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Role of Culture, Income Level and Governance Quality on Driver Behaviours

Burcu Arslan^{1a}, Türker Özkan¹

¹ Psychology, Middle East Technical University

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Abstract

The regional differences in road safety parameters have been attributed to cultural and economic factors. Nevertheless, there are differences in road safety outcomes between countries with similar cultural backgrounds and income levels. The current study examines this fact by considering the role of governance quality in the relationship between culture, income level, and driver behaviours. In this study, we modelled driver behaviour scores from 65 countries with Hofstede's cultural dimensions, Schwartz's cultural values, and the worldwide governance indicators from the World Bank's database. Hayes' PROCESS macro was utilised to analyse the moderation roles of governance quality and income level in the relationship between culture and driver behaviours. High governance quality can prevent or discourage drivers to commit non-speeding violations. Governance quality could regulate the relationship between cultural variables, income level, and driver behaviours. The Power Distance dimension was associated with non-speeding violations in high-income countries with medium or low governance quality. The embeddedness value was associated with speeding behaviours in countries with low governance quality and high/medium income. Governance quality is a critical factor of road safety in high- and middle-income countries. Where there is a lack of qualified governance to establish and enforce rules and individuals have access to social and material power, the culture becomes the determinant of aberrant driver behaviours. This is the first study relating governance quality to driver behaviours at the country level. The implications and limitations of the study were acknowledged.

Key findings

- This is the first study to examine the influence of governance quality on driver behaviours.
- Governance quality is a critical factor in the prediction of aberrant driver behaviours in high/middle-income countries by altering the cultural factors' effects on driver behaviours.
- The Power Distance dimension increases non-speeding violations in high-income countries with medium or low governance quality.
- The embeddedness value is associated with speeding in high/middle-income countries if the governance quality is low.
- The relationship between high-level income and a high level of road safety cannot be guaranteed without effective governments.

Introduction

Road traffic injuries cause the death of approximately 1.19 million people annually (WHO, 2023). This unacceptably high number makes traffic fatality rates (TFR) the 12th leading cause of death for all ages (WHO, 2023). Young people (5-29 years) are notably reported as vulnerable as road crashes are the leading cause of death. Even though WHO (2023) reported some progress across the globe, the decrease in the deaths on roads are far from what is required for the UN Decade of Action for Road Safety Target of halving fatality rates by 2030 (WHO, 2023).

Although low-income countries have less than 1 percent of motor vehicles and paved inter-urban roads in the world, 13 percent of fatalities occurs in low-income countries. Also, the best legislation practices on key risk factors, such as speeding, seat belt use, helmet use, and drink-driving, are more common in high-income countries than middle- and low-income countries (WHO, 2023). These numbers indicate that the gross domestic product (GDP) is a critical indicator for TFR.

Nevertheless, the relationship between TFR and income level is not always predictable. For example, even though Saudi Arabia and France are high-income countries, the TFR of these countries is very different. The estimated TFR per 100,000 population is 19 in Saudi Arabia and 5 in France (WHO, 2023). These differences might reflect the importance of the quality of road infrastructure, strong legislation, and enforcement, which are all representations of the quality of governance (Gaygisiz, 2010). The quality of governance determines the developments in institutions and policy regimes (Rodrik et al., 2004). So, it can be claimed that traffic safety policies depend on the quality of governance (Gaygisiz, 2010).

Both regional differences in TFR and the quality of governance are tied to a shared factor in various studies, which is "culture" (Gaygisiz, 2009; Gaygisiz, 2010; Licht et al., 2005; Üzümcüoğlu et al., 2018). The culture of a country determines the values of individuals and institutions, leading to congruent behaviours and thoughts with these values (Hofstede, 2001; S. Schwartz, 2006; S. H. Schwartz, 1999), including road users' behaviours in traffic (Üzümcüoğlu et al., 2018).

The common key risk factors leading to road fatalities stated by WHO (2023), speeding, drink-driving, cell phone use, seat belt use etc., are mostly investigated as risky driver behaviours, which could lead to fatalities on the road. Thus, investigating the underlying factors of driver behaviours are crucial for road safety.

As mentioned before, these key factors are also related to regulations of countries with different income level, as culture is related to behaviours. To sum up, driver behaviours might be related to culture, countries' regulations, and income levels. The current study investigates driver behaviours and income level in the context of quality of governance and culture.

Driver behaviour

Human-related factors on the road are thought of as the leading causes of TFR (Dingus et al., 2016; Evans, 1991). The human factor was investigated under two concepts in the literature: driver performance/skills and driver behaviours (Özkan & Lajunen, 2011). Driver performance/skill refers to the driver's motor and information processing skills, mainly answering the question of "what *can* drivers do?" (Elander et al., 1993; Özkan & Lajunen, 2011). Driver behaviours refer to a driver's preferred driving style and answer the question "What do drivers *usually* do?" (Elander et al., 1993; Özkan & Lajunen, 2011).

Özkan and Lajunen (2021) proposed a model with two paths to crash, showing how driver skills and behaviours contribute to the crash risk. According to this model, general cognitive abilities and drivers' experience and exposure determine drivers' skills and, in turn, crash risk. On the other hand, drivers' knowledge, exposure, personality, attitudes, beliefs, and other sociocultural factors affect drivers' behaviours and crash risks (Özkan & Lajunen, 2011). Considering this distinction, it can be concluded that the cultural environment can shape driver behaviours.

The driver behaviours were conceptualised by Reason et al. (1990) and divided into three categories: violations, errors, and slips/lapses. Violations were defined as deliberate deviations from safety rules, whereas errors reflected the unintentional failures of intended safety outcomes. Slips/lapses were generally defined as memory or attentional failures. Later, Lawton et al. (1997) added a new category to the violation: aggressive violations. The aggressive violations were conceptualised as an intentional failure of safe actions with aggressive motivation. In addition, Özkan and Lajunen (2005) constructed an additional scale with a new approach, namely positive driver behaviour, which shows the motivation to take care of the traffic environment and other road users.

Various studies reported differences in driver behaviours between countries. The country-specific factors were found to affect the driver behaviours, such as cultural factors (Kaçan et al., 2019; Nordfjærn et al., 2014; Özkan et al., 2006a; Özkan & Lajunen, 2011; Üzümcüoğlu et al., 2018), economic factors (de Winter & Dodou, 2016; Özkan & Lajunen, 2011; Üzümcüoğlu et al., 2018) and enforcement (Üzümcüoğlu et al., 2018).

de Winter and Dodou (2016) conducted a comprehensive study of the effects of national conditions (economic situation, mean temperature, crash statistics) on driver violations. They collected driver behaviour data from 41 countries using the 7-item violation scale of DBQ as constructed in the study of de Winter (2013). The negative relationship between economic situations and violation scores has indicated that the investigation of critical factors across countries is required to decrease global TFR.

Economy

Economic parameters were the most stated factor for regional differences in TFR around the globe. As mentioned, the Global Status Report on the Road Safety of WHO (2023)

stated that 92 percent of the global fatalities from road crashes occur in the low and middle-income countries. Various studies provide additional evidence for this relationship (e.g., de Winter & Dodou, 2016; Gaygisiz, 2009; Wegman et al., 2017; Yannis et al., 2014). Bisha et al. (2006) investigated the effect of economic growth on road fatalities and provided a threshold for this effect. The gross domestic product (GDP) per capita growth between \$1,500 and \$8,000 (USD) was unrelated to any road fatalities increase. That is, the economy does not have a linear relationship with road fatalities. The increase in GDP leads to an increase in TFR in low-income countries but a decrease in TFR in high-income countries. It was argued that economic growth in low-income countries might increase mobility and, in turn, increase road casualties. However, the increase in GDP might also lead to improvements in traffic control investments and capacities and safer cars, which, in turn, lead to decreased road casualties.

Besides TFR, driver behaviour was also related to economic conditions. de Winter and Dodou (2016) and Üzümcüoğlu et al. (2018) found a strong negative correlation between GDP and mean of violation scores, specifically non-speeding violations. They discussed that the differences in the education system and enforcement quality might explain the results (e.g., the high number of drivers without a licence in low-income countries). These findings also might indicate that the legislation and implementation of road safety policies by governmental institutions via the education system, enforcement agencies, and other civil services might be related to the effect of GDP on driver behaviours.

Governance Quality

The definition of governance proposed by the World Bank is "the manner in which power is exercised in the management of a country's economic and social resources for development" (World Bank, 1992). The quality of governance was argued to have a significant effect on economic improvements as well as the development of other measures in a country (Gaygisiz, 2010, 2013; Licht et al., 2005). For example, some authors pointed out that low GDP could be a sign of low governance quality (Gaygisiz, 2010, 2013; Rodrik et al., 2004). Besides economic improvements, the quality of governance was associated with socioeconomic development in 73 countries (Gaygisiz, 2013). It was indicated that the level and quality of governance determine the quality of civil services, constitutional and legal services, and level of corruption in institutions. In turn, it affects the development of various measures in a country (Rodrik et al., 2004).

A measurement of governance quality has been established and published annually by the World Bank since 1996 under the name of Worldwide Governance Indicator (WGI) (Kaufmann et al., 2011). The WGI includes six dimensions of governance:

- **Voice and Accountability (VA)** represents the perception of the ability to participate in the selection of government and freedom of association, speech, and media.
- **Political Stability and Absence of Violence (PV)** represents the perception of the likelihood that the government can be overthrown or destabilised unconstitutionally or violently, such as by politically motivated violence or terrorism.
- **Government Effectiveness (GE)** refers to the perception of the quality of public services, the civil services, their level of independence from political pressures, the quality of formulation and implementation of policies, and the credibility of the government's commitment to such policies.
- **Regulatory Quality (RQ)** refers to the government's ability to formulate and implement sound policies and regulations that permit and promote private sector development.
- **Rule of Law (RL)** points to the perception of the extent to which agents have confidence in and abide by the rules of society.
- **Control of Corruption (CC)** measures perceptions of the extent to which public power is exercised for private gain, including petty and grand forms of corruption and "capture" of the state by elites and private interests.

The data source of these six indicators represents the perception of a large number of varied groups of people, such as citizens, firms with first-hand knowledge of governance, expert survey respondents, etc. Kauffman et al. (2011) pointed out that the indicators should not be considered as distinct measures. Each of them focuses on a specific aspect of governance quality, but they are still strongly correlated. Kauffman et al. (2011) exemplified that better accountability leads to less corruption or a more effective government leads to a better regulatory environment.

Gaygisiz (2010) argued that governance quality is associated with the quality of traffic systems, such as the level of road infrastructure, strong regulations for driver behaviours and consistency of enforcement. Thus, it might be responsible for TFR. She conducted a study with data from 46 countries and reported the quality of governance had a negative correlation with TFR in a country. Based on this finding, the governance quality can be considered an underlying variable of the fact that the countries with the best legislation and practices regarding road safety are the ones with the lowest TFR (WHO, 2023).

Culture

The regional differences in driver behaviours might be due to the conditions of roads, quality in enforcement, and the education system, which are all related to economic situations. However, these are also related to differences in drivers' values, behaviours, and skills across countries (Özkan et al., 2006a, 2006b), which reflect the culture of the traffic system. According to Leviakangas (1998), the differences in driver behaviours and skills reflect the region's traffic culture.

Hofstede's Cultural Dimensions and Traffic Safety

According to Hofstede (2001), the term "culture" refers to "the collective programming of the mind that distinguishes the members of one group or category of people from another" (p. 9). He argued that the centre of the mechanism of the culture is the societal norms of the majority group. Based on this, he suggested five dimensions of culture. *Power distance* is the unequal distribution of power in a society. *Individualism* is the extent to which individuals stand up for their self-interest in conflicts in a given society. *Masculinity* defines the extent to which individuals place a value on traditional male emotions such as competitiveness, ambition, and the importance of wealth. *Uncertainty avoidance* refers to individuals' tolerance for uncertain conditions in the future. *Short-term vs. long-term orientation* focuses on quick or long-lasting solutions for problems. Finally, *indulgence vs. restraint* is the extent of value placed on the gratification of basic human needs and enjoyment in life.

These cultural dimensions are used to understand the regional differences in road safety. The relationship between cultural dimensions and TFR demonstrated their importance in road safety. Uncertainty Avoidance (Gaygisiz, 2009; Hofstede, 2001; Melinder, 2007; Özkan & Lajunen, 2007), Power Distance (Gaygisiz, 2009; Gaygisiz, 2010; Özkan & Lajunen, 2007) and Masculinity (Özkan & Lajunen, 2007) were the dimensions positively related with TFR. On the other hand, Individualism (Gaygisiz, 2010; Hofstede, 2001; Özkan & Lajunen, 2007) and Long-term Orientation (Solmazer et al., 2016) were known as negatively associated with TFR. Üzümcüoğlu et al. (2018) have explored the relationship between cultural dimensions, TFR, and mean of driver behaviours of the 37 nations. The non-speeding violations were negatively related to individualism. The long-term orientation dimension was also found to indirectly affect TFR through non-speeding behaviour.

Schwartz's Cultural Values and Traffic Safety

Schwartz (2006) viewed "culture" as 'the rich complex of meanings, beliefs, practices, symbols, norms, and values prevalent among people in a society' (p. 138). He conceptualised the seven cultural values based on societies' answers to three common concerns. The first concern was to what extent persons are either autonomous or embedded in their group. Three value dimensions were suggested to answer this concern; embeddedness, intellectual autonomy, or affective autonomy. Embeddedness is the importance of social connections and self-identification within the group based on their social status. Intellectual autonomy places a high value on sharing ideas independently. Affective autonomy encourages individuals to pursue pleasure and excitement in life. The second concern was how individuals behave to protect the social structure. There were two value dimensions as a response to this concern; egalitarianism, where equality and taking care of others is essential, and hierarchy, where roles in society are given based on individuals' positions. Two values, mastery and harmony, rep-

resented the third concern about the relationship between individuals and the environment. People of societies high on *mastery* manipulate the environment for their interest, whereas those high on *harmony* adjust themselves to the environment.

Like Hofstede, Schwartz's cultural values have been considered as a factor related to the differences in TFR across countries. Of all cultural values, harmony, intellectual autonomy, and affective autonomy were stated as negatively related to TFR (Gaygisiz, 2009; Gaygisiz, 2010; Özkan & Lajunen, 2007; Solmazer et al., 2016). Embeddedness, hierarchy, and mastery were found as positively related to TFR (Gaygisiz, 2009; Gaygisiz, 2010; Solmazer et al., 2016; Üzümcüoğlu et al., 2018). Üzümcüoğlu et al. (2018) showed that embeddedness and egalitarianism were positively associated with non-speeding driver behaviours. It was also stated that the relationship between TFR and embeddedness was through the non-speeding behaviours of drivers.

Aim of the Study

The GDP, culture, and governance quality are mainly studied related to TFR. From the findings of the studies discussed, it is clear that driver behaviours are also related to a country's culture and economic conditions. However, the quality of governance has not been studied with driver behaviours yet. Knowing that the quality of governance manifests itself through the formulation and implementation of policies (Kaufmann et al., 2011), and is also related to the TFR (Gaygisiz, 2010), it can be argued that the quality of governance, directly or indirectly, may affect the driver behaviours.

The current study explores the relationship between GDP, quality of governance, cultural values, and driver behaviours at the national level. In detail, the combined moderator role of the GDP and the governance quality (GQ) on the relationship between cultural variables and driver behaviours is investigated (Figure 1).

Method

Data Collection

The speeding and non-speeding violations: The data were provided by Bazilinskyy and colleagues (personal communication, 5 September 2019). The self-report of violations was collected for ten different studies between 2015 and 2019 (Bazilinskyy et al., 2019). Nearly 15,000 participants from 65 countries participated in the studies. However, only 58 countries' violation data were calculated (Table 1). The items referring to violations are presented in Table 2.

The Worldwide Governance Indicators: Indicator scores of 65 countries included in the study were taken from the World Bank (Kaufmann et al., 2011; World Bank, 2018b). Since the indicators are highly correlated with each other (Gaygisiz, 2010, 2013; Kaufmann et al., 2011), as recommended by Gaygisiz (2010, 2013), the single-factor governance quality was calculated. According to the principal

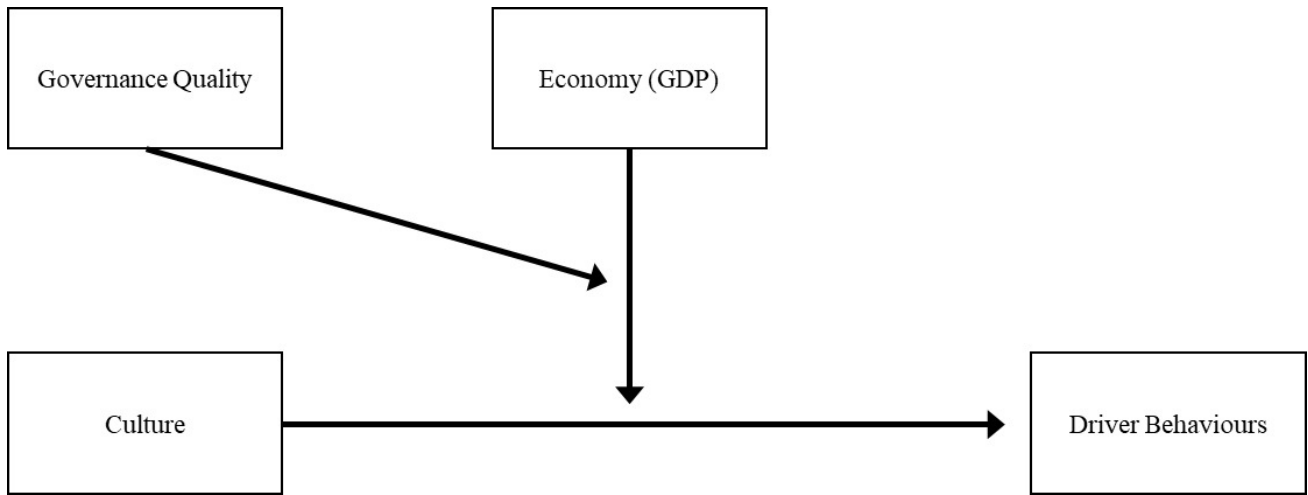


Figure 1. Visual Representation of the aim of the study

Table 1. Countries included in this study by income level (n=65)

Low- and middle-income countries			High income countries		
Algeria	India	Peru	Australia	Hong Kong	Saudi Arabia
Argentina	Indonesia	Philippines	Austria	Hungary	Singapore
Bangladesh	Kenya	Russia	Belgium	Ireland	Slovakia
Bosnia and Herzegovina	Macedonia	Serbia	Canada	Israel	Slovenia
Brazil	Malaysia	South Africa	Chile	Italy	Spain
Bulgaria	Mexico	Sri Lanka	Croatia	Latvia	Sweden
Colombia	Moldova	Tunisia	Czech Republic	Lithuania	United Arab Emirates
Dominic Republic	Morocco	Turkey	Denmark	Netherlands	United Kingdom
Egypt	Nepal	Ukraine	Finland	New Zealand	United States of America
	Nigeria	Venezuela	France	Poland	Uruguay
	Pakistan	Vietnam	Germany	Portugal	
			Greece	Romania	

Table 2. The items of speeding and non-speeding violations

Speeding Violation	Disregarding the speed limit on a residential road
	Disregarding the speed limit on a motorway
Non-Speeding Violation	Using a mobile phone without a hands-free kit
	Driving so close to the car in front that it would be difficult to stop in an emergency
	Sounding the horn to indicate annoyance with another road user
	Becoming angered by a particular type of driver, and indicate hostility by whatever means one can
	Racing away from traffic lights with the intention of beating the driver next to own vehicle

component analysis, the indicators were loaded into two factors: government effectiveness was loaded into one factor with an alpha coefficient of .98. In the current study, other indicators were loaded into the “governance quality” factor. The eigenvalue of the Governance Effectiveness (GE) factor was 1.09 and explained 18.16 percent of the variance. The eigenvalue of the Governance Quality (GQ) factor was 4.04 and explained 67.29 percent of the variance. The alpha coefficients of indicators in the Governance Quality factor were as follows: .88 for VA, .90 for PV, .94 for RQ, .81 for RL, and .95 for CC. The factor scores were calculated by the regression method.

Hofstede’s cultural dimensions: The cultural dimensions of the countries were taken from the book of Hofstede (2001). Long-term orientation dimension scores of 57 countries, Indulgence vs. Restraint dimension scores of 55 countries, and other cultural dimensions of 60 countries included in the study were obtained.

Schwartz’s cultural values: Schwartz’s value dimensions of 52 countries were taken from an online open-source published by Schwartz (2008). The data were collected from college students and school teachers between 1988 and 2007.

Economy: GDP per capita in 2018 was taken from the World Bank. The gross domestic product was divided by the midyear population and was in US dollars (see World Bank, 2018a).

Results

Bivariate Correlational Analysis

Table 3 displays the correlations among the variables in the analysis. Of all variables, Masculinity and Hierarchy variables were negatively correlated with speeding behaviours ($r = -.271$ and $r = -.340$, respectively). Non-speeding behaviours, on the other hand, were correlated with numerous variables. TFR of countries was positive, and GDP was negatively correlated with non-speeding behaviour ($r = .572$ and $r = -.668$, respectively). It was also significantly correlated with Power Distance ($r = .543$), Individualism ($r = -.583$), Long-term Orientation ($r = -.276$), Embeddedness ($r = .756$), Hierarchy ($r = .361$), Affective Autonomy ($r = -.665$), Intellectual Autonomy ($r = -.600$), Egalitarianism ($r = -.299$), Governance Quality ($r = -.759$).

The Relationship between Governance Quality and Driver Behaviours

The linear regression was initially conducted to understand the relationship between governance quality and driver behaviours. Governance quality was not significantly related to speeding violations ($p = .38$) while the non-speeding violations were significantly predicted by governance quality ($R^2 = .76$, $F(1, 56) = 76.30$, $p < .001$). Further, governance quality had a negative relationship with non-speeding violations ($\beta = -.76$, $t = -8.73$, $p < .001$, $CI\ 95\% [-.95, -.60]$).

Moderator Role of Governance Quality on the relationship between Culture, Income level and Driver Behaviours

The moderated moderation analysis was conducted to assess whether governance quality moderates the effect of GDP on the relationship between cultural variables and driver behaviours. The Hayes' PROCESS macros for SPSS (2013) were used to conduct the moderated moderation analysis. Each of Hofstede's cultural variables and Schwartz's cultural variables were added to the model to predict driver behaviours. The interaction was probed at +1SD (high), mean (middle), and -1SD (low) points of independent variables and interaction terms.

Hofstede's cultural variables as predictors of driver behaviours

The first moderated moderation analysis explored the relationship between Hofstede's cultural variables and driver behaviours with GDP and the governance quality of countries. Only power distance yielded significant results in the hypothesised model.

Power Distance (PD) as a predictor of driver behaviours

As presented in Table 4, non-speeding behaviour scores were regressed onto power distance, GDP and governance quality (GQ) and four interaction terms: PD x GDP, PD x GQ, GDP x GQ, and PD x GDP x GQ. The significant model explained 65 percent of the variance in non-speeding behaviour, $F(7, 44) = 11.74$, $p < .001$. The GQ was found to be related to non-speeding behaviours ($b = -1.73$, $t = -4.33$, $p < .001$). Of interaction terms, PD x GDP was significant, ($b = .00$, $t = 2.13$, $p < .05$). The three-way interaction, PD x GDP x GQ was marginally significant ($b = .00$, $t = -1.99$, $p = .051$).

Further, inspecting the conditional effect of PD on non-speeding revealed at a high level of GDP with a low level of GQ ($b = .05$, $95\% CI [0.03, 0.09]$, $t = 2.15$, $p < .05$) and with a middle level of GQ ($b = .03$, $95\% CI [0.05, 0.56]$, $t = 2.47$, $p < .05$) (Figure 2). The highest increase in non-speeding behaviour was found at the high level of PD in the countries with high GDP and low GQ. Similarly, the non-speeding behaviours increased significantly with PD value in countries with high GDP and middle GQ. In countries with high GDP, PD as a cultural value is related to rule-breaking behaviours when the governance quality is low or middle (Figure 3).

Speeding behaviour scores were also regressed onto the same variables and interaction terms. The model was not significant ($p = .41$). The power distance value and other interaction terms did not explain the speeding behaviour.

Schwartz's cultural variables as predictors of driver behaviour

The moderated moderation analysis explored the relationship between Schwartz's cultural variables and driver behaviours with countries' GDP and governance quality (GQ).

Embeddedness as a predictor of driver behaviours

Non-speeding behaviour scores were also regressed onto Embeddedness, GDP, and Governance Quality (GQ), and four interaction terms: Embeddedness x GDP, Embeddedness x GQ, GDP x GQ, and Embeddedness x GDP x GQ. The model was significant, explaining 73 percent of the variance in non-speeding behaviour ($F(7, 38) = 15.35$, $p < .001$). There was no significance among Embeddedness, GDP, GQ, and the interaction terms in relation to non-speeding behaviour.

The speeding behaviour was also regressed on the same variables and interaction terms. The model was significant, explaining 37 percent of the variance, $F(7, 38) = 3.23$, $p < .001$. The GQ was found to be a significant predictor of speeding behaviour in this model ($b = 9.11$, $t = 2.32$, $p = .02$). The three-way interaction, Embeddedness x GDP x GQ, was also found significant, $b = -.001$, $t = -2.09$, $p < .05$ (Table 5) (Figure 4).

Inspecting the conditional effect of Embeddedness on speeding behaviour, in the countries with middle or low GQ, the high and middle levels of GDP revealed significant outcomes; middle GQ and high GDP ($b = 6.48$, $95\% CI [1.10,$

Table 3. Correlations among all variables in the analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Speeding Behaviour	1																			
Non-speeding Behaviour	.152	1																		
Fatality per 100 000 population	-.202	.572**	1																	
GDP per capita (\$)	-.039	-.668**	-.609**	1																
Power Distance	.039	.543**	.500**	-.623**	1															
Individualism	.076	-.583**	-.529**	.639**	-.686**	1														
Masculinity	-.271*	-.042	.216	-.057	.132	.045	1													
Uncertainty Avoidance	.222	.147	-.050	-.318*	.213	-.202	-.063	1												
Long-term Orientation	.198	-.276*	-.383**	.130	.055	.161	-.184	.016	1											
Indulgence	.000	-.208	.106	.401**	-.302*	.221	.152	-.208	-.473**	1										
Harmony	.237	-.185	-.357*	.012	-.075	.192	-.097	.262	.316*	-.047	1									
Embeddedness	-.005	.756**	.568**	-.688**	.603**	-.635**	.080	-.039	-.218	-.325*	-.433**									
Hierarchy	-.340*	.361*	.426**	-.358*	.318*	-.394**	.094	-.214	-.128	-.107	-.570**	.588**	1							
Mastery	-.139	.029	.219	-.016	-.022	-.140	.102	-.052	-.107	.068	-.380**	.012	.387**	1						
Affective Autonomy	.071	-.665**	-.498**	.672**	-.641**	.643**	-.167	-.093	.257	.260	.163	-.835**	-.423**	.113	1					
Intellectual Autonomy	.204	-.600**	-.575**	.545**	-.445**	.488**	-.181	.174	.227	.213	.514**	-.869**	-.650**	-.186	.707**	1				
Egalitarianism	-.024	-.299*	-.312*	.495**	-.471**	.380**	-.001	.033	-.186	.494**	.346*	-.671**	-.440**	-.036	.429**	.554**	1			
Governance Quality	.116	-.759**	-.705**	.837**	-.626**	.666**	-.179	-.217	.249	.218	.199	-.732**	-.425**	-.117	.694**	.632**	.422**	1		
Governance Efficiency	.079	-.098	-.137	.087	.071	-.043	.126	.234	.101	-.003	.262	-.097	-.048	-.116	.046	.116	.054	.156	1	

** $p < .0011$

* $p < .005$

Table 4. The moderated moderation analysis predicting non-speeding behaviour from Power Distance (PD), GDP, and Governance Quality (GQ)

		R2	MSE	F	p
Model Summary		.65	.41	11.74	.000
Model:		coefficient	se	t	p
Constant		0.59	0.75	0.78	.44
PD		-0.01	0.01	-0.87	.39
GDP		-0.00	0.00	-2.03	.05
PD*GDP		0.00	0.00	2.17	.04
GQ		-1.73	0.82	-2.12	.04
PD*GQ		0.01	0.01	1.15	.26
GDP*GQ		0.00	0.00	1.96	.06
PD*GDP*GQ		0.00	0.00	-1.99	.05
GDP	GQ	Effect	se	t	p
High (44117.67)	Low (-.926)	0.05	0.02	2.15	.04
	Middle (.039)	0.03	0.01	2.47	.02

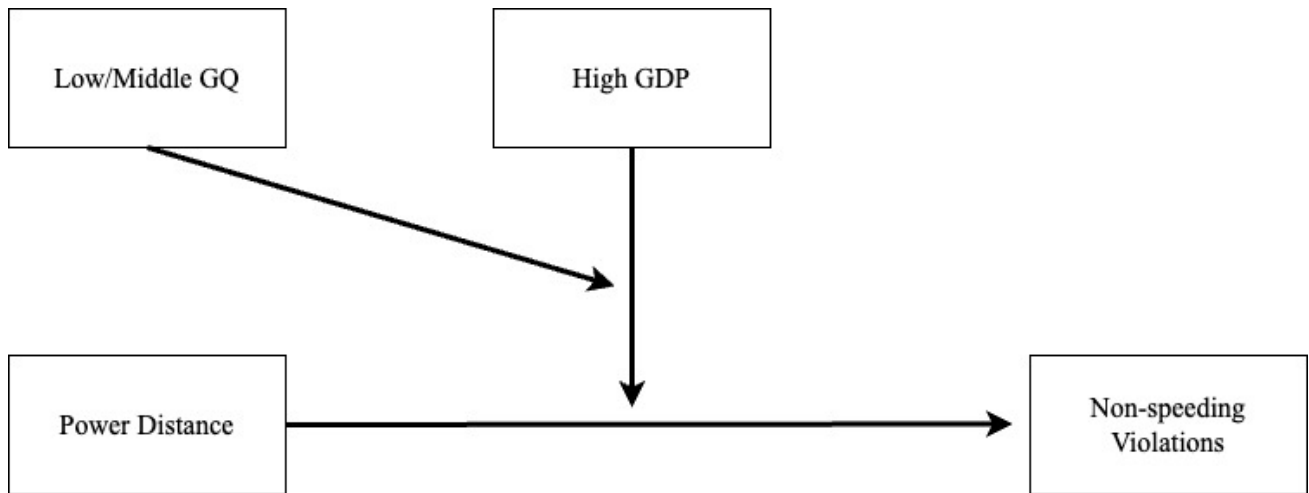


Figure 2. Moderated role of low governance quality and high GDP on the relationship between power distance and non-speeding violations

11.87], $t=2.44$, $p<.05$), middle GQ and middle GDP ($b= 2.97$, 95% CI [0.71, 5.24], $t= 2.66$, $p<.05$), low GQ and middle GDP ($b= 7.30$, 95% CI [2.33, 12.29], $t= 2.96$, $p<.01$), low GQ and high GDP ($b= 12.86$, 95% CI [2.68, 23.03], $t= 2.55$, $p<.05$). In the countries with middle or low GQ, as the GDP increases, the Embeddedness value becomes more positively related to speeding behaviours. In detail, the highest increase in speeding behaviour depending on Embeddedness was found in the condition of high GDP and low GQ. On the other hand, the lowest increase was in the condition of middle GDP and middle GQ (Figure 5).

Discussion

The regional differences in road safety attracted significant attention in the literature. The cultural variables were considered to explain these differences. Various studies have provided strong evidence for this assumption (Gaygisiz,

2009; Hofstede, 2001; Melinder, 2007; Özkan & Lajunen, 2007; Solmazer et al., 2016; Üzümcüoğlu et al., 2018). Besides culture, when clustering the countries according to their TFR, it becomes clear that the clusters mainly diverged based on economic development (WHO, 2023). While not all countries with the same level of income have a similar TFR, governance-related factors, such as strong legislation, become prominent for road safety (Gaygisiz, 2013).

The current study showed that governance quality is negatively associated with non-speeding violations. This relationship could be a further explanation of the negative relationship between governance quality and road traffic fatalities (Gaygisiz, 2010). Good legislation and strong enforcement as indicators of good governance prevent or discourage drivers from committing violations on the roads and lead to a decrease in fatality rates. However, when governmental institutions cannot regulate and enforce the preventive measures sufficiently, drivers' aberrant behaviours

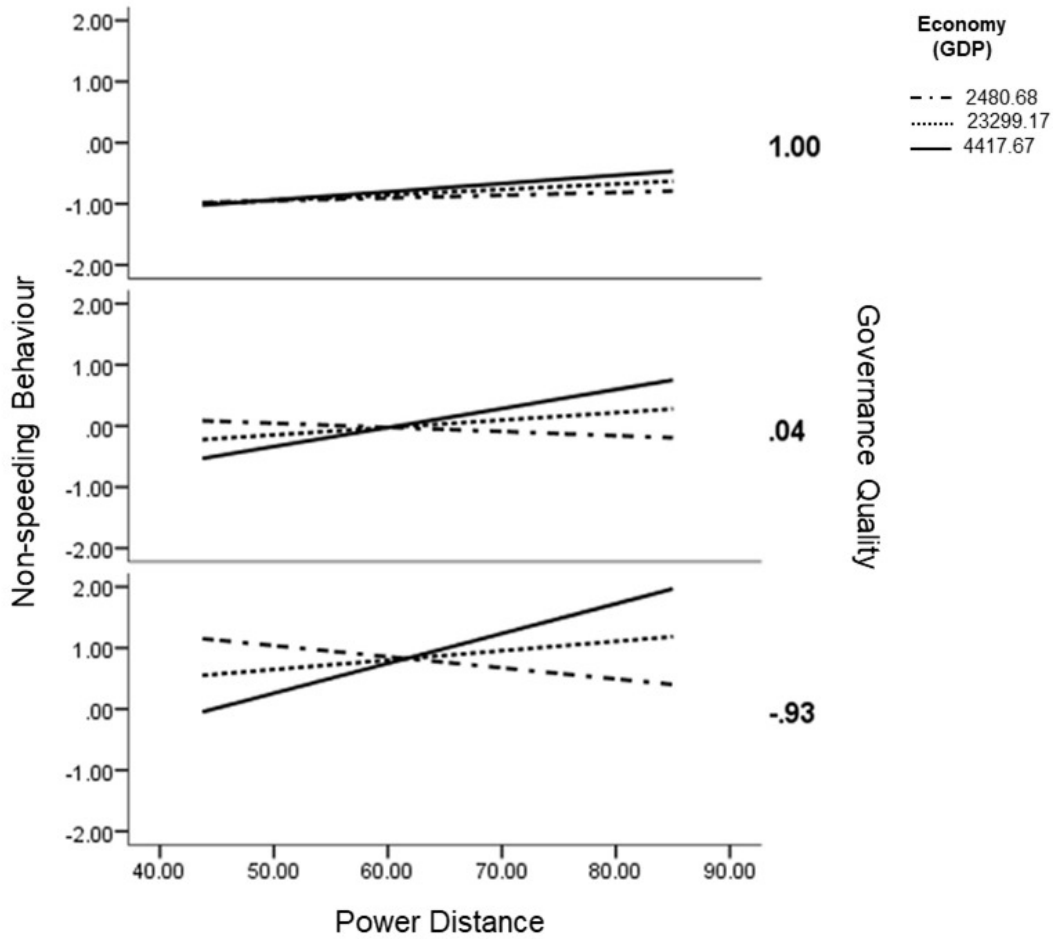


Figure 3. The conditional effect of power distance on non-speeding behaviour as a function of governance quality and economy

Table 5. The moderated moderation analysis predicting speeding behaviour from Embeddedness, GDP, and Governance Quality (GQ)

		R2	MSE	F	p
Model Summary:		.373	.841	3.236	.008
Model:		Coefficient	se	t	p
Constant		2.98	5.66	.52	.60
Embeddedness		-0.81	1.52	-0.53	.59
GDP		-0.00	0.00	-1.92	.06
Embeddedness*GDP		0.00	0.00	1.98	.06
Governance Quality		9.11	3.91	2.33	.03
Embeddedness*GQ		-2.05	1.02	-2.01	.05
GDP*GQ		0.00	0.00	1.78	.08
Embeddedness*GDP*GQ		-0.00	0.00	-2.09	.04
GDP levels	GQ	Effect	se	t	p
Middle (24326.64)	Low (-.859)	7.31	2.46	2.97	.01
	Middle (.112)	2.98	1.12	2.67	.01
High (455.83)	Low (-.859)	12.86	5.03	2.56	.01
	Middle (.112)	6.49	2.66	2.44	.02

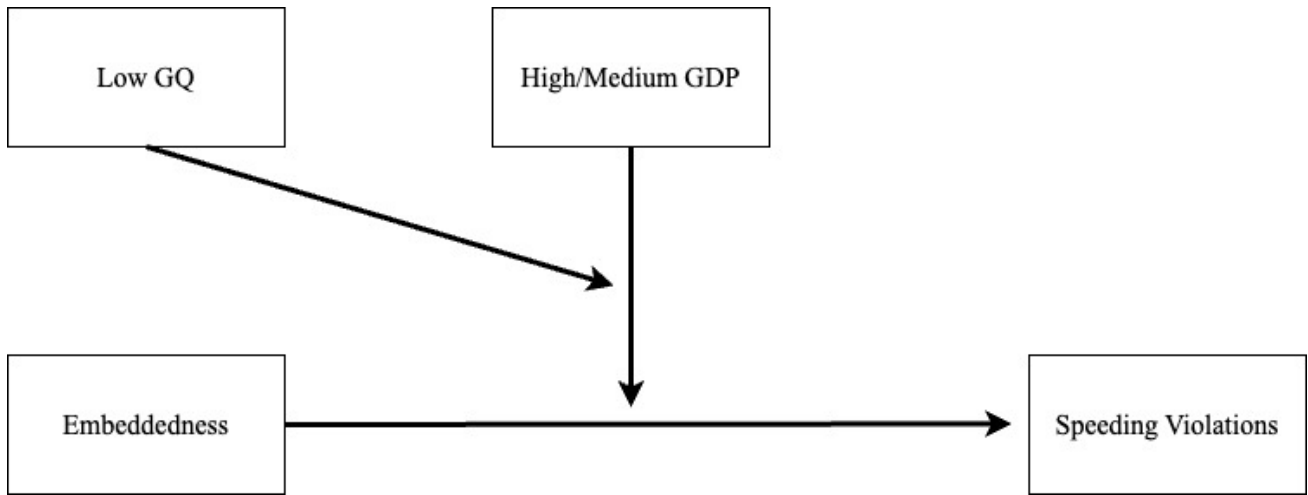


Figure 4. Moderated role of medium/low governance quality and high/medium GDP on the relationship between embeddedness and speeding violations

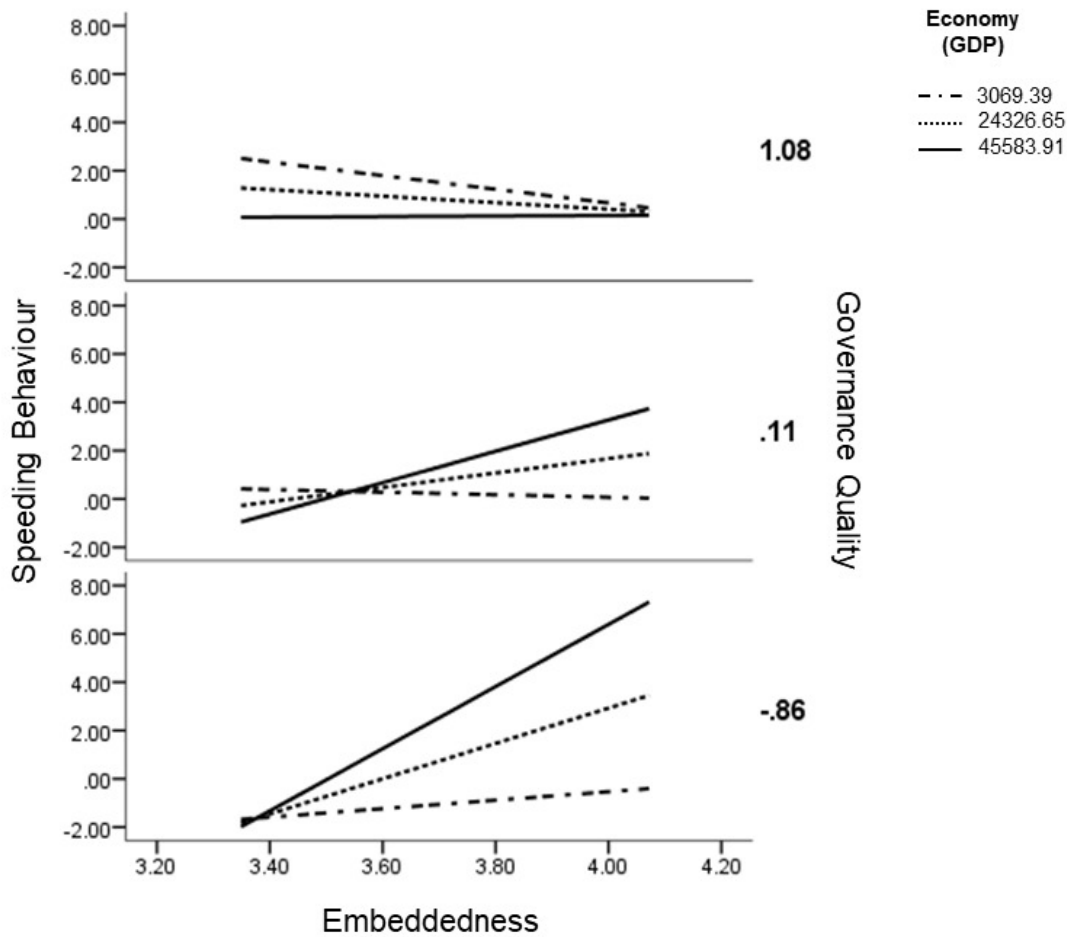


Figure 5. The conditional effect of embeddedness on speeding behaviour as a function of governance quality and economy

can result from other factors, such as culture, as proposed in the current study.

The cultural variables were found to be associated with driver behaviours by a relationship with GDP and governance quality. Of Hofstede’s cultural dimensions, the power

distance was found to be positively related to non-speeding behaviour, where the GDP is high and the governance quality is low or middle. It can be indicated that the decrease in governance quality may manifest itself as, for example, weak policies, insufficient enforcement, or corrupted insti-

tutions. These disqualifications in governance may lead to factors other than rules or legislation to decide the rate of violations of drivers. Where GDP is high, access to both material and social resources can be enabled and give individuals social power. So, in cultures with high power distance where power structures define which rules are for whom, this power undermines the obligation of following traffic rules. A similar finding that controlling the effect of GDP drops the effect of power distance on road safety was also found by Gaygısız (2009). However, de Winter and Dodou (2016) argued that non-speeding behaviours are more prominent in less developed countries. The current findings extended this argument by suggesting that high GDP can increase non-speeding violations in countries with low-qualified governance.

Among Schwartz's cultural values, speeding behaviour was related to Hierarchy, and non-speeding behaviour was related to Embeddedness, Hierarchy, Affective/Intellectual Autonomy, and Egalitarianism. According to moderated moderation analysis, Embeddedness value was positively related to speeding behaviour when GDP is high or medium and governance quality is medium or low. In the study of Üzümcüoğlu et al. (2018), embeddedness was related to the TFR through non-speeding behaviour when GDP was controlled. Thus, it was concluded that the drivers in embedded societies might consider themselves entitled to behave in traffic according to their social status, which allows them to break the rules. In the current study, when the GDP and governance quality were treated as moderators, the embeddedness was associated with speeding behaviour. In other words, speeding behaviour might be related to earnings from economic conditions, such as high-quality cars, road infrastructures, etc. In addition, when there is no perception of high governance quality, speeding behaviour is expected to increase in embedded societies. In sum, where there is a lack of qualified governance to establish and enforce rules and individuals have access to social and material power, the culture becomes the determinant of driver behaviours.

The culture is accepted as deeply rooted and resistant to change (Hofstede, 2001; S. Schwartz, 2006). Thus, even though understanding the cultural underlining of traffic safety is very important, shifting the unsafe-behaviour-promoting cultural variables into safety-related cultural variables is very difficult. Hence, it is crucial to identify modifiable factors that might enhance or inhibit the relationship between culture and road safety. The current study suggests that governance quality can undermine the predictive value of culture in driver behaviours, especially in high-income countries. If governance is perceived as qualified by strong policies, legislations, sanction power, and uncorrupted institutions, the compliance of rules would not depend on other factors.

The findings were not significant in the condition of high governance quality. It can be claimed that in countries with high-quality governance, the rules, legislation, and institutions are established and enforced so strongly and clearly that obedience to traffic rules is the only option. In addition, the governance quality demonstrated no effect on the

role of low GDP on the relationship between culture and driver behaviours. In countries with low GDP, it can be presumed that there are limits to factors such as road infrastructures, the number of cars in traffic, or mobility options. Thus, driver behaviours can be affected by external factors other than governance or culture. Governance's effect on road safety in low-income countries should be investigated with different underlying factors in future studies.

There are implications of these findings for road safety professionals and decision-makers. For high and middle-income countries, governmental efforts for road safety are fundamental, as well as good infrastructures and high-quality vehicles. If there is a decrease in the strength of legislation, regulations or enforcement, road safety decreases. According to the latest global report on road safety (WHO, 2023), there is a global reduction in traffic fatality rates globally. This reduction is a product of strong governmental efforts. However, low- and middle-income countries, even upper-middle-income countries, still have worrisome fatality rates. The middle-income countries should focus more on strengthening the governance quality of institutions, having legislation on crash risk factors, road infrastructure and motor vehicle standards, driver education and enforcing the laws consistently and strongly. The core aim for middle and high-income countries should be to "leave no room" for drivers to commit violations.

Another implication is that as governance quality is not focused on road safety regulations etc., it consists of freedom of speech, lack of corruption, accountability of governmental institutions, as well as regulatory power. The sum of all these governance characteristics was found to be associated with road safety, showing that road safety requires a multidimensional approach. If there is a feeling of lack of order in governance measures, this could be reflected as a lack of order in road safety. Also, improvements in any other areas might improve the road safety measures.

Study strengths and limitations

This is the first study to analyse the association between the culture, income level, quality of governance and driver behaviour. The analysis established a clear relationship between country level GDP, the strength of governmental agencies, cultural variables and driver behaviours. However, this relationship is not linear with an increase in GDP leading to increased purchasing power and motorisation that increases fatalities from road crashes. As motorisation increases in low- and some middle-income countries, this study identified the concurrent need for government and infrastructure quality to prevent fatality crashes from occurring.

It should be noted that the categorisations of GDP in the current study do not reflect the categorisations by the World Bank. World Bank (2018a) defines the income levels of countries as low (less than \$1,005), lower-middle (\$1,006-\$3,955), upper-middle (\$3,956-\$12,235), and high (more than \$12,235). The moderation analysis of Hayes' PROCESS (2003) probed the interaction at +1, 0, and -1 Standard Deviation points of variables within the dataset.

Thus, for analysis of Hofstede's dimension, the thresholds of the GDP of 52 countries are \$44,117.67 for high GDP (+1SD), \$23,299.17 for medium GDP (0 SD), and \$2,480.68 for low GDP (-1SD). In the analysis with Schwartz's cultural values, the thresholds for the GDP of 46 countries are \$45,583.90 for high GDP (+1SD), \$23,326.64 for medium GDP (0 SD), and \$3,069.38 for low GDP (-1SD). That should be considered while inferring the findings of the current study.

A note of caution is that since the study is based on aggregated data from different sources, the representativeness could be a matter in question. Hofstede collected the data from IBM workers, whereas Schwartz collected the data from the teachers and students. The World Bank constructed WGI using data from different sources of the population. Bazilinskyy et al. (2019) collected data from crowdsourcing respondents who are considered experienced researcher participants. Although the data gathered from such a large number of participants that the distribution of scores draws near-normal distribution, this issue should be kept in mind. They also noted that survey packages including driver behaviour data were different in some countries. This might lead participants to differently interpret the research questions under investigation and answer accordingly. This might point out the issue of social desirability bias. Studies showed that driver behaviour questionnaires can be susceptible to social desirability bias (Özkan & Lajunen, 2021; Yılmaz et al., 2022). Violations are particularly associated with high self-deception bias and low impression management bias. Yılmaz et al. (2022) showed that drivers without the deliberate tendency to impress others but honestly believing their overrated abilities reported high ordinary violations. This susceptibility could be even higher in cross-cultural studies due to different attributions and attitudes toward traffic violation across countries (Özkan & Lajunen, 2011; Şimşekoğlu et al., 2012).

Conclusion and future studies

In conclusion, the present study showed that no single factor could explain road safety. Studying the interactions of different aspects of traffic is crucial to understanding underlying factors. For example, even though the high GDP is expected to enhance road safety, the interaction with cultural tendencies could produce dangerous driver behaviour. In these conditions, governance quality becomes a fundamental factor in regulating that interaction.

There are some suggestions for future studies to extend these findings. First, the current study examines Hofstede's cultural dimensions and Schwartz's cultural values as previous studies used in road safety research. Other cultural models such as Inglehart's cultural map has not been used in road safety research. Adding different cultural models to proposed model in this study might expand the knowledge on culture and road safety. Additional theoretical models

may provide further explanations to how culture and other characteristics of countries can determine their road safety level. Secondly, the current study places governance quality on the top of model to show the role of governance in interaction between income level and culture. Previous studies also suggested that the governance quality could be related directly to economy (Gaygısız, 2010, 2013), and culture of a country (Kyriacou, 2024). Thus, the governance quality, economy and culture should also be investigated using path or mediation models to understand their interacted effect on road safety.

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Author contributions

Burcu Arslan: Methodology, Investigation, Data curation, Writing – original draft. Türker Özkan: Methodology, Data curation, Writing – review and editing.

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Human Research Ethics

The original study protocols conducted by Bazilinskyy et al. (2019) including the survey data analysed in this study, were approved by the Human Research Ethics Committee of the Delft University of Technology in the scope of project HFAuto – Human Factors of Automated Driving (PITN-GA-2013-605817)

Data Availability

All data used in the study obtained from open sources or via direct connections with authors who are originally collected the data, which are explained in detail in the Data Collection section of the paper.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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References

- Bazilinskyy, P., Kyriakidis, M., Dodou, D., & de Winter, J. C. F. (2019). When will most cars be able to drive fully automatically? Projections of 18,970 survey respondents. *Transportation Research Part F: Traffic Psychology and Behaviour*, 64, 184–195. <https://doi.org/10.1016/j.trf.2019.05.008>
- Bishai, D., Quresh, A., James, P., & Ghaffar, A. (2006). National road casualties and economic development. *Health Economics*, 15(1), 65–81. <https://doi.org/10.1002/hec.1020>
- de Winter, J. C. F. (2013). Predicting self-reported violations among novice license drivers using pre-license simulator measures. *Crash Analysis & Prevention*, 52, 71–79. <https://doi.org/10.1016/j.aap.2012.12.018>
- de Winter, J. C. F., & Dodou, D. (2016). National correlates of self-reported traffic violations across 41 countries. *Personality and Individual Differences*, 98, 145–152. <https://doi.org/10.1016/j.paid.2016.03.091>
- Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences*, 113(10), 2636–2641. <https://doi.org/10.1073/pnas.1513271113>
- Elander, J., West, R., & French, D. (1993). Behavioural correlates of individual differences in road-traffic crash risk: An examination of methods and findings. *Psychological Bulletin*, 113(2), 279. <https://doi.org/10.1037/0033-2909.113.2.279>
- Evans, L. (1991). *Traffic safety and the driver*. Science Serving Society.
- Gaygisiz, E. (2009). Economic and cultural correlates of road-traffic crash fatality rates in OECD countries. *Perceptual and Motor Skills*, 109(2), 531–545. <https://doi.org/10.2466/pms.109.2.531-545>
- Gaygisiz, E. (2010). Cultural values and governance quality as correlates of road traffic fatalities: A nation level analysis. *Crash Analysis & Prevention*, 42(6), 1894–1901. <https://doi.org/10.1016/j.aap.2010.05.010>
- Gaygisiz, E. (2013). How are cultural dimensions and governance quality related to socioeconomic development? *The Journal of Socio-Economics*, 47, 170–179. <https://doi.org/10.1016/j.socec.2013.02.012>
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.
- Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviours, institutions, and organizations across nations*. Sage Publications.
- Kaçan, B., Fındık, G., Üzümcüoğlu, Y., Azık, D., Solmaz, G., Ersan, Ö., ... Pashkevich, M. (2019). Driver profiles based on values and traffic safety climate and their relationships with driver behaviours. *Transportation Research Part F: Traffic Psychology and Behaviour*, 64, 246–259. <https://doi.org/10.1016/j.trf.2019.05.010>
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2011). *The worldwide governance indicators: methodology and analytical issues* (World Bank Policy Research Working Paper No. 5430). The World Bank. <https://doi.org/10.1017/s1876404511200046>
- Kyriacou, A. P. (2024). Economic inequality, culture, and governance quality. *Journal of Economic Surveys*, 1–28. <https://doi.org/10.1111/joes.12623>
- Lawton, R., Parker, D., Manstead, A. S., & Stradling, S. G. (1997). The role of affect in predicting social behaviours: The case of road traffic violations. *Journal of Applied Social Psychology*, 27(14), 1258–1276. <https://doi.org/10.1111/j.1559-1816.1997.tb01805.x>
- Leviäkangas, P. (1998). Crash risk of foreign drivers—the case of Russian drivers in South-Eastern Finland. *Crash Analysis & Prevention*, 30(2), 245–254. [https://doi.org/10.1016/s0001-4575\(97\)00077-8](https://doi.org/10.1016/s0001-4575(97)00077-8)
- Licht, A. N., Goldschmidt, C., & Schwartz, S. H. (2005). Culture, law, and corporate governance. *International Review of Law and Economics*, 25(2), 229–255. <https://doi.org/10.1016/j.irle.2005.06.005>
- Melinder, K. (2007). Socio-cultural characteristics of high versus low risk societies regarding road traffic safety. *Safety Science*, 45(3), 397–414. <https://doi.org/10.1016/j.ssci.2006.07.004>
- Nordfjærn, T., Şimşekoğlu, Ö., & Rundmo, T. (2014). Culture related to road traffic safety: a comparison of eight countries using two conceptualizations of culture. *Crash Analysis & Prevention*, 62, 319–328. <https://doi.org/10.1016/j.aap.2013.10.018>
- Özkan, T., & Lajunen, T. (2005). A new addition to DBQ: Positive driver behaviours scale. *Transportation Research Part F: Traffic Psychology and Behaviour*, 8(4–5), 355–368. <https://doi.org/10.1016/j.trf.2005.04.018>

- Özkan, T., & Lajunen, T. (2007). The role of personality, culture, and economy in unintentional fatalities: An aggregated level analysis. *Personality and Individual Differences*, 43(3), 519–530. <https://doi.org/10.1016/j.paid.2006.12.020>
- Özkan, T., & Lajunen, T. (2011). Person and environment: Traffic culture. In B. Porter (Ed.), *Handbook of traffic psychology* (pp. 179–192). Academic Press. <https://doi.org/10.1016/B978-0-12-381984-0.10014-1>
- Özkan, T., & Lajunen, T. (2021). From self-reports to Auto-Tech-Detect (ATD) based self-reports in traffic research. In R. Vickerman (Ed.), *International Encyclopedia of Transportation* (Vol. 7, pp. 2–7). Elsevier Ltd.
- Özkan, T., Lajunen, T., Chliaoutakis, J. E., Parker, D., & Summala, H. (2006a). Cross-cultural differences in driving behaviours: A comparison of six countries. *Transportation Research Part F: Traffic Psychology and Behaviour*, 9(3), 227–242. <https://doi.org/10.1016/j.trf.2006.01.002>
- Özkan, T., Lajunen, T., Chliaoutakis, J. E., Parker, D., & Summala, H. (2006b). Cross-cultural differences in driving skills: A comparison of six countries. *Crash Analysis & Prevention*, 38(5), 1011–1018. <https://doi.org/10.1016/j.aap.2006.04.006>
- Reason, J., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations on the roads: a real distinction? *Ergonomics*, 33(10–11), 1315–1332. <https://doi.org/10.1080/00140139008925335>
- Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule: the primacy of institutions over geography and integration in economic development. *Journal of Economic Growth*, 9(2), 131–165. <https://doi.org/10.1080/00140139008925335>
- Schwartz, S. (2006). A theory of cultural value orientations: Explication and applications. *Comparative Sociology*, 5(2–3), 137–182. <https://doi.org/10.1163/156913306778667357>
- Schwartz, S. (2008, January). *The 7 Schwartz cultural value orientation scores for 80 countries*. https://www.researchgate.net/publication/304715744_The_7_Schwartz_cultural_value_orientation_scores_for_80_countries/citations
- Schwartz, S. H. (1999). A theory of cultural values and some implications for work. *Applied Psychology: An International Review*, 48(1), 23–47. <https://doi.org/10.1111/j.1464-0597.1999.tb00047.x>
- 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. <https://doi.org/10.1080/13669877.2012.657221>
- Solmaz, G., Üzümcüoğlu, Y., & Özkan, T. (2016). The role of traffic law enforcements in the relationship between cultural variables and traffic fatality rates across some countries of the world. *Transportation Research Part F: Traffic Psychology and Behaviour*, 38, 137–150. <https://doi.org/10.1016/j.trf.2016.01.001>
- Üzümcüoğlu, Y., Özkan, T., & Lajunen, T. (2018). The relationships between cultural variables, law enforcements and driver behaviours across 37 nations. *Transportation Research Part F: Traffic Psychology and Behaviour*, 58, 743–753. <https://doi.org/10.1016/j.trf.2018.07.009>
- Wegman, F., Allsop, R., Antoniou, C., Bergel-Hayat, R., Elvik, R., Lassarre, S., ... Wijnens, W. (2017). How did the economic recession (2008–2010) influence traffic fatalities in OECD-countries? *Crash Analysis & Prevention*, 102, 51–59. <https://doi.org/10.1016/j.aap.2017.01.022>
- World Bank. (1992). *Governance and development*. <http://documents.worldbank.org/curated/en/604951468739447676/Governance-and-development>
- World Bank. (2018a). *World development indicators*. <https://databank.worldbank.org/source/world-development-indicators>
- World Bank. (2018b). *Worldwide governance indicators (WGI)*. <https://info.worldbank.org/governance/wgi/#home>
- World Health Organization. (2023). *Road traffic injuries*. <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries>
- Yannis, G., Papadimitriou, E., & Folla, K. (2014). Effect of GDP changes on road traffic fatalities. *Safety Science*, 63, 42–49. <https://doi.org/10.1016/j.ssci.2013.10.017>
- Yılmaz, Ş., Arslan, B., Öztürk, İ., Özkan, Ö., Özkan, T., & Lajunen, T. (2022). Driver social desirability scale: A Turkish adaptation and examination in the driving context. *Transportation Research Part F: Psychology and Behaviour*, 84, 53–64. <https://doi.org/10.1016/j.trf.2021.11.009>