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The influence of fatalistic beliefs and risk perceptions on road safety attitudes in Latin America; A two-country study

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ABSTRACT

Road safety is a major challenge in the Latin American region; however, there is a significant lack of research undertaken there. To contribute to addressing this gap, this paper reports on an exploration of the antecedents of traffic safety attitudes in two Latin American contexts: Brazil and Ecuador. Building on related work undertaken in other countries, the research explored the relationships between fatalistic beliefs, traffic risk perceptions, and road safety attitudes, while accounting for age, gender, and exposure to the road environment. Data from 2432 individuals, analysed using Structural Equation Modelling, revealed differences in the extent to which different fatalistic belief constructs (including divine control, luck, helplessness, internality, and general fatalism) were related to road safety attitudes. Moreover, fatalistic beliefs were found to influence road safety attitudes both directly and indirectly through their influence on risk perceptions. Those that reported more fatalistic beliefs also reported more dangerous attitudes to road safety and a lower perception of on-road risk. Mirroring findings from work undertaken in other countries, we found males compared to females and younger compared to older respondents to report more dangerous attitudes to road safety, with inconclusive results for risk perceptions. We also found very similar patterns of results in the data from the two countries included in the research. Results are discussed with regards to informing the design of road safety interventions aimed at influencing individual road user attitudes and, ultimately, human behaviour and system performance.

1. Introduction

Road trauma, the 8th leading cause of death worldwide and the leading cause of death in those between five and 29 years old, is a global challenge that is most acute in low- and middle-income countries (LIMCs; WHO, 2018). It is a complex problem to which many inter-related factors contribute. Human attitudes and behaviours, although only two of myriad aspects (and arguably both symptoms of the wider sociotechnical system), are nevertheless influential, and are factors can be influenced through training, education, and infrastructure design (among other things). Understanding what guides those attitudes and behaviours, so that we might better support change, has therefore unsurprisingly represented a strong area in which road safety researchers have been active. The very large

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majority of that work, however, has been undertaken in high-income countries, in particular Europe and the US. Work in LMICs is less abundant. This is particularly true in the case of Latin America, where a dearth of road safety work has been highlighted (Martinez et al. 2019). The current research addresses this gap, exploring some of the factors that influence road safety attitudes in Latin American. This region sees the fourth highest road fatality rates in the world (behind sub-Saharan Africa and southern and south-eastern Asia; FiA Foundation, 2016), with the social and economic cost to the countries within that region greater than those incurred in high-income countries (Wijnen & Stipdonk, 2016). Moreover, the recent past has seen little or no reductions in collision rates in the region (Pan American Health Organisation, 2019).

This research focusses on two countries in Latin America, namely Brazil and Ecuador. Both are middle income countries (OECD, 2021) and both see road fatality figures higher than their regional average, at 19.7 (Brazil) and 21.3 (Ecuador) road traffic fatalities per 100,000 people each year (compared to an average of 15.6 across the wider Americas; WHO, 2018). In Brazil, although improvements to safety have been made over the past 30 years (with reductions in fatality rates between 1990 and 2019), it remains the fifth leading country for deaths due to road injury and it is unlikely to meet the 2030 sustainable development goal (SDG) road safety targets (Blumenberg et al. 2018; Malta et al. 2022). The importance of research in providing an impetus for road safety efforts having been highlighted in the country (Koon et al. 2022). In Ecuador, despite high fatality rates, investment in road safety is low, and the majority of roads receive the lowest safety ratings from the International Road Assessment Program (iRAP; Ramírez et al. 2021). Alongside rising collision rates (Pan American Health Organisation, 2019), there is a chronic lack of research undertaken in the country (Espinoza-Molina et al., 2021), with SDG targets also highly unlikely to be met.

In our own previous work, we reported on an investigation of the relationships between fatalistic beliefs, road safety attitudes, and self-reported pedestrian behaviours in six settings (Bangladesh, China, Kenya, Thailand, the UK, and Vietnam), finding (among other things) that fatalistic beliefs mediate the relationship between attitudes and behaviours (McIlroy et al., 2020a; see also Dinh et al., 2020a and Liu et al. 2021) and that the relationships between factors of interest differ between regions, in both strength and, in some cases, direction. Research focussing on road safety attitudes and the factors that influence them in Brazilian and Ecuadorian contexts is currently wholly lacking yet could prove useful for guiding the design of road safety strategies aimed at encouraging behavioural or attitudinal change. This research therefore builds upon that previous work by exploring the influence of both fatalistic beliefs and traffic risk perceptions (something not included in our previous work) on road safety attitudes.

The effect of road safety attitudes on traffic safety behaviours has been demonstrated across cultures and road user roles (Assum, 1997; Chen, 2009; Hasanat-E-Rabbi et al. 2021; Hassan & Abdel-Aty, 2013; Kummeneje & Rundmo, 2020; Lund & Rundmo, 2009; Papadimitriou et al. 2013; Zhou et al., 2009). Those with safer attitudes also report behaving in a safer way when interacting with the road system, whether that is when driving a car, riding a motorcycle or bicycle, or walking. Targeting these attitudes in, for example, training programmes or awareness campaigns, can offer a relatively inexpensive way to positively influence road safety. That said, just as behaviour has factors that influence it, so do attitudes. It is therefore also important to understand those underlying factors.

As previously described, in our own previous work we found fatalistic beliefs to have an impact on behaviour partly through its relationship with road safety attitudes (McIlroy et al., 2020a; Dinh et al., 2020a; Liu et al. 2021). Fatalistic beliefs are those centred around the idea that events and occurrences are pre-ordained or externally controlled, be that through luck, divine will, or fate. It is not a single, unified idea, but a multi-dimensional construct, with each dimension having a potentially unique influence on a person's attitudes and behaviours.

In work aiming to distinguish some of the different underlying constructs, and to condense the many facets that had thus far been explored in the literature, Esparza (2005) and Esparza et al. (2015) described, and offered a tool to measure, five related concepts: general fatalism (i.e., everything is pre-ordained), internality (a reversed concept; i.e., a person's actions determine outcomes), divine control (i.e., God guides all occurrences), luck (i.e., luck dictates what happens), and helplessness (i.e., people are powerless to change things). Although in most cases more fatalistic beliefs have been linked with more dangerous attitudes and behaviours (e.g., Dixey, 1999; Kouabenan, 1998; Omari & Baron-Epel, 2013; Maghsoudi et al., 2018; Nordfjærn et al., 2012; Peltzer & Renner, 2003; Şimşekoğlu et al. 2013; Ngueutsa & Kouabenan, 2017; Teye-Kwadjo, 2019), there have been some exceptions to this, notably when research has looked specifically at the influence of religion.

For example, in work carried out in Iran, Nabipour et al. (2015) found that those with a stronger belief in divine control (i.e., that God influences life events) were less likely to engage in risky pedestrian behaviours and less likely to have been involved in collisions in the past. Yıldırım (2007) reported similar results in a Turkish sample; those reporting stronger religiosity also reported performing safer driver and pedestrian behaviour. This does, however, vary across countries. Kayani et al. (2012) found the opposite to be true in Pakistan, while in our own work we found a stronger sense of divine control over one's life to be positively associated with safety in Bangladesh, but negatively associated with safety in Thailand and Vietnam (McIlroy et al., 2020a). There is currently no work available on this topic in any Latin American context, hence the nature of these relationships in samples from that region is unclear.

Just as fatalistic beliefs have been shown to influence behaviour through their effect on a person's attitudes, so has traffic risk perception, a person's interpretation of the likelihood of a road traffic collision occurring and the potential severity of the consequences (Deery, 1999). Typically, a higher perception of risk (i.e., an expectation that collisions are more likely and will have more severe consequences) is associated with safer attitudes and behaviours. This has been shown in the driving domain (e.g., Lund & Rundmo, 2009; Ulleberg & Rundmo, 2003; Nordfjærn et al. 2011; Şimşekoğlu et al. 2012), as well as the motorcycling (e.g., Tarigan & Sukor, 2018), cycling (e.g., Bösehans & Massola, 2018; Puchades et al. 2018), and pedestrian domains (e.g., Dinh et al. 2020b; Liu et al. 2021; Poudel-Tandukar et al. 2007; Rosenbloom et al. 2011; Yagil, 2000; Zhou et al. 2009; Zhou & Horrey, 2010). These cited works were undertaken in a wide array of countries, including (but not limited to) China, Ghana, Nepal, Norway, Israel, Turkey, and Vietnam. Once again, however, there is a conspicuous lack of work exploring risk perceptions and traffic safety in any Latin American country.

There are also some examples in the literature of the combined exploration of risk perception and fatalistic beliefs in a traffic safety

context. For example, Şimşekoğlu et al. (2013) found that the influence of risk perception and fatalism on self-reported behaviours differed between Turkey and Iran; however, they did not investigate attitudes, nor delve deeper into the potential for relationship mediation. Teye-Kwadjo (2019) did perform this type of analysis, finding the influence of both fatalism and risk perceptions on behaviour to be mediated by attitudes. Work presented by Ngueutsa and Kouabenan (2017) is also of interest here; those authors found risk perceptions to mediate the relationship between fatalistic beliefs and behaviours (with no exploration of attitudes). It remains to be seen how traffic risk perception might influence the relationship between fatalistic beliefs and road safety attitudes, and it is also unclear what aspects of fatalism, i.e., which of its various dimensions, are most influential, or most influenced. The goal of the current research is to shed light on these issues in the under-studied context of Latin America. This work thereby contributes to the literature on road safety attitudes through its focus on the as yet unexplored relationships between risk perceptions, fatalistic beliefs, and roads safety attitudes, doing so in two countries that have to date received very little attention from the road safety research community.

1.1. Aims and hypotheses

This work addresses the research needs expressed above by examining the influence of fatalistic beliefs on road safety attitudes and exploring the extent to which those relationships are mediated through risk perceptions. It does so via a self-report questionnaire disseminated in Brazil and Ecuador. Following on from the research outlined above, we hypothesised 1) that the size of the effect of fatalistic beliefs on road safety attitudes would depend on the dimension of fatalism in question, and 2) that the effect of fatalistic beliefs on road safety attitudes would be at least partly mediated through traffic risk perceptions. We make no specific hypotheses concerning the potential country differences in the explored relationships. We also do not make any specific hypotheses regarding the differences in relationships that might exist between the different fatalistic belief and risk perception dimensions explored. As there is such a lack of this kind of research in Latin American countries, we also explore the differences (or lack thereof) in road safety attitudes and risk perceptions between gender and age groups.

2. Method

2.1. Survey instrument

The questionnaire reported here was similar to that used in our own previous research (e.g., Dinh et al., 2020a, b, Hasanat-E-Rabbi et al. 2021, McIlroy et al., 2020a, 2020b). Four sections are relevant to the current research: demographics, risk perceptions, general attitudes to road safety, and fatalistic beliefs. The demographics section included items on age, gender, education, religion, income, collision involvement, and transport choices. One question asked respondents to indicate the number of hours they use their main form of transport each week, with seven possible responses options, from less than one hour to more than 20 hours.

The risk perception section comprised 15 items adapted from those described in Nordfjærn and Rundmo (2009) and was split into two parts, both of which asked for perceptions of the likelihood of a person being seriously or fatally injured. The first framed the question in terms of several collision scenarios (e.g., head-on collisions, collision with a pedestrian, collision with another vehicle at a junction, etc.) the other more generally in terms of the risk of interacting with the road system when taking different road user roles (e.g., pedestrian, cyclists, driver). Both invited response on a five-point Likert scale from ‘extremely likely’ to ‘extremely unlikely’.

The road safety attitudes section was adapted from Iversen and Rundmo (2004) and Peltzer and Renner (2003), with previous work showing a 13-item version to be reliable across contexts of use (McIlroy et al., 2020b). Respondents were asked the extent to which they agreed with statements detailing behaviours that could be considered risky (e.g., “During a long trip a driver should stop as little as possible in order not to lose time”) with responses invited on a five-point Likert scale from ‘strongly agree’ to ‘strongly disagree’. Fatalistic and religious beliefs were measured using the short version of the questionnaire reported in Esparza et al.’s (2015), a 30-item scale that measured five underlying factors: general fatalism, helplessness, internality, luck, and divine control. All items were measured on a five-point Likert scale from ‘strongly agree’ to ‘strongly disagree’.

The questionnaire was translated from English, the language in which it was developed, into Brazilian Portuguese and Ecuadorian Spanish by researchers in Brazil and Ecuador, respectively. In accordance with Brislin’s (1970) guidance, the translated versions were then back-translated into English by a different bi-lingual individual, and the two English versions (original and back-translated) compared. Any discrepancies were discussed, and agreement on edits reached, before finalisation of the translated questionnaires.

2.2. Data collection and respondents

In Brazil, the questionnaire was hosted on the *SurveyMonkey* platform. Researchers sent a questionnaire link to friends and families and asked that the link be passed on, therefore representing the snowball sampling approach. In order to broaden the sample, researchers also undertook in-person data collection activities, approaching members of the public at bus stops, subway stations, community centres, supermarkets, and other public areas in and around the Rio de Janeiro area. In these cases, the respondents answered the questions showed in the *SurveyMonkey* platform using researchers’ devices. The final sample included respondents mainly from the Rio de Janeiro Metropolitan area (comprising 22 municipalities, including Rio de Janeiro city); however, the link was also used by respondents from other areas.

To collect data in Ecuador the *SurveyMonkey* platform was again used. The survey was distributed through the professional and personal profiles of the research group’s social networks, including on Facebook, Twitter, and Instagram. In addition, the questionnaire link was shared using institutional mailing coordination with the Metropolitan Transit Agency (AMT) and the National Transit

Agency (ANT). As in Brazil, further to the online data collection activity, in-person data collection was also undertaken. Rather than use a tablet, paper-based versions were distributed in and around the Quito area. In both Brazil and Ecuador, the aim of in-person data collection was to attract responses from individuals less likely to use the online version.

As this research was part of a larger, multi-country project, ethical approval for the study was sought from and granted by the University of Southampton's ethics committee (ID 40682.A2), that institution being the consortium's coordinating partner. Ethical approval was also sought from and granted by the Pontifical Catholic University of Rio de Janeiro (Protocol 75/2020) and La Universidad de las Américas, Quito (ID EOP-201112-001) for data collection in Brazil and Ecuador.

2.3. Data treatment

All analyses were performed using SPSS and Amos. As the measures used had not yet been confirmed in Latin American samples, the factor structures of the road safety attitudes (one factor), traffic risk perception (two factors), and fatalistic beliefs (five factors) scales were assessed using Confirmatory Factor Analysis (CFA) in Amos, with model fit deemed to be acceptable when GFI > 0.90, CFI > 0.95, NFI > 0.90, RMSEA < 0.07, SRMR < 0.08 (Hooper et al, 2008; Kline, 2015), with Hu and Bentler (1999) suggesting a two-index strategy whereby model fit can be accepted if RMSEA is below 0.06 and SRMR is below 0.09. Following confirmation of the structure, each factor's internal reliability was then assessed using Cronbach's alpha (the generally accepted threshold for which is >0.7 for each factor; Tavakol & Dennick, 2011). Mean scores for each factor, for each participant, were then computed. Age and gender differences were assessed using regression analyses (two for each country): one for road safety attitudes, one for risk perceptions. In each case, exposure (i.e., the number of hours spent using their main form of transport each week) was included as a control variable. The relationships between attitudes, risk perceptions, and fatalistic beliefs were assessed using Structural Equation Modelling. Specifically, the model assessed the extent to which the effect of fatalistic beliefs on road safety attitudes was direct or mediated through the two risk perception factors, individually and together (i.e., we assessed specific indirect effects and total indirect effects). Age, gender, and exposure to the road environment (in terms of hours spent travelling each week) were included as covariates. A multi-group path analysis approach, whereby the same model is tested across multiple groups, was taken to reveal the extent to which relationships measured were moderated by country (i.e., whether there were differences between the Brazil and Ecuador samples in the relationships between factors). More detail is provided in the relevant section, below.

3. Results

3.1. Sample

In total, 2432 individuals responded to the questionnaire: 1624 in Brazil and 808 in Ecuador. One respondent to the Brazil questionnaire did not respond to the age question. The age and gender splits are displayed in Table 1. Table 2 presents their self-reported collision involvement responses, Table 3 their religious affiliation. Respondents' income and education levels are presented in Figs. 1 and 2.

3.2. Assessing factors

As described above, the risk perception section had two parts: one that asked about specific events (*Collision event risk perception*), one that asked about the general risk experienced by different road users (*General traffic risk perception*). This two-factor structure was assessed using Confirmatory Factor Analysis (CFA). After including error covariances between nine pairs of items, the model fit was deemed somewhat low but nevertheless acceptable (CFI: 0.930, GFI: 0.921, NFI: 0.926, RMSEA: 0.085, SRMR: 0.0867). The questions are presented in full in Table 4 alongside means and standard deviations of responses as well as the Cronbach's alpha values for each of the two sub-scales, separated by country and for the complete, two-country sample.

CFA also revealed the structure of the fatalistic beliefs measure (with its five factors) to be acceptable following the inclusion of error covariances between four pairs of items (CFI: 0.912, GFI: 0.903, NFI: 0.902, RMSEA: 0.058, SRMR: 0.0629). All items are

Table 1
Age and gender characteristics of the sample of 2431 respondents answering both age and gender questions.

		Age						**Totals**
		18–24	25–34	35–54	45–54	55–64	Over 64	
Brazil	Male	287	114	59	56	63	11	**590**
	Female	491	161	108	129	85	27	**1001**
	Other response	20	10		1		1	**32**
Ecuador	Male	58	84	143	61	39	18	**403**
	Female	82	88	117	55	47	15	**404**
	Other response			1				**1**
Complete sample	Male	345	198	202	117	102	29	**993**
	Female	573	249	225	184	132	42	**1405**
	Other response	20	10	1	1		1	**33**
	Totals	**938**	**457**	**428**	**302**	**234**	**72**	**2431**

Table 2
Number (and rounded percentage) of responses to the question "Have you, as any type of road user (e.g., pedestrian, cyclist, driver, etc.), ever been involved in an accident on the roads where anyone (you or someone else) was injured badly enough to need to go to hospital?".

	No, never	Once	More than once
Brazil	1327 (82 %)	229 (14 %)	67 (4 %)
Ecuador	559 (69 %)	176 (22 %)	73 (9 %)
Complete sample	1886 (78 %)	405 (17 %)	140 (6 %)

Table 3
Number and percentage of respondents identifying as religious. *Any other* in the Brazil questionnaire included options of *Kardecism / Spiritism* and *Afro religions* (combined here).

	Brazil		Ecuador	
	No.	%	No.	%
No Religion	500	30.8	226	28.0
Buddhist	10	0.6	4	0.5
Christian	850	52.4	566	70.0
Hindu	1	0.1	1	0.1
Jewish	16	1.0	2	0.2
Any other	247	15.2	9	1.1
Total	**1624**	**100**	**808**	**100**

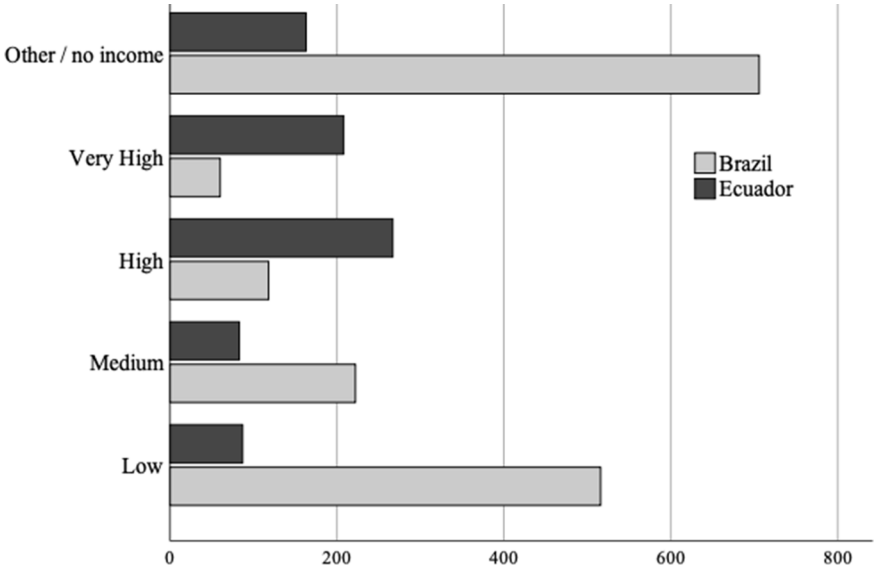

Fig. 1. Self-reported income levels, split by country. Response options were given in monetary brackets, unique to each Brazil and Ecuador. 'Other / no income' included students.

presented in Table 5, also alongside means and standard deviations and the Cronbach's alpha values for each factor, again separated by country and for the complete sample.Table 6..

Finally, the 13-item attitudes scale is presented in Table 5, again with means and standard deviations, and Cronbach's alpha values for each factor, for each country individually and both together. A Confirmatory Factor Analysis revealed the one-factor structure to be an acceptable fit to the data once error covariances were included between two pairs of items (CFI: 0.937, GFI: 0.962, NFI: 0.930, RMSEA: 0.059, SRMR: 0.0385).

3.3. Exploring demographic effects

Hierarchical regression analyses were run to assess the influence of age and gender on risk perceptions and attitudes (after accounting for exposure to the road environment). As they were categorical in nature, age, gender, and exposure were all recoded into dummy variables for these analyses. To simplify analyses and interpretations, only those respondents self-identifying as either male or female were included in the analyses (resulting in the exclusion of data from 32 respondents in Brazil and from one respondent in Ecuador). Six models were run: one for each of the two risk perception factors (*Collision event* and *General traffic risk perception*), for

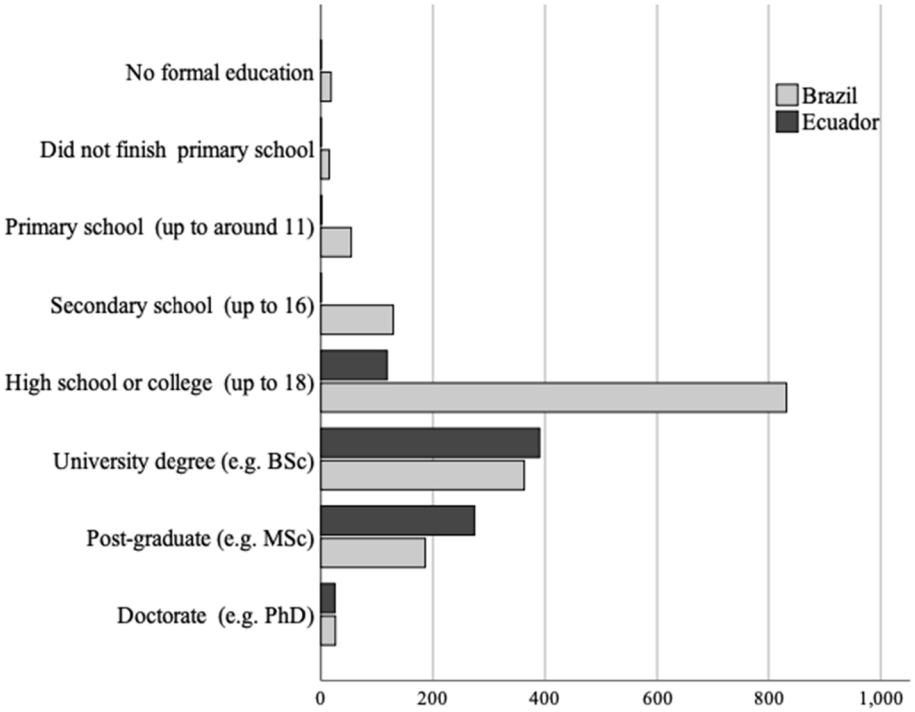

Fig. 2. Self-reported highest completed education levels, split by country.

Table 4
Traffic risk perception questions with means and standard deviations indicated, as well as Cronbach's alpha values for each of the two sub-scales, individually for each country and for the complete, two-country sample (with responses ranging from 1 = 'extremely unlikely' to 5 = 'extremely likely').

Question	Means (SDs)		
	Bra	Ecu	Comp
Collision event risk perception - Cronbach's alpha: Brazil = 0.87, Ecuador = 0.90, Complete = 0.87			
"Please indicate what you think is the likelihood that the each of following incidents occur on the roads in [Brazil/Ecuador] in a serious enough way as to result in serious or fatal injury"			
Head on collision	4.2 (0.9)	4.0 (0.9)	4.1 (0.9)
Vehicle running off the road	3.9 (0.9)	3.9 (0.9)	3.9 (0.9)
Vehicle overturns in the roadway	4.3 (0.9)	3.8 (0.9)	4.1 (0.9)
Collision caused by changing lane	3.9 (0.9)	4.1 (0.9)	4.0 (0.9)
Collision with another vehicle from behind	3.5 (1.0)	3.9 (0.9)	3.6 (1.0)
Collision with a pedestrian	4.3 (0.8)	3.7 (0.9)	4.1 (0.9)
Collision with another vehicle at a road junction	4.1 (0.9)	3.9 (0.9)	4.0 (0.9)
Vehicle explosion following collision	4.6 (0.8)	3.0 (1.0)	4.1 (1.1)
General traffic risk perception - Cronbach's alpha: Brazil = 0.89, Ecuador = 0.87, Complete = 0.89			
"Please indicate what you think is the general likelihood of a person being seriously or fatally injured when using the [Brazil/Ecuador] road system"			
As a pedestrian	3.4 (1.0)	3.7 (0.9)	3.5 (1.0)
As a rider of a bicycle	3.5 (1.0)	4.1 (0.8)	3.7 (1.0)
As a rider of a motorcycle	3.7 (1.0)	4.3 (0.8)	3.9 (0.9)
As a driver of a car	3.4 (1.0)	3.6 (0.8)	3.4 (0.9)
As a passenger of a motorcycle or motorised three-wheeler	3.6 (1.0)	4.1 (0.8)	3.8 (0.9)
As a passenger of a car	3.3 (0.9)	3.5 (0.8)	3.3 (0.9)
As a passenger of a bus or coach	2.9 (1.0)	3.6 (0.8)	3.1 (1.0)

Bra: Brazil, Ecu: Ecuador, Comp: Complete sample.

each of the two countries (Brazil and Ecuador), and one for *Attitudes* for each country. Exposure (the number of hours spent using their main mode of transport each week) was included in the first block, age in the second, gender in the third. Results are displayed in Table 7 (see Table 8).

Regarding gender, significant effects were found in Brazil for both risk perception factors (though more strongly for *General traffic*

Table 5
Fatalistic beliefs questions with means and standard deviations indicated, as well as Cronbach's alpha values for each of the sub-scales, individually for each country and for the complete, two-country sample (with responses ranging from 1 = 'strongly agree' to 5 = 'strongly disagree').

Question	Means (SDs)		
	Bra	Ecu	Comp
General Fatalism - Cronbach's alpha: Brazil = 0.82 Ecuador = 0.84, Complete = 0.83			
If bad things happen, it is because they were meant to happen	3.5 (1.1)	4.1 (1.0)	3.7 (1.1)
Life is very unpredictable, and there is nothing one can do to change the future	3.7 (1.1)	3.9 (1.1)	3.8 (1.1)
If something bad is going to happen to me, it will happen to me no matter what I do	3.8 (1.0)	4.0 (1.0)	3.8 (1.0)
There is no sense in planning a lot; if something good is going to happen, it will	3.6 (1.1)	3.8 (1.1)	3.6 (1.1)
People die when it is their time to die and there is not much that can be done about it	3.1 (1.2)	3.5 (1.2)	3.2 (1.2)
I have learned that what is going to happen will happen	3.0 (1.2)	3.0 (1.2)	3.0 (1.2)
Internality* - Cronbach's alpha: Brazil = 0.68, Ecuador = 0.73, Complete = 0.69			
What people get out of life is always due to the amount of effort they put in	3.2 (1.2)	3.8 (1.2)	3.4 (1.2)
What happens to me is a consequence of what I do	3.8 (0.9)	4.3 (0.9)	4.1 (0.9)
I can do almost anything if I really want to do it	3.3 (1.2)	3.8 (1.1)	3.4 (1.2)
What happens to me in the future mostly depends on me	3.9 (0.9)	4.2 (0.9)	4.0 (0.9)
My life is determined by my own actions	4.0 (0.8)	4.3 (0.7)	4.1 (0.8)
I feel that when good things happen, they happen as a result of my own efforts	5.0 (0.0)	4.3 (0.7)	4.8 (0.5)
Divine Control - Cronbach's alpha: Brazil = 0.94, Ecuador = 0.94, Complete = 0.94			
Everything that happens is part of God's plan	3.0 (1.4)	3.5 (1.4)	3.2 (1.4)
Everything that happens to a person was planned by God	3.3 (1.3)	3.7 (1.2)	3.4 (1.3)
Whatever happens to me in my life, it is because God wanted it to happen	3.2 (1.3)	3.6 (1.2)	3.4 (1.3)
God controls everything good and bad that happens to a person	3.4 (1.3)	3.7 (1.2)	3.5 (1.3)
God has a plan for each person, and you cannot change His plan	3.3 (1.3)	3.7 (1.2)	3.4 (1.3)
No matter how much effort I invest into doing things, in the end, God's decision will prevail	3.4 (1.3)	3.8 (1.2)	3.5 (1.2)
Luck - Cronbach's alpha: Brazil = 0.83, Ecuador = 0.81, Complete = 0.82			
When good things happen to people, it is because of good luck	3.5 (0.9)	3.8 (0.9)	3.6 (0.9)
When I get what I want, it's usually because I am lucky	3.9 (0.9)	4.0 (0.8)	3.9 (0.9)
The really good things that happen to me are mostly because of luck	3.7 (1.0)	4.1 (0.8)	3.9 (0.9)
Some people are simply born lucky	3.8 (1.0)	3.5 (1.1)	3.7 (1.1)
How successful people are in their jobs is related to how lucky they are	3.9 (1.0)	4.0 (0.9)	3.9 (0.9)
Luck does not exist (reverse coded)	2.7 (1.1)	3.1 (1.1)	2.9 (1.1)
Helplessness - Cronbach's alpha: Brazil = 0.77, Ecuador = 0.84, Complete = 0.79			
I feel that nothing I can do will change things	3.9 (0.9)	4.0 (0.8)	3.9 (0.9)
No matter how hard I try, I still cannot succeed in life	4.2 (0.9)	3.9 (1.0)	4.1 (1.0)
I often feel overwhelmed with problems, since I do not have control over solving these problems	2.8 (1.1)	3.6 (1.0)	3.0 (1.2)
Sometimes I fell there is nothing to look forward to in the future	3.5 (1.2)	4.0 (1.0)	3.7 (1.2)
I feel that I do not have any control over the things that happen to me	3.5 (1.0)	3.9 (0.8)	3.7 (1.0)
There is nothing I can do to succeed in life, since one's level of success is determined when one is born	4.1 (0.9)	4.2 (0.9)	4.2 (0.9)

Bra: Brazil, Ecu: Ecuador, Comp: Complete sample.
* Scores for the *Internality* factor were reversed such that lower scores indicated a more external locus of control, in line with the other four fatalistic belief factors.

Table 6
Road safety attitudes questions with means and standard deviations indicated, as well as Cronbach's alpha values for each of the sub-scales, individually for each country and for the complete, two-country sample (with responses ranging from 1 = 'strongly agree' to 5 = 'strongly disagree').

Question - Cronbach's alpha: Brazil = 0.83, Ecuador = 0.83, Complete = 0.85	Means (SDs)		
	Bra	Ecu	Comp
Many traffic rules must be ignored to ensure traffic flow	3.9 (1.1)	4.0 (1.1)	3.9 (1.1)
It makes sense to exceed speed limits to get ahead of slow drivers	3.5 (1.2)	3.8 (1.1)	3.6 (1.2)
Speed limits are exceeded because they are too restrictive	3.4 (1.1)	3.5 (1.2)	3.4 (1.1)
It is acceptable to drive when traffic lights shift from yellow to red	3.9 (1.0)	4.2 (0.9)	4.0 (1.0)
Taking chances and breaking a few rules does not necessarily make bad drivers	3.0 (1.1)	3.8 (1.2)	3.3 (1.2)
It is acceptable to take chances when no other people are involved	3.0 (1.1)	4.1 (1.0)	3.4 (1.2)
Traffic rules are often too complicated to be carried out in practice	3.7 (1.0)	4.0 (1.1)	3.8 (1.1)
If you are a good driver it is acceptable to drive a little faster	3.5 (1.1)	3.9 (1.0)	3.6 (1.1)
I will ride with someone who speeds if that's the only way to get home at night	3.4 (1.2)	3.7 (1.1)	3.5 (1.1)
I will ride with someone who speeds if others do	3.6 (1.1)	4.0 (0.9)	3.8 (1.0)
When the road is clear, there is no need to stop at a stop sign	3.5 (1.1)	4.3 (1.0)	3.7 (1.1)
Towards the crest of a hill, a driver should overtake the vehicle in front if they are going faster	3.7 (1.0)	4.0 (1.1)	3.8 (1.0)
It is acceptable to ride on a motorbike without a helmet	4.3 (0.9)	4.8 (0.6)	4.4 (0.9)

Bra: Brazil, Ecu: Ecuador, Comp: Complete sample.

risk perception) and for *Attitudes*, while in Ecuador only *Attitudes* were related to gender. Where results were significant, in all cases females scored more highly, indicating safer attitudes and a perception that injury-causing events are more likely, or that there is greater risk to road users.

Table 7
Results of regression analyses assessing the influence of age and gender on the two risk perception factors and attitudes. Model 1 contained exposure to the road environment, Model 2 included the addition of age, Model 3 included gender. Significant *p* values in bold.

	Collision event risk perception			General traffic risk perception			Attitudes		
	R^2	ΔR^2	*p*	R^2	ΔR^2	*p*	R^2	ΔR^2	*p*
Brazil									
Model 1 (exposure)	0.008		**0.030**	0.007		0.058	0.018		**<0.001**
Model 2 (Model 1 + age)	0.020	0.013	**<0.001**	0.026	0.019	**<0.001**	0.032	0.014	**<0.001**
Model 3 (Model 2 + gender)	0.023	0.002	**0.045**	0.040	0.015	**<0.001**	0.050	0.018	**<0.001**
Ecuador									
Model 1 (exposure)	0.003		0.885	0.009		0.271	0.012		0.122
Model 2 (Model 1 + age)	0.008	0.005	0.400	0.020	0.010	0.083	0.045	0.033	**<0.001**
Model 3 (Model 2 + gender)	0.009	0.001	0.338	0.033	0.014	**0.001**	0.053	0.021	**<0.001**

Table 8
Spearman rank correlations exploring the relationships between age and risk perceptions and attitudes. Significant *p* values in bold.

	Collision event risk perception		General traffic risk perception		Attitudes	
	rho	*p*	rho	*p*	rho	*p*
Brazil	-0.045	0.072	0.105	**<0.001**	0.138	**< 0.001**
Ecuador	-0.095	**0.007**	-0.074	**0.035**	0.102	**0.004**

In terms of age, significant effects were found in Brazil for both risk perception factors and for *Attitudes*, while in Ecuador only one risk perception factor (*General traffic risk perception*) and the *Attitudes* factor were related to age. To explore this more deeply, Spearman's rank correlation was calculated to assess whether there was a pattern in risk perceptions and attitudes across age categories (i.e., rather than just group differences, as shown in the regression). Results are presented in Table 8. Results for risk perceptions were mixed. In the Brazil sample, respondents' perception of the general likelihood of road users being seriously or fatally injured on the roads increased with age. The opposite was true in the Ecuador sample; however, in both cases, relationships were weak. For the perception of the likelihood of a given collision event occurring, the relationships were in the same direction in each country (with risk

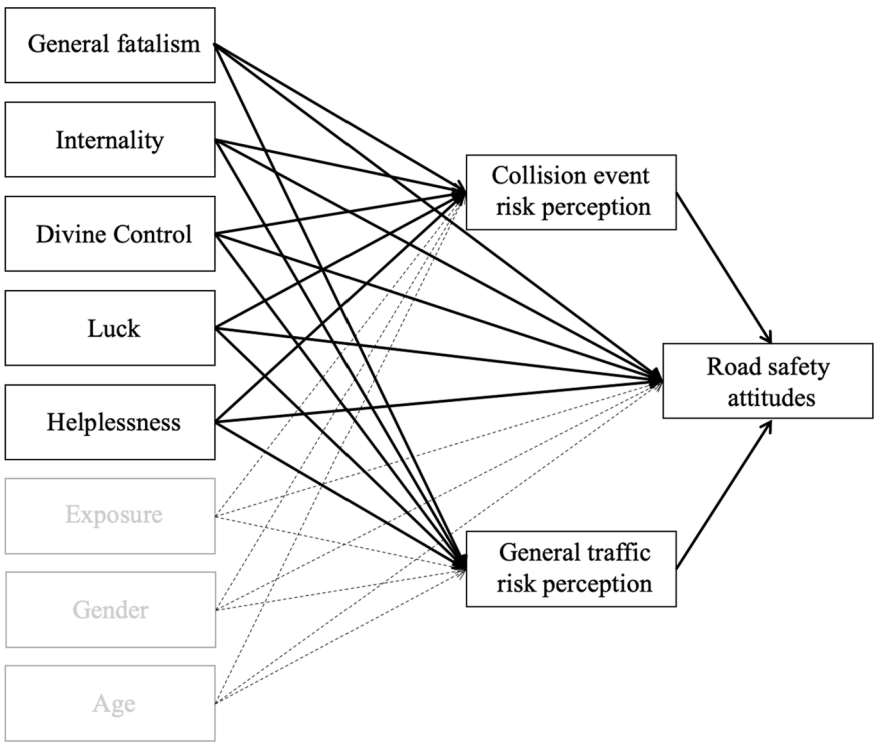

Fig. 3. Structural model used to assess the relationships between the study variables. Age, gender, and exposure to the road environment were included in the model but do not represent the focus of the work (hence are grey). Covariance relationships (i.e., double-headed arrows) were included between all exogenous variables (i.e., those on the left of the figure); for legibility reasons, these are not displayed in Fig. 4.

perceptions decreasing with age) but were also weak, with the correlation in the Brazil sample not statistically significant. *Attitudes* results were more consistent; in both Brazil and Ecuador, reported road safety attitudes were found to be safer as age increased.

3.4. Exploring relationships between factors

As described above, to assess the relationships between fatalistic beliefs, risk perceptions, and road safety attitudes, a structural equation modelling approach was taken. This allows for simultaneous testing of all model paths. Specifically, multiple mediation was assessed, a simplified version of the model of which is displayed in Fig. 3. This included the assessment of the direct relationships between each of the five fatalistic belief factors and road safety attitudes, the direct relationship between each of the two risk perception factors and road safety attitudes, and the indirect relationships between the five fatalistic belief factors and road safety attitudes as mediated through each of the two risk perception factors. Age, gender, and exposure were included as control variables (i.e., covariates). These were treated as exogenous variables in the model whereby direct relationships with endogenous variables (i.e., risk perceptions and attitude) were included as well as covariance relationships with all other exogenous variables (i.e., the fatalistic belief variables). For completeness, their effects on risk perceptions and road safety attitudes are also reported in the Tables below. Following Kline (2015) and Hu and Bentler (1999), model fit for the Brazil (CFI: 0.911, GFI: 0.972, NFI: 0.912, SRMR: 0.0455) and Ecuador (CFI: 0.879, GFI: 0.955, NFI: 0.882, SRMR: 0.0455) data were considered low but were accepted given high goodness of fit and low standardised root mean square residual values. Note that we do not report RMSEA as this has been shown to be an unreliable measure of model fit in models with low degrees of freedom (see Kenny et al. 2015).

In Table 9, below, five types of effects are presented: *total effects* are the total effects of each fatalistic belief factor on *Attitudes* without the mediating variables present; *direct effects* are the direct effect of the fatalistic belief factor on *Attitudes* when the mediating variables are included in the model; *total indirect effects* are the effects of each fatalistic belief factor on *Attitudes* as mediated through both risk perception factors simultaneously; *specific indirect effects*, of which there are two types (one for *Collision event risk perception*, another for *General traffic risk perception*), are the effects of each fatalistic belief factor on *Attitudes* as mediated through each risk perception factor individually. Table 9 also displays the total variance explained (i.e., R^2) in road safety attitudes (by fatalistic beliefs, risk perceptions, age, gender, and exposure to the road environment). In Table 10, the direct effects of each fatalistic belief factor on each risk perception factor are presented. The total variance in each risk perception factor explained by fatalistic beliefs in combination with age, gender, and exposure is again also displayed. In both tables, results are separated by country. Males acted as the reference category for the inclusion of gender. Bootstrapping in the AMOS software (with 2000 random samples and a 95 % confidence interval) was used to test the statistical significance of all effects (Cheung & Lau, 2008).

Almost no notable differences in the relationships examined were found between the two countries' samples, the only exception being the influence of age on road safety attitudes scores in Brazil and the lack thereof in Ecuador. All other relationships were highly comparable and subsequent discussions refer to both countries' data.

To interpret the effect sizes of the variety of significant effects presented in Tables 9 and 10 we follow Cohen's (1988) standards of

Table 9
Effects on Attitudes. Standardised regression weights.

Model	*Effects*	*Total effects*	*Direct effects*	*Indirect effects*		
				Total indirect effect	*Specific: General traffic risk perception*	*Specific: Collision event risk perception*
Brazil	*General Fatalism*	0.23***	0.22***	0.015**	0.003	0.013**
R^2 = *0.25***	*Internality*	0.06*	0.03	0.023***	0.007***	0.016***
	Divine Control	0.02	0.03	-0.011*	−0.005**	−0.006
	Luck	0.20***	0.19***	0.012**	0.004*	0.008*
	Helplessness	0.09**	0.08*	0.011	−0.003	0.014***
	Age	0.12***	0.12***	-0.006	0.003*	−0.009***
	Gender	0.16***	0.14***	0.016***	0.008***	0.008**
	Exposure	-0.01	-0.02	0.011**	0.002	0.009**
General traffic risk perception			0.08***			
Collision event risk perception			0.14***			
Ecuador	*General Fatalism*	0.31***	0.29***	0.017**	0.003	0.014**
R^2 = *0.29***	*Internality*	0.04	0.01	0.027***	0.009***	0.018***
	Divine Control	-0.07	-0.05	-0.011*	−0.005**	−0.007
	Luck	0.18**	0.17**	0.013**	0.004*	0.008*
	Helplessness	0.12**	0.10*	0.012	−0.004	0.016***
	Age	0.02	0.03	-0.006	0.003*	−0.009***
	Gender	0.19***	0.17***	0.019***	0.009***	0.009**
	Exposure	-0.04	-0.05	0.014**	0.003	0.011**
General traffic risk perception			0.07***			
Collision event risk perception			0.17***			

***p <.001, **p <.01, *p <.05.

Table 10
Effects of fatalistic beliefs on risk perceptions.

Model	*Effects*	*Effect on General traffic risk perception*		*Effect on Collision event risk perception*	
		R^2	β	R^2	β
Brazil		0.03*		0.06**	
	General Fatalism		0.04		0.11**
	Internality		0.06***		0.12***
	Divine Control		-0.06*		-0.05
	Luck		0.10*		0.06*
	Helplessness		0.04		0.10***
	Age		0.04*		-0.07**
	Gender		0.11***		0.06**
	Exposure		0.03		0.06***
Ecuador		0.04*		0.06**	
	General Fatalism		0.04		0.08**
	Internality		0.12***		0.11***
	Divine Control		-0.07*		-0.04
	Luck		0.06*		0.05*
	Helplessness		-0.06		0.10***
	Age		-0.06*		0.05**
	Gender		0.13***		0.06**
	Exposure		0.05		0.07

***$p < .001$, **$p < .01$, *$p < .05$.

0.1 for a small effect, 0.3 for medium, and 0.5 for large. The indirect effects are the product of two other effects and are therefore squared: 0.01 for small, 0.09 for medium, and 0.25 for large. We do not discuss mediation as 'full' or 'partial' (see Rucker et al., 2011 for a discussion on why those distinctions have little meaning), rather we simply draw attention to where relationships were significant with or without inclusion of the mediators.

Table 9 displays the effects on road safety attitudes of the demographic, risk perception, and fatalistic belief variables included. *General fatalism* was found to be significantly linked with road safety attitudes, with a small to medium effect size with or without the presence of risk perceptions as mediators. Those with greater fatalistic tendencies reported more dangerous attitudes to road safety. That said, the indirect influence of *General fatalism* through *Collision event risk perception* was significant, although with a small effect size. *Internality* was not directly linked with road safety attitudes, but there were significant indirect effects through the risk perception factors. This was true for both *General traffic* and *Collision event risk perception*, with the effect stronger for *Collision event risk perception* (though still small at 0.016 and 0.018 in the two countries). In each case, those with a more external locus of control reported a perception that road users are at lesser risk, and that injury causing events are less likely to occur. A similar pattern emerged for *Divine control*, with no direct effect on road safety attitudes but small indirect effects, this time only through *General traffic risk perception*; however, this pattern was in the opposite direction, with those indicating a stronger belief in divine influence over their lives also reporting a greater perceived risk to road users. *Luck* was significantly and directly associated with road safety attitudes. Those with a stronger belief in luck reported more dangerous road safety attitudes. Although some indirect effects were significant, they were small and significant only at $p < .05$. The *Helplessness* factor showed a mediated relationship with road safety attitudes, with a significant direct effect rendered weaker by the inclusion of the mediating variables. Specifically, it was through *Collision event risk perception* that the relationship was mediated, with a greater sense of helplessness associated with a perception that injury-causing events are less likely.

As mentioned above, the relationship age had with road safety attitudes differed between countries, being significant in Brazil but not so in Ecuador. In both countries, however, there was a small but significant indirect effect of age on road safety attitudes through *Collision event risk perception*. In both samples, older respondents reported a perception that an injury-causing event was less likely to occur compared to younger respondents. Gender effects were similar across countries, with direct and indirect effects found. Those identifying as male were found to report more dangerous attitudes to road safety compared to those identifying as female. The effect of *Exposure* on road safety attitudes was found to be mediated though *Collision event risk perception*, with no significant direct effect. This indicates that the extent to which a person uses the road system influences road safety attitudes through its effect on the perception of risk. Finally, in terms of the influence of the included factors on road safety attitudes, *General traffic risk perception* was found to have a small effect and *Collision event risk perception* to have a small to medium effect, both of which were highly significant in each country. Those that reported more dangerous attitudes also reported a perception of lesser on-road risk. In total, 25 % and 29 % of the variance in attitudes scores could be explained by the model in the Brazil and Ecuador samples respectively.

Table 10 displays the effects on the two risk perception factors of the demographic and fatalistic belief variables. As with roads safety attitudes, very similar patterns were seen in the Brazil and Ecuador samples, with only minor differences in effect sizes in most variables. The perception of the general risk faced by road users was most strongly influenced by the *Internality* fatalistic belief factor, although the effect was small. Those that reported a more external locus of control reported a perception that road user faced lower risk. This was also the case for *Collision event risk perception*, with an external locus of control associated with a perception that injury-causing events are less likely. Scores in the *Helplessness* factor also related significantly with *Collision event risk perception*, again with those feeling more helpless also reporting a lesser perception of risk. As detailed in the correlation analysis described above, the

influence of age was mixed across risk perception categories and country, with small effect sizes. *Gender*, on the other hand, showed a more consistent pattern in terms of its influence on risk perception; in both risk perception categories, males reported perceiving a lower risk than females. The influence of *Exposure* (i.e., the number of hours travelled each week) was only found to be significant for the *Collision event risk perception* factor in Brazil, with a small effect size. In total, 3 % and 4 % of the variance in *General traffic risk perception* in the Brazil and Ecuador samples respectively were explained by the demographic and fatalistic belief factors. For *Event risk perception*, this figure stood at 6 % in each country sample.

4. Discussion

This study sought to explore the relationships between a person's belief in external influence over one's life (through beliefs in fatalism, religion, luck, and relating to locus of control), their perception of risk in a traffic context, and their attitudes to road safety. It did so with data from two Latin American countries: Brazil and Ecuador. We hypothesised that the influence of fatalistic beliefs on road safety attitudes would depend upon the specific dimension of fatalism in question. Our results supported this hypothesis. We also hypothesised that the effect of fatalistic beliefs on attitudes would be at least partly mediated by traffic risk perceptions. This was also supported, with the presence of mediation dependent on the fatalistic belief dimension and risk perception dimension under study. We also explored the influence of age and gender on risk perceptions and road safety attitudes. We will discuss these in turn, followed by a more detailed discussion of the relationships between the risk, attitude, and belief factors in both data sets.

4.1. Age and gender

Previous research undertaken across a variety of European nations has found that females report safer attitudes to road safety compared to males (e.g., Cordellieri et al., 2016; Iversen & Rundmo, 2004). Our own previous also showed this to be the case in Bangladesh, China, Kenya, Thailand, the UK, and Vietnam (McIlroy et al., 2020a). Results presented above suggest this also to be true in Brazil and Ecuador, with strongly significant differences between males' and females' responses found in each data set. Conversely, risk perception results were mixed, with significant differences between males and females found in the Brazil sample but not in the Ecuador sample. This mirrors the literature. Lund and Rundmo (2009) found gender to be linked with traffic risk perception in Norway but not in Ghana. As we found in the Brazil sample, Lund and Rundmo (2009) found females in Norway to perceive risk to be greater than males. This was also found by Rhodes and Pivik (2011) in their US sample; however, DeJoy (1992) found no significant effect of gender on traffic risk perception in the US. More recently, this lack of relationship was also found by Cordellieri et al. (2016) in their European-wide study. One might conclude that the country differences found by Lund and Rundmo (2009) have something to do with culture or geography, with Norway and Ghana differing significantly in both these regards. Mixed results from the US, our own mixed results (between two culturally and geographically similar countries), and work from Nordfjærn & Rundmo (2009) finding no gender differences in risk perception in either Norway or Ghana, means the question is left open.

Patterns of results were somewhat similar for age, with differences in attitudes across age groups clear and consistent in both country samples, and non-significant or mixed for risk perceptions. It has previously been demonstrated that older individuals tend to report safer attitudes to road safety, a finding we replicated in our own previous work in China, Kenya, Thailand, the UK, and Vietnam (e.g., Yagil, 1998; Iversen & Rundmo, 2004; McIlroy et al., 2020b); we again replicate that finding here with data from Brazil and Ecuador. Risk perception results do not lend themselves to simple interpretation. For the perception of the general risk faced by road users, significant correlations were found in both Brazil and Ecuador; however, effects were very small, and in opposite directions. For the perception of the risk of certain events occurring, relationships with age were significant in Ecuador (with low effect size) but not in Brazil. As with gender and traffic risk perception, results in the age and risk perception literature are mixed. For example, Rhodes and Pivik (2011), Sivak et al. (1989), Useche et al. (2019) reported finding older adults to perceive greater traffic risk than younger adults, while Nordfjærn & Rundmo (2009) and Cox et al (2017) found no such age differences. Our data do little to resolve this issue.

4.2. Country similarities

It is first worth first noting that our analyses showed highly similar patterns of results across both the Brazil and Ecuador samples. This contrasts with our own previous multi-country study where we found relationships between factors to differ between countries (McIlroy et al., 2020a, 2020b). Specifically, we found the respondents from Bangladesh and Kenya that reported a greater belief in divine control also reported safer attitudes, whereas the respondents from Thailand and Vietnam reporting a greater belief in divine control were those that reported more dangerous attitudes to road safety (McIlroy et al., 2020a). We discussed those results in terms of the monotheistic culture of both Bangladesh and Kenya (being strongly Christian and Muslim, respectively), highlighting previous work by Yıldırım (2007) and Nabipour et al. (2015) that showed strong belief in divine power (in Muslim samples) to be linked with safer traffic behaviours.

In our structural equation model (above), the *Divine control* factor was not found to directly influence road safety attitudes in either Ecuador or Brazil; however, the indirect effect through *General traffic risk perception* was significant. Interestingly, its influence was opposite to that of the other two fatalistic belief factors for which significant relationships were found (i.e., *Internality* and *Luck*). For those reporting a more external conception of event causation, and those more strongly believing in luck, the mediated relationship between beliefs attitudes (through *General traffic risk perception*) was such that those with more fatalistic (or externally orientated) beliefs reported more dangerous attitudes to road safety (reflecting the wider literature on fatalism and road safety: e.g., Dixey, 1999; Kouabenan, 1998; Omari & Baron-Epel, 2013; Maghsoudi et al., 2018; Nordfjærn et al., 2012; Peltzer & Renner, 2003; Şimşekoğlu

et al. 2013; Ngueutsa & Kouabenan, 2017; Teye-Kwadjo, 2019). Religious belief, on the other hand, was indirectly linked with safer, not more dangerous attitudes. This finding is in line with our previous findings for Kenya and Bangladesh. As with those countries, both Brazil and Ecuador have strongly monotheistic, religious cultures, i.e., their populations are predominantly Christian (as evidenced in our sample; see also Pew Forum on Religion & Public Life, 2012). This lends weight to the argument that in strongly religious settings, a belief in divine control has a protective effect, whereas in less religious settings (e.g., Vietnam and Thailand in our previous work) it functions more like other fatalistic beliefs concepts insofar as it has a negative effect on safety.

4.3. Fatalistic beliefs, road safety attitudes, and the mediating role of risk perceptions

In terms of the relationships between fatalistic beliefs and attitudes, and the mediating role of risk perceptions, we hypothesised that different fatalistic belief factors would have differing impacts upon attitudes, and that these effects would be at least partly mediated through risk perceptions. Both hypotheses were confirmed. As patterns in both countries' data were largely the same, they will be discussed together. Regarding direct links, we found stronger beliefs in *General fatalism*, *Luck,* and *Helplessness* to be associated with more dangerous attitudes to road safety. For all three, we also found some level of mediation to be present; the influence of fatalistic beliefs on attitudes was mediated by a person's perception of risk. This reflects work by Ngueutsa and Kouabenan's (2017), though their work demonstrated the mediating influence of risk perceptions on the relationship between fatalistic belief and behaviour, rather than fatalistic beliefs and attitudes. Similarly, Teye-Kwadjo (2019) found fatalism and risk perceptions to be linked with road safety attitudes (in the same directions found here); however, that work did not explore risk perceptions as a mediator. Overall, our results concur with those reported elsewhere; those with a more external view of event causation reported perceiving less traffic risk.

In discussing the possibility that fatalistic people underestimate the risk associated with certain situations, and hence behave more dangerously, Teye-Kwadjo (2019) offered two explanations, both of which are also relevant here when considering road safety attitudes. The first concerns the avoidance of the cognitive effort associated with analysing risky situations; perceiving less risk is the easier option (Kouabénan, 2007). The second is the converse of the first, i.e., that perceiving greater risks, and performing the subsequent effortful thought processes that go in to analysing those risks (and modifying behaviour accordingly), has a reducing influence on a person's fatalistic views. This would need more targeted study to unpick; however, our results are consistent with both arguments.

Where most previous studies have used a single factor in the measurement of risk perception, our research employed two (perception of the risk of a collision event occurring and perception of the general risk experienced by different road users). This approach reflects that taken by Nordfjærn and Rundmo (2009); however, they did not report on the differing relationships associated with the two factors. To this end, our results showed some differences in the way the two types of risk perception linked with attitudes and fatalistic beliefs.

The mediating effect of risk perceptions was not shared equally between the two risk perception factors, with *Collision event risk perception* more strongly linked with the other factors than *General traffic risk perception*. Specifically, although both were significantly associated with *Attitudes*, *Collision event risk perception* showed a stronger relationship. Additionally, the *General fatalism* and *Helplessness* factors were both significantly associated with the perceived risk of specified collision events occurring but were not associated with a general perception of traffic risk. These findings may be due to the more concrete nature of the *Collision event* questions. Kanellaidis et al. (2000) discussed the importance of a driver's perception of risk of specific situations in guiding behaviour, while the health belief model (Rosenstock, 1974) posits that self-protective behaviour arises from a greater perceived risk of a particular risk event occurring. Just as with behaviour, it may be the case that attitudes are more influenced by the perception of risk of *specific* events than by more general risk perceptions.

This idea is lent weight when considering Weinstein's (1988) precaution adoption process model. This proposes that for an individual to perform preventive (in this case, traffic-safe) behaviours they must first perceive the risk of a specific action or event and then consider their own personal susceptibility to that risk. The *General traffic risk* factor included statements concerning a variety of road users. It is unlikely that our respondents would have identified with all road user types indicated, hence the connection between perceived risk and the personal susceptibility to that risk would likely have been lesser for some road user roles than for others. The omission of this necessary step, according to the precaution adoption process model, would result in a lesser influence on behaviour (Weinstein, 1988). It is likely also the case that the influence on attitudes would also be lesser, thus explaining our findings (compared to the more specific *Collision event* risk perception category, and its link with attitudes). To relate back to the traffic safety literature, it is interesting to note that in Teye-Kwadjo's (2019) research (where risk perception was linked with fatalism), the risk perception factor was specific, not general, concerning the perceived risk associated with several specified dangerous traffic situations.

Most traffic safety and fatalistic belief research has used just one measure of fatalism, rather than separate it into the multiple dimensions suggested by Esparza (2005) and Esparza et al., 2015). As we found previously (McIlroy et al., 2020a), the different fatalistic belief factors have differing influences on attitudes and behaviours. This also appears to be true in the context of risk perceptions; different dimensions of fatalism are linked differently to risk perceptions. We have already discussed the protective influence of a belief in divine control (compared to the negative influence of other fatalistic belief factors). An additional finding of note involved the *Internality* factor. Unlike *General fatalism*, *Luck*, and *Helplessness*, it was not strongly associated with attitudes; however, it was related to risk perception (like *Divine control*). Specifically, those reporting higher *Internality* scores (reverse coded such that this represented a more internal locus of control) also reported perceiving greater risk to roads users and a greater risk of collision events occurring on the roads. Previous research has shown risk perception functions as a mediating variable in the relationship between locus of control (to which our *Internality* scale is closely linked) and behaviour (e.g., You et al. 2013). It may be true that this is also the case for the relationship between locus of control and attitudes. That said, fatalism and beliefs in luck or divine influence can be described as

specific aspects of locus of control. For example, an individual with an external locus of control will attribute events to external factors; luck, fate, or God's influence are just three examples of many possible external factors (other people's behaviour being another common factor on which people lay blame: e.g., White & Blazek, 2019). These differences would need further study to clarify. Important here is that the factors have differing relationships with risk perceptions and road safety attitudes. As such, researchers should take care to consider exactly what aspect of externality they are considering when exploring such relationships.

5. Limitations

As with any self-report research, our research relied upon a person truthfully responding to the questions posed. There is a chance that people do not report their beliefs or attitudes openly or honestly. This would bring our conclusions into question. Given the wealth of research that has used questionnaires to successfully explore such concepts, and the similarity of our results with those reported elsewhere, we do not consider this limitation overly significant; however, it must still be acknowledged. Relatedly, we have explored the influence of beliefs and risk perceptions on road safety attitudes, not on behaviours. Although these is considerable research linking the two (both within and beyond the transport domain), there exists the possibility that (and situations in which) attitudes do not relate to performed behaviours. Although not a limitation of our research per se, this would limit the potential for safety intervention design to follow our work. More intermediary work would need to be conducted to further illuminate the complex relationships between risk perceptions, beliefs, attitudes, and behaviours (self-reported or observed).

A more significant limitation in our work is in the differences between the two country samples. The Brazil sample analysed here included a large number of individuals with no formal income. Although some of these would have been individuals that had lost their jobs as a result of the pandemic (with data collection happening in the pandemic's second year), many would have been students, thus over-representing that population. Although 18 to 29-year-olds are the most represented in road traffic fatality statistics (hence are of special interest), they were not our focus, and the imbalance must be accepted as a limitation. This imbalance was not evident in the Ecuador sample, where age and income splits were less weighted towards any particular group. These sample differences make it more challenging to make valid cross-country comparisons; however, this would be more problematic should we have found differences to exist, and subsequently tried to explain those differences (as differences could be attributed to sample characteristics rather than to underlying differences in the attitudes and beliefs of people from different countries). In reality, we found no notable differences between the results from the two samples despite those sample having different demographic characteristics; hence, the issue is of less significance. Nevertheless, the observant reader will note the lack of direct statistical comparisons between country data sets presented in this research. Comparing the Brazil data with the Ecuador data was not the main aim of this research, and any work aiming to make such comparisons would do well to ensure greater consistency in the demographic make-up of the samples compared.

As an additional issue, both samples were more highly educated than would be samples truly representative of the wider populations of each country. This is likely to be at least partly due to the imperfect sampling methods adopted (i.e., convenience sampling). Given the similarities in results between the two countries studied here, and the similarities between our results and those reported in the extant literature, we do not think these sampling issues detract from the value of our results. That said, we acknowledge the limitation and recommend concerted effort to repeat the work in communities characterised by lower education and income and with a greater representation of older individuals.

Finally, a strict interpretation of the reliability of the *Internality* scale reported above (at $\alpha = 0.68$ in the Brazil sample and 0.69 in the complete sample) would be that it is not sufficiently reliable for inclusion in subsequent analyses (being under the generally accepted 0.7 threshold). That said, several researchers have argued for values above 0.6 to reflect acceptable internal consistency (e.g., van Griethuijsen et al. 2015; Taber, 2018). As such, we retained the factor for inclusion in our analyses.

6. Conclusion

Although the modern, sociotechnical systems approach to road safety rightly warns against loading blame for road traffic collisions on the end user, humans nevertheless represent a fundamental component of the complex road transport system. Understanding the antecedents of their attitudes and behaviours is therefore a valuable step towards designing successful road safety strategies. The current research contributes to this understanding by focussing on the influence of a person's perception of risk and their beliefs in concepts such as fatalism, divine control, and luck, on their road safety attitudes, doing so in two Latin American contexts: Brazil and Ecuador.

Reflecting results elsewhere in the literature, we found younger individuals (compared to older individuals) and males (compared to females) to report more dangerous attitudes to road safety, with mixed results for a person's perception of the likelihood of injury causing events occurring on the roads and their perception of the general risk face by road users. We also demonstrated significant links between fatalistic beliefs and attitudes and evidence for the mediating role of risk perceptions in those relationships. Specifically, individuals with more fatalistic beliefs perceived lesser on-road risk and reported more dangerous attitudes to road safety. This has implications for interventions targeted at attitudinal (and, ultimately, behavioural) change given the impact of personal choices and actions on road safety outcomes.

CRediT authorship contribution statement

Rich C. McIlroy: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Claudia Mont'Alvão: Data curation, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. **Simone P. Cordovezv: . Jorge Vásconez-González:** Data curation, Investigation. **Esteban Ortiz Prado:** Data curation, Investigation, Methodology, Project administration, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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References

Assum, T. (1997). Attitudes and road accident risk. *Accident Analysis & Prevention, 29*(2), 153–159.
Blumenberg, C., Martins, R. C., Costa, J. C., & Ricardo, L. I. (2018). Is Brazil going to achieve the road traffic deaths target? An analysis about the sustainable development goals. *Injury prevention, 24*(4), 250–255.
Bösehans, G., & Massola, G. M. (2018). Commuter cyclists' risk perceptions and behaviour in the city of São Paulo. *Transportation Research Part F: Traffic Psychology and Behaviour, 58*, 414–430.
Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of Cross-Cultural Psychology, 1*(3), 185–216.
Chen, C. F. (2009). Personality, safety attitudes and risky driving behaviors—Evidence from young Taiwanese motorcyclists. *Accident Analysis & Prevention, 41*(5), 963–968.
Cheung, G. W., & Lau, R. S. (2008). Testing mediation and suppression effects of latent variables: Bootstrapping with structural equation models. *Organizational research methods, 11*(2), 296–325.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge.
Cordellieri, P., Baralla, F., Ferlazzo, F., Sgalla, R., Piccardi, L., & Giannini, A. M. (2016). Gender effects in young road users on road safety attitudes, behaviors and risk perception. *Frontiers in Psychology, 7*, 1412.
Cox, J. A., Beanland, V., & Filtness, A. J. (2017). Risk and safety perception on urban and rural roads: Effects of environmental features, driver age and risk sensitivity. *Traffic Injury Prevention, 18*(7), 703–710.
Deery, H. A. (1999). Hazard and risk perception among young novice drivers. *Journal of Safety Research, 30*(4), 225–236.
DeJoy, D. M. (1992). An examination of gender differences in traffic accident risk perception. *Accident Analysis & Prevention, 24*(3), 237–246.
Dinh, D. D., Nam, V. H., McIlroy, R. C., Plant, K. A., & Stanton, N. A. (2020a). Examining the roles of multidimensional fatalism on traffic safety attitudes and pedestrian behaviour. *Safety Science, 124*, Article 104587.
Dinh, D. D., Nam, V. H., McIlroy, R. C., Plant, K. A., & Stanton, N. A. (2020b). Effect of attitudes towards traffic safety and risk perceptions on pedestrian behaviours in Vietnam. *IATSS Research, 44*(3), 238–247.
Dixey, R. A. (1999). Fatalism', accident causation and prevention: issues for health promotion from an exploratory study in a Yoruba town. *Nigeria. Health Education Research, 14*(2), 197–208.
Espinoza-Molina, F. E., Ojeda-Romero, C. F., Zumba-Paucar, H. D., Pillajo-Quijia, G., Arenas-Ramírez, B., & Aparicio-Izquierdo, F. (2021). Road safety as a public health problem: Case of ecuador in the period 2000–2019. *Sustainability, 13*(14), 8033.
Esparza, O. A. (2005). *Factors derived from fatalism scales and their relationship to health-related variables*. The University of Texas at El Paso.
Esparza, O. A., Wiebe, J. S., & Quiñones, J. (2015). Simultaneous development of a multidimensional fatalism measure in English and Spanish. *Current Psychology, 34*(4), 597–612.
FiA Foundation (2016). *Step Change: An Action Agenda on Safe Walking for Africa's Children.* Retrieved 17/05/2022 from https://www.fiafoundation.org/media/402415/step-change-pages.pdf.
Hasanat-E-Rabbi, S., Hamim, O. F., Debnath, M., Hoque, M. S., McIlroy, R. C., Plant, K. L., & Stanton, N. A. (2021). Exploring the relationships between demographics, road safety attitudes, and self-reported pedestrian behaviours in Bangladesh. *Sustainability, 13*(19), 1–16.
Hassan, H. M., & Abdel-Aty, M. A. (2013). Exploring the safety implications of young drivers' behavior, attitudes and perceptions. *Accident Analysis & Prevention, 50*, 361–370.
Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*, 53–60.
Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1–55.
Iversen, H., & Rundmo, T. (2004). Attitudes towards traffic safety, driving behaviour and accident involvement among the Norwegian public. *Ergonomics, 47*(5), 555–572.
Kanellaidis, G., Zervas, A., & Karagioules, V. (2000). Drivers' risk perception of road design elements. *Transportation Human Factors, 2*(1), 39–48.
Kayani, A., King, M. J., & Fleiter, J. J. (2012). Fatalism and its implications for risky road use and receptiveness to safety messages: A qualitative investigation in Pakistan. *Health Education Research, 27*(6), 1043–1054.
Kenny, D. A., Kaniskan, B., & McCoach, D. B. (2015). The performance of RMSEA in models with small degrees of freedom. *Sociological Methods & Research, 44*(3), 486–507.
Kline, R. B. (2015). *Principles and practice of structural equation modelling*. Guilford publications.

Koon, A. D., Lopez-Hernandez, A., Hoe, C., Vecino-Ortiz, A. I., Cunto, F. J., de Castro-Neto, M. M., & Bachani, A. M. (2022). Multisectoral action coalitions for road safety in Brazil: An organizational social network analysis in São Paulo and Fortaleza. *Traffic Injury Prevention, 23*(2), 67–72.
Kouabenan, D. R. (1998). Beliefs and the perception of risks and accidents. *Risk Analysis, 18*(3), 243–252.
Kouabénan, D. R. (2007). Uncertainty, Beliefs, and Safety Management. *Le Travail Humain, 70*(3), 271–287.
Kummeneje, A. M., & Rundmo, T. (2020). Attitudes, risk perception and risk-taking behaviour among regular cyclists in Norway. *Transportation Research Part F: Traffic Psychology and Behaviour, 69*, 135–150.
Liu, M., Wu, J., Yousaf, A., Wang, L., Hu, K., Plant, K. L., McIlroy, R. C., & Stanton, N. A. (2021). Exploring the relationship between attitudes, risk perceptions, fatalistic beliefs, and pedestrian behaviors in China. *International Journal of Environmental Research and Public Health, 18*(7), 3378.
Lund, I. O., & Rundmo, T. (2009). Cross-cultural comparisons of traffic safety, risk perception, attitudes and behaviour. *Safety Science, 47*(4), 547–553.
Maghsoudi, A., Boostani, D., & Rafeiee, M. (2018). Investigation of the reasons for not using helmet among motorcyclists in Kerman. *Iran. International journal of injury control and safety promotion, 25*(1), 58–64.
Malta, D. C., Morais Neto, O. L. D., Cardoso, L. S. D. M., Veloso, G. A., Andrade, F. M. D. D., Vasconcelos, A. M. N., ... & Naghavi, M. (2022). Road traffic injuries and deaths and the achievement of UN Sustainable Development Goals in Brazil: results from the Global Burden of Disease Study, 1990 to 2019. *Revista da Sociedade Brasileira de Medicina Tropical, 55*.
Martinez, S., Sanchez, R., & Yañez-Pagans, P. (2019). Road safety: Challenges and opportunities in Latin America and the Caribbean. *Latin American Economic Review, 28*(1), 1–30.
McIlroy, R. C., Kokwaro, G. O., Wu, J., Jikyong, U., Nam, V. H., Hoque, M. S., … Stanton, N. A. (2020a). How do fatalistic beliefs affect the attitudes and pedestrian behaviours of road users in different countries? A cross-cultural study. *Accident Analysis & Prevention, 139*, Article 105491.
McIlroy, R. C., Nam, V. H., Bunyasi, B. W., Jikyong, U., Kokwaro, G. O., Wu, J., … Stanton, N. A. (2020b). Exploring the relationships between pedestrian behaviours and traffic safety attitudes in six countries. *Transportation Research Part F: Traffic Psychology and Behaviour, 68*, 257–271.
Nabipour, A. R., Khanjani, N., Nakhaee, N., Moradlou, H. Z., & Sullman, M. J. (2015). The relationship between religion and the on-road behaviour of adolescents in Iran. *Transportation Research Part F: Traffic Psychology and Behaviour, 29*, 113–120.
Ngueutsa, R., & Kouabenan, D. R. (2017). Fatalistic beliefs, risk perception and traffic safe behaviors. *European Review of Applied Psychology, 67*(6), 307–316.
Nordfjærn, T., & Rundmo, T. (2009). Perceptions of traffic risk in an industrialised and a developing country. *Transportation Research Part F: Traffic Psychology and Behaviour, 12*(1), 91–98.
Nordfjærn, T., Jørgensen, S., & Rundmo, T. (2011). A cross-cultural comparison of road traffic risk perceptions, attitudes towards traffic safety and driver behaviour. *Journal of Risk Research, 14*(6), 657–684.
OECD (2021). DAC List of ODA Recipients. Retrieved 18th of August 2021 from https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-List-ODA-Recipients-for-reporting-2021-flows.pdf.
Omari, K., & Baron-Epel, O. (2013). Low rates of child restraint system use in cars may be due to fatalistic beliefs and other factors. *Transportation Research Part F: Traffic Psychology and Behaviour, 16*, 53–59.
Papadimitriou, E., Theofilatos, A., & Yannis, G. (2013). Patterns of pedestrian attitudes, perceptions and behaviour in Europe. *Safety science, 53*, 114–122.
Peltzer, K., & Renner, W. (2003). Superstition, risk-taking and risk perception of accidents among South African taxi drivers. *Accident Analysis & Prevention, 35*(4), 619–623.
Pan American Health Organization (2019). Status of Road Safety in the Region of the Americas; OPS: Washington, DC, USA, 2019; ISBN 978-92-75-12086-6.
Pew Forum on Religion & Public Life (2012). *The Global Religious Landscape. A Report on the Size and Distribution of the World's Major Religious Groups as of 2010*. Pew Research Centre, Washington DC. Available from https://assets.pewresearch.org/wp-content/uploads/sites/11/2014/01/global-religion-full.pdf, accessed 27/01/2022.
Poudel-Tandukar, K., Nakahara, S., Ichikawa, M., Poudel, K. C., & Jimba, M. (2007). Risk perception, road behavior, and pedestrian injury among adolescent students in Kathmandu. *Nepal. Injury prevention, 13*(4), 258–263.
Puchades, V. M., Fassina, F., Fraboni, F., De Angelis, M., Prati, G., de Waard, D., & Pietrantoni, L. (2018). The role of perceived competence and risk perception in cycling near misses. *Safety Science, 105*, 167–177.
Ramírez, Y. G., Camachob, J., & Montoyac, J. (2021). Uso del modelo iRAP para evaluar la seguridad vial en carreteras de dos carriles en Ecuador. *Ciencia, Ingenierías y Aplicaciones, 4*(1), 7–23.
Rhodes, N., & Pivik, K. (2011). Age and gender differences in risky driving: The roles of positive affect and risk perception. *Accident Analysis & Prevention, 43*(3), 923–931.
Rosenstock, I. M. (1974). The health belief model and preventive health behavior. *Health Education Monographs, 2*(4), 354–386.
Rosenbloom, T., Beigel, A., & Eldror, E. (2011). Attitudes, behavioral intentions, and risk perceptions of fatigued pedestrians. *Social Behavior and Personality: an International Journal, 39*(9), 1263–1270.
Rucker, D. D., Preacher, K. J., Tormala, Z. L., & Petty, R. E. (2011). Mediation analysis in social psychology: Current practices and new recommendations. *Social and Personality Psychology Compass, 5*(6), 359–371.
Şimşekoğlu, Ö., Nordfjærn, T., & Rundmo, T. (2012). Traffic risk perception, road safety attitudes, and behaviors among road users: A comparison of Turkey and Norway. *Journal of Risk Research, 15*(7), 787–800.
Şimşekoğlu, Ö., Nordfjærn, T., Zavareh, M. F., Hezaveh, A. M., Mamdoohi, A. R., & Rundmo, T. (2013). Risk Perceptions, Fatalism and Driver Behaviors in Turkey and Iran. *Safety Science, 59*, 187–192.
Sivak, M., Soler, J., Tränkle, U., & Spagnhol, J. M. (1989). Cross-cultural differences in driver risk-perception. *Accident Analysis & Prevention, 21*(4), 355–362.
Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273–1296.
Tarigan, A. K., & Sukor, N. S. A. (2018). Consistent versus inconsistent behaviour of helmet use among urban motorcyclists in Malaysia. *Safety science, 109*, 324–332.
Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53.
Teye-Kwadjo, E. (2019). Risky driving behaviour in urban Ghana: The contributions of fatalistic beliefs, risk perception, and risk-taking attitude. *International Journal of Health Promotion and Education, 57*(5), 256–273.
Ulleberg, P., & Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science, 41*(5), 427–443.
Useche, S. A., Alonso, F., Montoro, L., & Tomas, J. M. (2019). When age means safety: Data to assess trends and differences on rule knowledge, risk perception, aberrant and positive road behaviors, and traffic crashes of cyclists. *Data in Brief, 22*, 627–634.
van Griethuijsen, R. A., van Eijck, M. W., den Haste, H., Brok, P. J., Skinner, N. C., Mansour, N., Gencer, A. S., & BouJaoude, S. (2015). Global Patterns in Students' Views of Science and Interest in Science. *Research in Science Education, 45*, 581–603.
Weinstein, N. D. (1988). The precaution adoption process. *Health psychology, 7*(4), 355.
White, L. T., & Blazek, D. R. (2019). Fatalism and external locus of control are different constructs, or Allik on allikas (Allik is the source) of many good ideas. In A. Realo (Ed.), *A Festschrift in Honor of Jüri Allik on the Occasion of his 70th Birthday* (pp. 163–173). Tartu, Estonia: University of Tartu Press.
WHO. (2018). *Global Status Report on Road Safety 2018*. Geneva: World Health Organisation.
Wijnen, W., & Stipdonk, H. (2016). Social costs of road crashes: An international analysis. *Accident Analysis & Prevention, 94*, 97–106.
Yagil, D. (1998). Gender and age-related differences in attitudes toward traffic laws and traffic violations. *Transportation Research Part F: Traffic Psychology and Behaviour, 1*(2), 123–135.
Yagil, D. (2000). Beliefs, motives and situational factors related to pedestrians' self-reported behavior at signal-controlled crossings. *Transportation Research Part F: Traffic Psychology and Behaviour, 3*(1), 1–13.
Yıldırım, Z. (2007). *Religiousness, conservatism and their relationship with traffic behaviour*. Middle East Technical University). Master's thesis.

You, X., Ji, M., & Han, H. (2013). The effects of risk perception and flight experience on airline pilots' locus of control with regard to safety operation behaviors. *Accident Analysis & Prevention, 57*, 131–139.

Zhou, R., Horrey, W. J., & Yu, R. (2009). The effect of conformity tendency on pedestrians' road-crossing intentions in China: An application of the theory of planned behavior. *Accident Analysis & Prevention, 41*(3), 491–497.

Zhou, R., & Horrey, W. J. (2010). Predicting adolescent pedestrians' behavioral intentions to follow the masses in risky crossing situations. *Transportation Research Part F: Traffic Psychology and Behaviour, 13*(3), 153–163.