseven et al. (2020) found empathy to be a positive predictor of prosocial moral reasoning in their decision-making when individuals encounter moral dilemmas regarding whether or not they should help a person in need.

The results of our cluster analysis showed that 40.5% of our sample of drivers could be described as "safe and resourceful" since they reported more prosocial driving behaviors, fewer violations, and fewer car crashes, and had higher levels of perspective taking than the "self-focused and less prosocial" group (27.5% of our total sample) and the "unsafe and psychologically vulnerable" group (32%). By contrast, the "self-focused and less prosocial" drivers reported fewer prosocial driving behaviors and had the lowest levels of emotional empathy, to the extent that they generally felt less concerned by other people's well-being. Although self-compassion did not contribute to driving behaviors in our regression analyses, the cluster analysis showed that it is still part of a pattern of positive resources that are significantly greater in quantity among safer drivers. Since self-compassion has been found to help individuals handle stressful situations (Breines et al., 2014; Ewert et al., 2021) and is associated with acceptance of one's own as well as others' flaws and imperfections (Zhang et al., 2020), it could also be helpful in handling the stressful driving environment.

Our second hypothesis was also partially validated since only alexithymia remained a significant positive predictor of violations after controlling for gender and age. Researchers have found positive associations between alexithymia and impulsiveness, aggressiveness and a tendency toward having a hostile attribution bias (Li et al., 2020; Velotti et al., 2016). Perceiving other users' behaviors as hostile could trigger anger, which is a strong predictor of violations (Albentosa et al., 2018; Delhomme & Villieux, 2005). It could also lead drivers to react impulsively, another predictor of violations (Bıçaksız & Özkan, 2016). Moreover, positive relationships between alexithymia and risk-taking have been found in various contexts such as extreme sports (Barlow et al., 2015), risky drinking (Greene et al., 2019; Lyvers et al., 2018; Obeid et al., 2020), and other kinds of substance abuse (Palma-Álvarez et al., 2021). For these authors, alexithymic individuals might be using risky behaviors as a means of numbing unidentifiable feelings or of replacing them with strong, easily recognizable emotions such as fear. However, in the field of road traffic, Lheureux et al. (2018) found the positive interaction between alexithymia and risk taking to be moderated by private self-consciousness, that is, the ability of individuals to reflect upon themselves and identify their own personal characteristics (e.g., being aware of one's own difficulties in recognizing and processing emotions). Only alexithymic drivers lacking this ability seemed to take more risks while driving.

More research is needed to identify variables that could further explain the interaction between alexithymia and traffic violations.

As expected, we found alexithymia and personal distress to be positive predictors of driving errors. Both vulnerabilities reflect difficulty processing emotions. Moreover, a higher tendency to feel emotional distress in stressful environments is often associated with a higher level of alexithymia (Nam et al., 2020). Studies on driving errors have shown that emotions, especially negative ones, can deteriorate driving performance by increasing risk-taking (Hu et al., 2013). The driving environment and interactions with other road users can generate strong emotions that can be overwhelming and difficult to handle for some drivers (Bowen et al., 2020). This could lead to impaired information processing and decision-making, which increase the risk of errors (Reason et al., 1990) and is in line with studies that have found positive associations between emotion-regulation difficulties and driving errors (Sani et al., 2017; Šeibokaitė et al., 2017). Our regression results were supported by the cluster analysis, which revealed that "unsafe and psychologically vulnerable" drivers reported engaging more frequently in violations and errors, had gotten significantly more demerit points than the other two groups, and were higher in alexithymia. They also reported higher levels of personal distress and had been involved in more crashes than "safe and resourceful" drivers.

5. Limitations and future research avenues

This study has several limitations. One is its cross-sectional design since it does not allow us to grasp causal relations between variables. Furthermore, psychological resources and vulnerabilities were assessed as general rather than situational dispositions. In the past decade, a growing number of studies have focused on the motivational component of empathy (Borja Jimenez et al., 2020; Decety, 2017; Zaki, 2014). The authors have emphasized the need to distinguish between an individual's general disposition towards empathy and his/her propensity to empathize with others in specific situations (Keysers & Gazzola, 2014). In this motivation-based approach, context is crucial because individuals tend to down-regulate their empathy when it is perceived as too effortful or costly (in terms of money, time, or even cognitive resources; Cameron et al., 2019), or when empathizing might interfere with personal goals (Zaki, 2019). On the road, when drivers are preoccupied or subject to time constraints, they might not be motivated to empathize with other road users. In these conditions, prosocial driving behaviors might even be seen as a waste of time in one's terribly busy schedule. Drivers may instead be more prone to engage in violations such as speeding or using their mobile phone. In line with this motivation-based approach, road safety research could benefit from the development of scales specifically designed to assess situational empathy in the context of driving. More research is also needed to further investigate the relationships between empathy, drivers' motivations and driving behaviors. Furthermore, the present study only focuses on drivers, but future research should include other road users (pedestrians, cyclists, truck drivers, etc.) as their psychological resources and vulnerabilities may also influence the way they behave in the traffic environment. Finally, as empathy seems to be a positive resource on the road, the implementation of empathy training programs among high-risk drivers (such as traffic offenders) could be tested in future studies. For example, researchers in the Czech Republic have designed a rehabilitation program based on empathy-induction techniques for drivers whose license was suspended for serious offenses (Shaw et al., 2020). Interestingly, Shaw et al. (2020) found that after five weekly four-hour group interventions, offending drivers presented an increased activation of brain areas involved in

empathy, especially areas through which people generate inferences about the beliefs and mental states of others. More research is needed to determine whether this increased neural activity can impact actual driving behaviors, but it nonetheless provides interesting perspectives on how empathy might be used to improve road safety.

6. Conclusion and practical applications

The present findings provide interesting paths to be explored related to the prevention actions that aim at reducing road risk. Safe drivers, who are higher in empathy and self-compassion, seem to be more able to cope with the challenges they encounter daily on the road. On the contrary, unsafe drivers, who are more at risk of negative driving outcomes (offenses, car crash, etc.), seem to have more trouble dealing with stressful situations and negative emotions. Protection and vulnerability factors could be considered in the process of learning of driving. Future drivers could be screened to detect personal dispositions deficits such as empathy, which might increase their risk to engage in dangerous driving behaviors. Exercises such as role play could then be used during driving lessons to increase the ability of young drivers to adopt other users' perspectives and promote positive interactions while driving. Prevention policies and campaigns could also benefit from safety messages that encourage drivers' empathy and consideration towards other road users (Delhomme et al., 2009). Finally, drivers who present a high risk to be involved in road-traffic crashes, such as driving offenders, might benefit from prevention programs that would teach them to better regulate their emotions while driving, to cope more adaptively with stressful traffic situations, and better manage interactions with other road users.

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Conflict of interest

The authors declare that they have no conflict of interest related to this article.

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