



Regulatory focus, time perspective, locus of control and sensation seeking as predictors of risky driving behaviors



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ABSTRACT

Empirical evidence shows that most of the road safety efforts fail to reach the most risk-prone drivers. In light of this issue, we have developed this study in order to distinguish between high-risk drivers and low-risk drivers based on variables that have already been shown to affect the effectiveness of preventive messages: regulatory focus orientation, time perspective, locus of control and sensation seeking. We sent paper and pencil questionnaires to five thousand low-risk drivers and five thousand high-risk drivers randomly selected based on their driving records. A driver who has been convicted of two or more traffic infractions with demerit points (e.g., exceeding speed limits, red light violation, no seatbelt, etc.) in the last two years was considered a high-risk driver whereas a low-risk driver had no traffic offense registered in his driving record in the last four years. We received two thousand and sixty-four completed questionnaires for a response rate of 20.6%. Seven hundred and ninety-eight belonged to the group of high-risk drivers and one thousand two hundred and sixty-six to the group of low-risk drivers. The results show that a promotion focused orientation, a present hedonistic perspective, an internal locus of control, and sensation seeking are associated with more risky driving behaviors and could therefore distinguish between high-risk and low-risk drivers. These results increase the understanding of risky drivers' personalities and motivations. The literature review provides insight into how these findings might be considered in developing more effective road safety programs and campaigns, and the conclusion encourages researchers to explore these new avenues in future research.

1. Introduction

Each year 1.2 million people lose their lives on roads and 20 to 50 million of others will spend long days, weeks or months in a hospital trying to recover from car accidents. Many of them will never be able to live the life they used to because of major trauma and/or a disability. If nothing is done, the World Health Organization predicts that road crashes will become the 7th leading cause of death worldwide in 2020 (WHO, 2015).

These figures are disturbing. They are even more disturbing when one considers that, in most cases, traffic injuries are preventable and caused by human factors such as adopting an excessive speed, plowing through a red light, driving under the influence of alcohol or drugs and/or not wearing a seatbelt (WHO, 2015).

To change drivers' behaviors and encourage them to adopt safer driving habits, many countries have relied on road safety campaigns. However, empirical evidence shows that all prevention efforts are not

equally persuasive and that most of them fail to reach the most risk-prone drivers (Lewis et al., 2007; Robertson and Pashley, 2015).

In this article, we propose that this lack of efficacy stems at least partially from the lack of adaptation of road safety campaigns to the specific characteristics of high-risk drivers. While government agencies in charge of road safety policies tend to sprinkle their advertising budgets on the whole population as though all drivers represent a similar potential danger, we argue that high-risk drivers are characterized by some individual traits that distinguish them from low-risk drivers and may explain the failure of current road safety strategies.

This argument is far from new and has been emphasized many times in the literature. Over the past two decades, a vast amount of research has been undertaken to identify the different characteristics of drivers that could predict risky driving behaviors i.e. behaviors, deliberate or not, that endanger the life of the driver and/or other road users (e. g. speeding, running a red light, not wearing a seatbelt, crossing a white line) (Dula and Geller, 2003). Based on these studies, a large number of

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psychological and demographic variables (e.g., driving anger, impulsiveness, boredom, extraversion, age, gender, etc.) have emerged as predictors of risky driving (Dahlen et al., 2012, 2005; Delhomme et al., 2012; Precht et al., 2017; Sarma et al., 2013). These earlier studies are all extremely important in understanding the complex profile of high-risk drivers. However, they unfortunately provide very little substantial guidance to practitioners on how they can concretely adapt or modify road safety messages to more effectively reach the specific population of high-risk drivers. In light of this issue, we decided to develop this study in order to distinguish high-risk from low-risk drivers based on variables that may influence the persuasion of road safety messages. An extensive literature review allows us to focus our investigations on four individual traits: regulatory focus orientation, time perspective, locus of control and sensation seeking. These four individual traits possess the dual characteristics of being potentially linked to risky driving behaviors and of being able to influence the effectiveness of prevention messages. Some have already been associated with risky driving while others have been largely neglected by the literature. In any case, they have never been studied jointly before and therefore no information exists regarding their potential correlation, their relative strength in predicting risky driving behaviors and/or their marginal contribution to the definition of a high-risk driver

The links between regulatory focus orientation, time perspective and risky driving behavior have yet to be demonstrated. Very little research has examined the effect of these two traits on road safety despite existing relationships with other risky behaviors. Concerning the locus of control, research linking locus of control to risky driving is numerous, but seems to contradict each other. Finally, sensation-seeking has been extensively studied and the relationship between sensation-seeking and risky driving is widely established but has never been studied in conjunction with the other three variables of this study.

As mentioned earlier, these four traits were chosen because they are all relevant to the development of prevention strategies. Indeed, as we will see below, depending on their regulatory orientation, their time perspective, their locus of control and/or their level of sensation-seeking, individuals are not influenced in their driving behavior by the same prevention message which, to be effective, will have to be adapted to the specificities of these individual traits.

In addition to these four traits and because of their well-known link to risky driving, we included age, gender and driving experience in our statistical models as control variables. Since gender and age can potentially facilitate the targeting of the prevention strategy, we also examined their moderating effects on the relationship between our independent variables and risky driving.

1.1. Regulatory focus orientation, risky driving and message orientation

According to the Regulatory Focus Theory (Higgins, 1997), the population can be divided into two equal categories of persons characterized by two different motivational orientations: promotion focus versus prevention focus. A promotion focused person is motivated to achieve aspirations in life and is sensitive to positive outcomes, whereas a prevention-focused person is motivated to achieve protection in life and is sensitive to negative outcomes. It has been demonstrated that these two categories of persons differ in terms of their risk perception and risky behaviors. Because the promotion-focused individuals are principally driven by positive goals, they worry less about the potential risks induced by their behaviors or choices. Risk taking can even be a way to attain positive outcomes. Inversely, prevention-focused individuals are more risk adverse and motivated to minimize hazards (Crowe and Higgins, 1997; Higgins, 1997).

Due to the natural eagerness motivations of the promotion focused drivers and the natural vigilant motivations of the prevention-focused drivers, promotion focused drivers should be more risk-prone and prevention-focused drivers should be more safety-minded on the road. However, only two studies have directly investigated the relationship

between regulatory focus and risk-taking in traffic and both used only young drivers, thus making generalizations difficult.

The first one was developed by Werth and Förster (2007) who used a computer program and a foot pedal linked to a computer. They found that promotion-focused participants brake later than prevention-focused participants in an ambiguously dangerous situation, such as when the “potential danger can be seen well ahead of time” and is “not necessarily dangerous”. Their sample was composed of 52 undergraduates with a majority of women.

The second one was developed by Hamstra et al. (2011) who did two studies. In the first study, they used GPS data to measure the natural speeding behaviors of 120 young participants (20–30 years old) over a two month period. They found that the higher the participant’s score in terms of promotion-focused orientation, the more he or she exceeded speed limits. In a second study, they used a driving simulator and 31 young volunteers (from 18 to 31 years old) and showed that promotion-focused participants more closely followed the car in front of them, thus adopting riskier behaviors than the prevention-focused participants.

The results of these two studies are consistent with the existence of a relationship between the promotion-focused orientation and risky driving behaviors. However, this assumption has still to be validated with a representative sample of drivers.

Thus, we propose the following first hypothesis:

H1. The higher the score on promotion focus, the more likely risky driving is. The higher the score on prevention focus, the less likely risky driving is.

If validated, this hypothesis may in part explain why current road safety campaigns, that focus generally on the risk involved and are negatively framed, fail to reach risk-prone drivers. Indeed, it has been demonstrated that, in order to be effective, a “message’s regulatory focus” should match the viewer’s regulatory focus (Lee and Aaker, 2004). In sum, to have an impact on a promotion-focused person, the message has to put the emphasis on the positive achievement resulting from the adoption of the recommended behavior, whereas for a prevention-focused person it will have to show the risk avoided due to the adoption of the recommended behavior (Aaker and Lee, 2001; Zhao and Pechmann, 2007).

For instance, Kim (2006) demonstrated that an anti-smoking message such as “If you do not smoke, you can obtain positive results, such as improving your respiratory system (...) and more important, attaining greater energy for your everyday life” is more efficient on promotion focused high school students than an anti-smoking message saying “If you do not smoke, you can avoid negative results, such as lung cancer (...) and more important, you can protect your life.” The reverse was true for prevention-oriented students.

1.2. Time perspective, risky driving and message orientation

Zimbardo and Boyd, 1999 described the *time perspective* as the manner in which “individuals, and cultures, partition the flow of human experience into the distinct temporal categories of past, present, and future” (p. 1008). They distinguish between five types of persons. Those who are “Present hedonistic” that tend to make decisions based on the immediate benefits and pleasures that can be gained from them. Those who are “Present Fatalistic” that are also present-oriented but with a fatalistic attitude believe that their lives are more a matter of destiny than controlled by their decisions or actions. Those who are “Future-oriented” focus on their long-term goals and make decisions based on their anticipated future positive consequences. Those who are “Past Negative” remain in a past shaped by unfavorable memories. Finally, those who are “Past Positive” that are nostalgic for the good old days tend to preserve it by adopting a safe attitude when making decisions.

Significant associations between the time perspective and adoption

of risky behaviors have been highlighted in the literature (Adams and Nettle, 2009; Hall et al., 2015; Keough et al., 1999; Zimbardo and Boyd, 2006). Most research has contrasted the future perspective with the present hedonistic perspective, highlighting the protective role of the future perspective and the potentially dangerous role of the present hedonistic perspective. Some studies also show that fatalism or a negative view of the past can be linked to unhealthy behaviors and that, conversely, nostalgia for the good old days (past positive) leads to the adoption of healthy behaviors. (Daugherty and Brase, 2010; Cheng et al., 2012; Laghi et al., 2012; Hamilton et al., 2003). However, to the best of our knowledge, only two studies have examined the effect of time perspective on the adoption of risky driving behaviors and these two studies were only interested in present versus future perspectives. In 1986, Chebat and Chandon used a six-item scale to measure the present orientation and future orientation of 683 Canadian adult drivers (Chebat and Chandon, 1986). They found that present orientation was positively correlated and future orientation was negatively correlated with attitudes towards speeding. Ten years later, Zimbardo et al. (1997) used a previous and less developed version of the Zimbardo Time Perspective Inventory (ZPTI) scale with 1714 students and showed a correlation between students' risky driving behaviors and the present hedonistic time perspective.

In conclusion, these two studies employed different samples and different instrument measures but still converged on the existence and direction of the relationship. This led us to hypothesize such a relationship in our conceptual model as H2:

H2a. Present Hedonistic Time perspective is positively related to risky driving.

H2b. Future Time Orientation is negatively related to risky driving.

Since nothing has been said in the road safety literature about the effect of the other time perspectives, we adopt an exploratory approach and do not formulate any hypothesis concerning past positive, past negative and present fatalistic perspectives. However, in light of previous findings regarding their relationship to health behaviors we can envisage that past negative and present fatalistic perspectives will be positively and past positive negatively related to risky driving.

The implications of these hypotheses for road safety could be important. If, as previous research appears to indicate, high-risk drivers are more present-oriented than low-risk drivers, it may be envisaged to train them to change their time frame in order to reduce their risky driving behaviors. Such a strategy has already proved to be efficient in other domains (Arnocky et al., 2014; Hall and Fong, 2003). For instance, Hall and Fong (2003), with a brief intervention delivered in three sessions of 30 min, managed to successfully enhance the physical activity of a group of adolescents. They asked the adolescents to set a long-term goal for their physical activities, to list the short-term costs and benefits of physical activity and to contrast them with their long-term counterparts. After the sessions, the authors compared the physical activity of the intervention group to those of the other two groups, one that did not receive any treatment and another that had been asked to set short-term and realistic goals for their physical activities. The results showed that the participants in the intervention group exercised significantly more post than pre-intervention and that this effect is significantly more important than for the two other groups. More recently, Arnocky et al. (2014) asked participants to visualize either their typical day in four years (future condition) or what is currently their typical day (present condition). Then, they measured their environmental concerns and willingness to engage in pro-environmental behaviors. They found that those in the future condition expressed significantly more environmental concern and willingness to aid the environment after the priming procedure than those in the present condition regardless of their initial temporal orientation.

These results show that an individual's time frame could be modified with positive effects at the behavioral level.

1.3. Locus of control, risky driving and message orientation

According to Rotter's article on the locus of control (Rotter, 1966), persons differ in the degree that they believe that their lives are driven by their own actions and skills (internal locus of control) or, on the contrary, are controlled by some powerful persons or external forces such as chance or fate (external locus of control).

During the last three decades, numerous studies have explored the relationship between the locus of control (LOC) and risky driving behaviors, but their results are inconsistent and inconclusive. These inconsistencies may be explained in particular by the use of different traffic-specific LOC scales. According to early studies on this topic, people with an external locus of control would be the most dangerous in terms of road safety because they do not take enough precautions and safety measures to prevent car accidents (Montag and Comrey, 1987; Lajunen and Summala, 1995). For instance, Montag and Comrey (1987) used a targeted locus of control scale, the MDIE (Montag Driving Internality Externality scale), to measure the LOC of a sample of 400 drivers where half of them had been involved in a fatal accident. They found that the external LOC was positively correlated and the internal LOC was negatively correlated to involvement in fatal accidents. These results have been replicated by Gidron et al. (2003) who measured the internal LOC of ninety-five Israeli students and found that low internal LOC drivers were involved in more accidents than high internal LOC drivers. However, these results are questionable. On one hand, it is plausible that drivers are more involved in car accidents because of their external locus of control. On the other hand, it is also possible that drivers that have been involved in a car accident developed an external locus of control as a self-defense mechanism in order to assign the responsibility of the accident to external factors (Montag and Comrey, 1987; Lajunen and Summala, 1995).

More recent studies have reported opposite results. By principally using the traffic locus of control scale (T-LOC), they found that drivers with an internal LOC are more dangerous than drivers with an external LOC due to their tendency to overestimate their driving skills and their ability to avoid a car accident (Özkan and Lajunen, 2005; Warner et al., 2010). However, those studies used only self-reported measures of driving behaviors (Lajunen et al., 1997) and are challenged by other studies that fail to find a relationship between drivers' traffic locus of control and risky driving behaviors (Marengo et al., 2012; Sarma et al., 2013).

In this research, we decided to use a general measure of the locus of control and to measure its impact on risky driving. There were four reasons for this decision. The first is our desire to clarify the debate about the type of LOC that can influence risky driving without having to position ourselves for one specific scale instead of another (Turnipseed, 2014; Lajunen and Summala, 1995). The second is based on the criticism surrounding the MDIE. The impression of control in a given situation can be greatly influenced by recent past experiences. It is therefore likely, for example, that being fined for a traffic offense may change the impression of driving control for a period of time without changing the person's overall impression of control over life events (Lajunen and Summala, 1995). Therefore, the predictive potential of a traffic-specific measure may be limited. Third, and in line with our other scales that are non-related to traffic safety, we wanted to limit as much as possible the potential of social desirability bias. Since, as we will explain below, our questionnaire was sent directly by the Quebec Society for Automobile Insurance (SAAQ), it is highly likely that respondents asked about elements related to driving can direct their responses in favor of a safer image of themselves. Finally, we wanted to facilitate cross-domain comparisons and the adaptability to road safety of communication strategies that have proven effective in other areas of prevention. The current specific locus of control scales are so different and adapted that they make this comparison and adaptation difficult (Turnipseed, 2014).

The ambiguity of contradictory previous findings leads us to

formulate a synthetic hypothesis:

H3. LOC is related to risky driving.

Here again, understanding what locus of control characterizes high-risk drivers and distinguishes them from low-risk drivers may have real and concrete implications in terms of road safety strategies. Studies in the field of health communication have shown that to be effective, a preventive message must fit with an individual's locus of control (Kong and Shen, 2011; Wallston et al., 1978; Williams-Piehotka et al., 2004). For instance, Kong and Shen (2011) asked 164 participants to read one of the two versions of a printed public service announcement (PSA) related to obesity and healthy eating habits. One version of the PSA was based on a “social responsibility” frame with the slogan “Promoting a healthy environment” and the tagline “Fast food restaurants’ determination and effort will be most important in keeping obesity away!” Meanwhile, the other was based on an “individual responsibility” frame with the slogan “Promoting a healthy eating habit” and the tagline “Make a better choice. Your determination and effort will be most important in keeping obesity away!” They found that participants with an internal locus of control expressed more positive attitudes and higher behavioral intentions when the message focused on individual responsibility instead of social responsibility. For participants with an external locus of control, they found the opposite result.

We believe that our study could make these findings applicable to the road safety domain.

1.4. Sensation seeking, risky driving and message orientation

According to Zuckerman (2014), sensation seeking is “a trait defined by the need for varied, novel and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences” (p. 10).

Contrary to the previous selected variables, the relationship between sensation seeking and risky driving behaviors has been well established and recognized in the literature (Ayvaşık et al., 2005; Jonah, 1997; Machin and Sankey, 2008; Oppenheim et al., 2016; Rimmö and Åberg, 1999; Weller et al., 2006). For instance, Oppenheim et al. (2016) showed that the higher a driver score is on the sensation seeking scale, the more risky his driving behaviors will be as evaluated by the Driving Behaviour Questionnaire (DBQ). In addition, Ayvaşık et al. (2005) demonstrated that respondents who scored high on sensation seeking had a higher number of traffic violations than those who scored low on the scale.

Thus, our fourth hypothesis is as follows:

H4. The higher the Sensation Seeking score, the more likely that risky driving is.

Beyond the fact that it is interesting to explore this variable in conjunction with other personality traits that have been understudied, our choice to consider the sensation seeking trait was also grounded in its implication in terms of prevention. Indeed, by using a prevention strategy called SENTAR (sensation seeking targeting strategy), some researchers have shown that, in order to be effective on sensation seekers, preventive messages have to be of high sensation value (i.e., they must “elicit sensory, affective, and arousal responses”) (Palmgreen et al., 1991, p. 219). High sensation seekers are influenced by stimulating messages that are novel, complex and emotional. They need a more arousing content to experience the same level of arousal as low sensation seekers (Noar et al., 2010; Palmgreen and Donohew, 2006; Zimmerman et al., 2007). Everett and Palmgreen (1995) manipulated the sensation value of anti-cocaine messages and tested their efficiency on 120 undergraduates divided into two groups, high vs. low sensation seekers, based on their score on the sensation-seeking scale. They found that messages with a high sensation value were more effective than messages with a low sensation value on sensation seekers. That is, they generated higher message recall, antidrug behaviors and perceived

efficacy. On low sensation seekers, the opposite results were found.

2. Methodology

2.1. Respondents

2.1.1. Recruitment process

Ten thousand paper and pencil questionnaires with an addressed pre-stamped envelope were sent to a random sample of 18–65 years old drivers by the Quebec Society for Automobile Insurance (Société de l'assurance automobile du Québec-SAAQ), the governmental agency responsible of driver licensing and vehicle registration in the province of Quebec, Canada. We asked their collaboration to identify two groups of drivers, low versus high-risk, based on their driving records and to select a random sample of five thousand drivers in each group. Numerous studies have highlighted the positive relationship existing between the number of traffic infractions received by drivers and their subsequent involvement in a fatal or severe road crash (Barraclough et al., 2016; Factor, 2014; Gebers and Peck, 2003; Ho et al., 2015). For instance, Factor (2014), using an individual-level dataset aggregating the tickets received by drivers and their involvement in road accidents, showed that the probability of being involved in a serious or fatal accident increases by 65% when the driver has received an average of one ticket per year. Based on these findings we consider a driver who was convicted of two or more traffic infractions with demerit points¹ (e.g., exceeding speed limits, red light violations, seatbelt, etc.) in the last two years as a high-risk driver in this study, whereas a driver with no traffic offense registered in his driving record in the last four years (or since obtaining his driving license for a younger driver with less than four years of driving experience) was considered at low risk. This choice of at least two convicted offenses in the last two years to be in the high-risk group also reduces the likelihood of targeting unlucky drivers that would have been caught by police controls for a traffic infraction that does not reflect their usual driving behavior. On the other hand, a traffic offense free driving record for at least the last four years increases the probability of being a low risk driver.

It is the SAAQ that proceeded to the mailing of the ten thousand paper and pencil questionnaires with a cover letter and a pre-stamped return envelope addressed to the researchers' office. This procedure avoided to give to the researchers the name and address of the drivers. The questionnaires sent to the sample of drivers in the high-risk group were printed on light blue paper, and those sent to the sample of drivers in the low-risk group were printed on white paper. The completed anonymous questionnaires were returned directly to the researchers in the pre-stamped envelope. The color of the returned questionnaires indicated the group to which the respondents belonged. This research study was approved by research ethics committee of the researchers' university.

2.1.2. Profile

In the random sample of 5000 high-risk drivers, the average age was 39.8 years (SD = 12.5) with 67.9% males. The number of respondents in that group was 798 (788 with no missing information on gender), the average age was 45.1 years (SD = 12.2) and 58.9% were males. In the random sample of 5000 low-risk drivers, the average age was 43.9 years (SD = 13.7) with 41.1% males. The number of respondents in that

¹ Only traffic infractions with demerit points are included in the driving record of the drivers at the SAAQ. These infractions are recognized as risky driving behaviors. Infractions not related to risky behavior such as parking tickets and other similar sanctions that do not result in demerit points are therefore not considered in the formation of our groups. The list of traffic violations with demerit points in the province of Quebec can be found on this web page: <https://saaq.gouv.qc.ca/en/drivers-licences/demerit-points/offences-and-demerit-points/>

group was 1266 (1264 with no missing information on gender), the average age was 47.3 years (SD = 13.2) and 36.6% were males. Not surprisingly, the response rate was lower in the high-risk driving group. In both groups, the average age of the respondents was higher (by 3 and 5 years), and the percentage of male respondents was lower (by 4.5% and 9%), with the largest differences being in the high-risk driving group.

2.2. Measures

At the beginning of the questionnaire, respondents were invited to indicate their age, gender and driving experience (numbers of years licensed). Then, their regulatory orientation was measured using a version translated into French and adapted to a non-academic sample of the Regulatory Focus Orientation scale developed by Lockwood et al. (2002) (Partouche-Sebban, 2013), which encompasses two subscales: the prevention-focused scale with 7 items such as “In general, I am focused on preventing negative events in my life” (Cronbach alpha = .65) and the promotion focused scale with 7 items such as “I frequently imagine how I will achieve my hopes and aspirations.” (Cronbach alpha = .75).

We assessed sensation seeking by translating into French the Brief Sensation Seeking Scale (Hoyle et al., 2002) that included 8 items such as “I get restless when I spend too much time at home” (Cronbach alpha = .81).

For evaluating the locus of control, we used the validated French version of the scale developed by Levenson (1981; Rossier et al., 2002; Loas et al., 1994) that included 24 items divided into three 8 items subscales : the internal locus of control scale with items such as “Whether or not I get to be a leader depends mostly on my ability” (Cronbach alpha = .55), the powerful others scale with items such as “I feel like what happens in my life is mostly determined by powerful people” (Cronbach alpha = .75), and the chance scale with items such as “To a great extent my life is controlled by accidental happenings” (Cronbach alpha = .69)².

Finally, respondent’s time perspective was evaluated with the validated French version of the Zimbardo Time Perspective Inventory (Zimbardo and Boyd, 1999; Apostolidis and Fieulaine, 2004), which includes 54 items divided into five subscales: the present hedonistic (e.g., “It is important to put excitement in my life”) (Cronbach alpha = .81), the past positive (e.g., “It gives me pleasure to think about my past”) (Cronbach alpha = .59), the present fatalistic (e.g., “You can’t really plan for the future because things change so much”) (Cronbach alpha = .77), the future (e.g., “I am able to resist temptation when I know that there is work to be done”) (Cronbach alpha = .68) and the past negative (e.g., “Painful past experience keep being replayed in my memories”) (Cronbach alpha = .83)³.

All the above scale measures in the questionnaire used five-level Likert items (1 to 5). For each respondent, the averages of the subscales items were computed to obtain the score of the measures. In order to have a measure of the relative importance, for each respondent, of their promotion and prevention orientation, we also calculated a dominant regulatory focus score by following the procedure of Lockwood et al. (2002). We subtracted the prevention score from the promotion score and interpreted a positive score as representative of a person who is more promotion than prevention focused.

² The relatively low Cronbach’s alpha of the internal locus of control scale is similar to that reported in the literature (e.g. Loas et al., 1994; Rossier et al., 2002).

³ The relatively low Cronbach’s alpha of the past positive scale is similar to that reported in the literature (e.g. Sircova et al., 2015; Worrell and Mello, 2007).

3. Results

Table 1 shows the mean and standard deviation of each measure for all respondents and the pairwise correlation coefficients. Age is strongly positively correlated with driving experience ($r = 0.91$) and negatively correlated with sensation seeking ($r = -0.37$). The correlation coefficients between age and the other measures are in absolute value less than .23. The way that the regulatory focus score was computed explains the positive correlation of .53 with the promotion-focused score and the negative correlation of -.60 with the prevention-focused score. All correlation coefficients between regulatory focused and the other measures are in absolute value less than .35. The correlation coefficients between all other pairs of variables vary between .01 and .62.

Table 2 presents the means by group and gender and the results of the two-way-analysis of variance to evaluate the effects of the group (low-risk vs. high-risk) and gender for each variable. In our sample, the interaction group by gender is statistically non-significant for all variables. The mean of risky drivers is statistically higher than the mean of low-risk drivers for the measures of promotion focused, regulatory focused, sensation seeking, LOC internal, and present hedonistic, and statistically lower for LOC powerful others, age and driving experience. The mean of male drivers is statistically higher than the mean of female drivers for the measures of sensation seeking, LOC internal, LOC chance, LOC powerful others, and for age and years of driving experience, while the mean of male drivers is statistically lower for promotion-focused, regulatory-focused and present hedonist individuals.

Table 3 shows the results of multiple logistic regression analyses. The dependent variable is the driver’s group with the risky drivers being the target group. The first model includes the explanatory variables age, gender, the computed regulatory focused variable, sensation seeking, and locus of control and temporal perspective measures. Driving experience was not included because of its high correlation with age, and the regulatory focused variable was preferred to having both the promotion and prevention-focused subscales in the model. The second model in Table 3 was obtained with the stepwise selection method using a significance level of 5% for entry and stay in the model.

Both models give very similar results. Therefore, only the results of Model 2 are described in what follows. A higher regulatory focused score significantly increases the risk of being a risky driver (OR = 1.37, 95% C.I. 1.17–1.60), which supports the first research hypothesis. A higher present hedonist score is also associated with a higher risk of being a risky driver (OR = 1.31, 95% C.I. 1.05–1.65), which supports H2a. For the third research hypothesis, a higher internal locus of control increases the risk of being a risky driver (OR = 1.34, 95% C.I. 1.06–1.69). As expected with H4, the risk of being in the risky driving group significantly increases with higher sensation seeking scores (OR = 1.53, 95% C.I. 1.30–1.79). Higher scores of the locus of control powerful others and of the past positive subscales reduce the risk of being in the risky driving group (OR = 0.76, 95% C.I. 0.64 to 0.91 and OR = 0.78, 95% C.I. 0.64 to 0.95 respectively). For the two control variables, consistent with the literature, male and younger drivers are more likely to be in the risky driving group (OR = 2.64, 95% C.I. 2.17–3.22 and OR = 0.99, 95% C.I. 0.98–1.00 respectively).

We ran additional analyses to check if gender and age could moderate the effect of regulatory focus, sensation seeking, locus of control or time perspective on risky driving. We repeated the previous logistic regression analyses with the addition of the double interactions between age and all other independent variables and between gender and all other independent variables in the model. None of these double interactions was statistically significant in the logistic regression model with all the terms, and none of them was selected in the model when the stepwise method was used.

4. Discussion

The purpose of this study was to contribute to the road safety

Table 1
Descriptive statistics of the different variables for all respondents.

	N	Mean	S.D.	Correlation coefficients														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1. Age	2049	46.4	12.9	1														
2. Driving experience	2037	27.8	12.8	.91*	1													
3. Prevention focus	2057	3.19	0.61	-.18†	-.21*	1												
4. Promotion focus	2057	3.96	0.58	-.22†	-.21*	.36*	1											
5. Regulatory focus	2057	0.77	0.67	-.03	.01	-.60*	.53†	1										
6. Sensation seeking	2060	2.64	0.76	-.37†	-.33*	.10*	.18†	.06†	1									
7. LOC internal	2060	3.71	0.44	.01	.03	.04	.34†	.26*	.12*	1								
8. LOC chance	2060	2.51	0.53	-.06†	-.08†	.32*	.07†	-.23†	.18*	.05†	1							
9. LOC powerful others	2060	2.30	0.57	-.07†	-.09†	.32*	.03	-.26*	.13*	.03	.62*	1						
10. Present hedonist	2058	3.13	0.53	-.17†	-.17†	.12*	.24†	.10†	.53†	.18†	.33†	.20*	1					
11. Future	2057	3.61	0.44	.03	.03	.07†	.23*	.13*	-.22*	.23*	-.15*	-.05†	-.26*	1				
12. Past positive	2057	3.48	0.51	-.05†	-.04	.02	.20*	.15*	.02	.18*	.03	.002	.15*	.15*	1			
13. Present fatalistic	2057	2.38	0.60	-.03	-.06†	.29*	-.001	-.26*	.16*	-.09†	.60*	.47*	.44*	-.29*	.02	1		
14. Past negative	2057	2.46	0.72	-.14†	-.17†	.46*	.09†	-.34†	.14*	-.13†	.43†	.43†	.27†	-.09†	-.16*	.55*	1	

† : 0.001 ≤ p-value < .05.
* : p-value < .001.

Table 2
Results of two-way analysis of variance (group and gender) for each variable.

	Mean (S.D.)				two-way ANOVA						Partial eta square			R ²
	female		male		group		gender		group*gender		group	gender	interaction	
	high	low	high	low	high vs. low risk		male vs. female		interaction					
	n = 324	n = 801	n = 464	n = 463	F(1,df ¹)	p-value	F(1,df ¹)	p-value	F(1,df ¹)					
Age	43.1 (11.9)	46.3 (13.2)	46.4 (12.2)	49.0 (13.2)	24.2	< .001	25.9	< .001	0.3	.574	.012	.013	< .001	.020
Driving experience	24.7 (11.7)	26.9 (12.7)	28.7 (12.6)	30.5 (13.2)	11.9	.001	40.4	< .001	0.1	.749	.006	.019	< .001	.022
Prevention focus	3.14 (0.63)	3.21 (0.61)	3.18 (0.58)	3.20 (0.64)	2.6	.110	0.4	.528	0.7	.421	.001	< .001	< .001	.002
Promotion focus	4.12 (0.57)	3.95 (0.57)	3.98 (0.57)	3.85 (0.58)	30.7	< .001	21.5	< .001	0.6	.448	.015	.010	< .001	.021
Regulatory focus	0.99 (0.71)	0.75 (0.67)	0.80 (0.64)	0.65 (0.66)	38.6	< .001	20.7	< .001	1.9	.165	.019	.010	.001	.024
Sensation seeking	2.82 (0.81)	2.45 (0.72)	2.86 (0.74)	2.60 (0.72)	82.9	< .001	7.0	.008	2.3	.130	.039	.003	.001	.052
LOC internal	3.75 (0.47)	3.64 (0.42)	3.79 (0.42)	3.72 (0.45)	19.3	< .001	8.4	.004	0.7	.394	.009	.004	< .001	.018
LOC chance	2.45 (0.51)	2.50 (0.50)	2.51 (0.53)	2.55 (0.59)	2.7	.099	5.0	.025	0.02	.896	.001	.003	< .001	.003
LOC powerful others	2.22 (0.57)	2.28 (0.54)	2.30 (0.58)	2.38 (0.62)	7.1	.008	11.1	.001	0.08	.773	.004	.005	< .001	.008
Present hedonist	3.28 (0.58)	3.10 (0.52)	3.17 (0.49)	3.02 (0.52)	46.1	< .001	17.3	< .001	0.5	.475	.022	.008	< .001	.026
Future	3.60 (0.47)	3.64 (0.43)	3.58 (0.45)	3.61 (0.42)	2.0	.160	1.5	.218	0.1	.757	.001	< .001	< .001	.002
Past positive	3.47 (0.51)	3.50 (0.52)	3.47 (0.51)	3.47 (0.49)	0.5	.489	0.2	.692	0.5	.497	< .001	< .001	< .001	.001
Present fatalistic	2.35 (0.60)	2.41 (0.58)	2.35 (0.60)	2.37 (0.64)	2.5	.113	0.5	.495	0.3	.573	.001	< .001	< .001	.002
Past negative	2.48 (0.74)	2.45 (0.71)	2.45 (0.68)	2.48 (0.72)	0.01	.921	0.01	.914	0.7	.416	< .001	< .001	< .001	< .001

¹ : df = 2043 for age; df = 2023 for driving experience; df = 2043 for prevention, promotion and regulatory focus, future, past positive, present fatalistic and past negative; df = 2046 for sensation seeking and LC variables; df = 2044 for present hedonist.

literature by exploring the roles of different individual traits in the adoption of risky driving behaviors while taking into account the importance of these individual traits in the development of targeted road safety messages. We examined the role of regulatory orientation, the locus of control, the temporal perspective, and sensation seeking in adopting risky driving behaviors, controlling for age and gender. At this point, it is important to note the high ecological validity of our sampling procedure that was based on real data, i.e. drivers' driving record, and not on self-reported behaviors.

The results support most of our hypotheses. In line with the many studies in the field of road safety (e.g., Constantinou et al., 2011), our findings highlight the effects of age and sensation seeking in the adoption of risky driving behaviors. We find that the younger the driver, the more likely he/she is to be in the group of high-risk drivers. Likewise, for the sensation-seeking criterion, the more the driver is a sensation seeker, the greater his/her probability of being in the group of high-risk drivers.

Consistent with the limited research on regulatory focus orientation

Table 3
Results of multiple logistic regression analyses with high-risk vs. low-risk drivers as the dependent variable.

Parameters	Model 1 : all independent variables					Model 2 : stepwise variable selection				
	Estimate	p-value	odd ratio	95% CI		Estimate	p-value	odd ratio	95% CI	
				Lower	Upper				Lower	Upper
Intercept	-2.321	.002				-2.425	< .001			
Age	-0.007	.095	0.99	0.99	1.00	-0.008	0.051	0.99	0.98	1.00
Gender (male)	0.965	< .001	2.63	2.15	3.20	0.970	< .001	2.64	2.17	3.22
Regulatory focus	0.312	< .001	1.37	1.16	1.61	0.314	< .001	1.37	1.17	1.60
Sensation seeking	0.412	< .001	1.51	1.28	1.78	0.422	< .001	1.53	1.30	1.79
LOC internal	0.296	.019	1.34	1.05	1.72	0.293	0.014	1.34	1.06	1.69
LOC chance	-0.101	.445	0.90	0.70	1.17					
LOC powerful others	-0.198	.078	0.82	0.66	1.02	-0.269	0.003	0.76	0.64	0.91
Present hedonist	0.336	.011	1.40	1.08	1.81	0.273	0.018	1.31	1.05	1.65
Future	-0.067	.599	0.94	0.73	1.20					
Past positive	-0.206	.046	0.81	0.66	0.99	-0.245	0.014	0.78	0.64	0.95
Present fatalistic	-0.203	.098	0.82	0.64	1.04					
Past negative	0.139	.124	1.15	0.96	1.37					
		AIC =	2497.4				AIC =	2494.9		
		BIC =	2570.5				BIC =	2545.5		
	Pseudo R ² = .152					Pseudo R ² = .149				

Note: CI = Confident interval.

(Hamstra et al., 2011; Werth and Förster, 2007), we find that the more that the driver is promotion oriented, the greater its likelihood of belonging to the high-risk driver group and that the opposite is true for the prevention orientation. On this point, our research is innovative because, unlike previous research, it shows that this effect is valid for all drivers regardless of age or gender. The risky driving behavior of “promotion-focused” drivers may be explained by the way that they approach risk-taking, not as something negative but as a means of achieving positive outcomes. Therefore and in the light of this result, it is possible that shock based road safety advertisements which “present individuals with the negative outcomes that they may experience as a result of engaging in the depicted unsafe and/or illegal behaviors” (Lewis et al., 2007, p.203) are effective for the least risky drivers while being unable to reach the most risk-prone drivers. Future research is encouraged to explore this link between risky driving, regulatory focus orientation and the effectiveness of message framing.

Our findings support prior evidence that the present time perspective is linked to taking risks in traffic (Chebat and Chandon, 1986; Zimardo et al., 1997) and show that having a present time perspective increases the likelihood of being in the high-risk driver group. However, contrary to our prediction, the future time perspective is not a positive determinant of low-risk drivers as opposed to the “past positive perspective”. This suggests that persons who are nostalgic for the good old days and look at their past with rose-tinted glasses are less willing to be high-risk drivers. This result, while it must be tempered given the low internal validity of the past-positive scale, opens the door to further research to explain how nostalgia could be beneficial to safe driving behaviors. In addition, it would be interesting to consider whether changing drivers' time perspective could be an effective way to reduce risky driving behaviors.

Also, concerning the debate on the impact of external versus internal locus of control on drivers' behaviors, our results indicate a negative effect of internal locus of control and a positive effect of external locus of control, especially for the beliefs that events and life are controlled by powerful others. Internal drivers may perceive that they have the necessary skills to avoid a car accident or that they are sufficiently in control when adopting a risky driving behavior. For external drivers, the fear of repercussions by the authorities (powerful others) may have played a role in the development of safe driving behaviors. This result should be analyzed with caution given the relatively low internal reliability of the internal LOC scale. However, it paves the way for the development of further research on the potentially safe behavior of

external drivers and raises questions about how prevention messages could be directed at internal drivers who strongly believe in their individual abilities and their control over their destiny.

Finally, it is important to note that the effects of sensation-seeking, regulatory orientation, time perspective and locus of control were independent of gender and age. The gender and age of respondents do not influence the relationship between these individual traits and the likelihood to be in the high-risk group. This further demonstrates their importance in improving the understanding and definition of a high-risk driver.

5. Limitations

One limitation of this study is that all of our independent variables were evaluated using self-assessments, which could raise questions about the veracity of the responses. However, all measures that were used have already been used successfully in previous research. Moreover, respondents that were answering from home without the presence of an interviewer were not aware of the purpose of the study and that they had been assigned to a certain group of drivers. No measurements of risky driving behavior were made in the questionnaire and none of the scales referred directly to driving behavior. We, therefore, think that the risk of social desirability bias in responses was limited.

Another important limitation is the potential sampling bias associated with the self-selection of respondents causing age and gender differences from our original sample. From our point of view, given that these gender and age differences from the original sample were equivalent in both samples and that gender and age did not influence our results, we do not believe that this bias affected our findings. The fact that the "sensation-seeking" trait appears in our study, as in many previous studies, as an important predictor of belonging to the high-risk group, also reinforces this belief. Moreover, if our sample potentially suffers from a self-selection bias due to the difference in the response rates between the two groups, one would think that this bias would have reduced the level of risk in the group of high-risk drivers. Therefore, the results of this study would underestimate the statistically significant effect sizes found between high and low risk drivers.

Our operationalization of high-risk and low-risk drivers using convicted traffic violations has also some potential biases. Many traffic violations committed by drivers are not sanctioned simply because no police officer was there to witness the infraction and give a ticket. Our

low-risk group most likely contains drivers who committed traffic violations in the last two years that were not sanctioned. Hence, the effects of our independent variables might be larger than those estimated and reported in our study because of this potential misclassification of high-risk drivers in the low-risk group. On the other hand, some drivers might have been “unlucky” and committed a rare traffic violation in the last two years that was sanctioned by the police. These low-risk drivers would have been misclassified in the high-risk group, potentially leading once again to an underestimate of the magnitude of the effect of our independent variables in our study. By choosing two or more convicted infractions in a relatively short period of time, i.e. two previous years, we increase the likelihood of mostly selecting drivers that are repeatedly adopting risky driving behaviors in our high-risk group. By choosing no convicted infraction in a relatively longer time period, i.e. four years, we reduce the likelihood of having many drivers in our low-risk group that are repeatedly adopting risky driving behaviors and “lucky” of never being sanctioned. Hence, with this operationalization we have tried to reduce as much as possible to potential bias of underestimating the effect of our independent variables on our dependent variable.

Finally, we did not control for the effect of driving exposure. It is very likely that the more a driver drives, the more likely he or she is to be fined and therefore to be part of the high-risk group and vice versa. For us, regardless of the level of exposure, a driver who has two or more convicted traffic violations in the past two years is a driver adopting repeatedly risky driving behaviors. However, we encourage future studies to replicate our research taking into account the potential moderating effect of exposure levels.

Despite these limitations, we are confident that the results of this study can increase the understanding of high-risk drivers and ultimately improve traffic safety programs and communications. We encourage researchers to replicate our findings in future research. We also invite practitioners to take our results into account when developing their programs and road safety actions. As part of this research, our objective was to highlight the effects of certain individual traits and especially to suggest avenues to explore the improvement of the effectiveness of messages targeting high-risk drivers. We, therefore, encourage future research to test these avenues and to determine how, based on the characteristics of high-risk drivers highlighted in this study, it is possible to increase the effectiveness of road safety messages.

Declarations of interest

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