1 **The relationships between cultural variables, law enforcements and driver**

2 **behaviours across 37 nations**

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1. INTRODUCTION

According to the World Health Organization's estimations, approximately 1.25 million people die due to road traffic injuries, and these fatalities cost approximately 3% of the Gross Domestic Product (GDP) for governments. Globally, road traffic injuries are the ninth leading cause of death and estimated to be the seventh leading cause in 2030 (WHO, 2015).

Understanding the role of human factors in road traffic accidents is important to prevent road traffic accidents and to decrease fatality rates. Driving performance and driver behaviours are two separate components of human factors that affect how drivers behave in traffic. Hence, it is claimed that majority of reasons behind road traffic accidents are related with driving skill/performance and driving style/behaviour of drivers (Elander, West, & French, 1993; Evans, 1991). Information processing, motor, and safety skills represent driver performance, which reflects what drivers "can" do and might be improved with practice and training. The way drivers prefer to drive is called driver style/behaviour, which reflects what drivers usually "do" while driving (Elander et al., 1993). The focus of the present study is driver behaviours.

Driver behaviours are mainly measured by using Driver Behaviour Questionnaire (DBQ), which is based on a theoretical taxonomy of aberrant behaviours that includes errors and violations (Reason, Manstead, Stradling, Baxter, & Campbell, 1990). Similar to differences in TFRs among countries, there are also studies indicating differences in driver behaviours between countries (e.g. Özkan, Lajunen, Chliaoutakis, Parker, & Summala, 2006). de Winter and Dodou (2016) conducted a study among 41 countries and showed a negative relationship between the economic situation of a country on the one hand, and the occurrence of traffic violations and TFRs, on the other. The findings highlight the importance

32   of investigating the underlying reasons between the stated relationships to decrease the

33   number of TFRs globally. It is reasonable to expect that, at the national level, the culture of a

34   country might have influences on driver behaviours (i.e., violations).

35   **1.1 Economy**

36   Traffic fatality rates (TFRs) show regional differences, with the majority of TFRs

37   occurring in low and middle-income countries. To illustrate, TFRs in low and middle-income

38   countries are twice as high as in high-income countries and constitute 90% of global road

39   traffic fatalities, although the number of vehicles registered in these countries accounts for

40   only 54% of the registered vehicles in the world (WHO, 2015).

41   The economic situation of a country is the most important factor in explaining the

42   differences in TFRs (Jacobs & Cutting, 1986). Studies conducted at the national level have

43   shown significant relationships between economy, and TFRs (e.g. de Winter & Dodou, 2016;

44   Gaygısız, 2010; Özkan & Lajunen, 2007; Solmazer, Üzümcüoğlu, & Özkan, 2016).

45   Additionally, the literature suggests that high-income level is associated with higher

46   perceived law enforcements and governance, which are important variables for traffic

47   enforcements (Gaygısız, 2010; Solmazer, Üzümcüoğlu, & Özkan, 2016). In another study

48   that focused on driver behaviors and accidents in 41 nations, findings showed that economy

49   is negatively related to violations and number of accidents (de Winter & Dodou, 2016). In the

50   light of the findings, it can be assumed that economic status of a country might influence the

51   quality of road infrastructure, law enforcements, and traffic culture in the given context,

52   which can directly and/or indirectly affect TFRs. Hence, economy is included as a control

53   variable in the present study.

1.2. Culture

Hofstede defines culture as ''the collective programming of the mind that distinguishes the members of one group or category of people from another'' (Hofstede, 2001). On the other hand, Schwartz defined as "the rich complex of meanings, beliefs, practices, symbols, norms, and values prevalent among people in a society" (Schwartz, 2006). Hofstede's (2001) and Schwartz's (2006) approaches to culture have some similarities; however their conceptualizations are not the same. Hence, they are treated as different concepts in the current study.

Hofstede (2001) suggested five cultural dimensions based on his definition: power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, and short-term versus long-term orientation. Power distance is about inequality between people in a given culture. Individualism versus collectivism describes how people in a given society define their self-image (I versus we). Masculinity versus femininity refers to the division of emotional roles between genders. Uncertainty avoidance is about the level of comfort with uncertainty and ambiguity. Finally, short-term versus long-term orientation refers to people's focus on time-orientation (present versus future) (Hofstede, 2001).

Apart from Hofstede's framework, Schwartz suggested that societies have three concerns to deal with and introduced seven value dimensions based on these concerns (Schwartz, 2006). The first concern is ''to what extent persons are either autonomous or embedded in their group'', and Schwartz suggested three value dimensions based on this concern: embeddedness, intellectual autonomy and affective autonomy. In cultures with higher embeddedness, people give importance to their social connections and identify themselves with their groups. Societies with high intellectual autonomy encourage their members to share their own ideas independently and have experiences which make them feel good. In societies with high affective autonomy, people pursue affectively positive

79   experience, which are about pleasure, exciting life and varied life. The second concern is to

80   "guarantee that people behave in a responsible manner that preserves the social fabric" and is

81   represented by two value dimensions: hierarchy and egalitarianism. In societies with a

82   hierarchical orientation, people have different roles based on their positions, whereas in

83   egalitarian societies, people perceive all members as equal and care about others' welfare.

84   The third concern is about the relationship between an individual and the natural and social

85   environment, and is related to two value dimensions: mastery and harmony. In harmonic

86   societies, people do not manipulate the natural and social environment but rather adjust

87   themselves; in mastery societies, on the other hand, people give importance to manipulating

88   the natural and social environment in order to achieve "active self-assertion" (Schwartz,

89   2006).

90   **1.3. Culture and traffic related outcomes**

91   The relationships between individual level variables and traffic related behaviors and

92   outcomes are well known in the literature. The literature also includes studies focusing on

93   how to change driver behaviors at individual level. However, road traffic injuries are listed as

94   the ninth leading cause of fatalities across the world (WHO, 2015). The high numbers of

95   people die on the roads make road traffic accidents a global problem.

96   Each year approximately 1.25 million people die on the roads (WHO, 2015). In order

97   to develop strategies to tackle with the worldwide road traffic problems, a global perspective

98   is required. However, the studies evaluating the driver behaviors and road traffic related

99   outcomes with a global perspective are limited. In the literature, there are several studies that

100   have examined the differences in driver behaviours among countries, and the relationship

101   between cultural variables and traffic-related outcomes at the national level. For instance,

102   Özkan et al. (2006) investigated the cross-cultural differences in driver behaviours among six

103   countries (i.e., Finland, Great Britain, Greece, Iran, the Netherlands and Turkey). Drivers

104   from Great Britain, the Netherlands, Finland and Iran reported higher numbers of ordinary

105   violations than drivers from Turkey and Greece, whereas drivers from Greece, Turkey and

106   Iran reported higher numbers of aggressive violations than drivers from Finland, Great

107   Britain and the Netherlands. The findings also revealed significant results for the mediating

108   role of driver behaviours on the relationship between culture/country and accident rates.

109   Wallén Warner, Özkan, Lajunen, and Tzamalouka (2011) examined speeding violations

110   among Finnish, Swedish, Turkish, and Greek drivers, and showed that Turkish and Greek

111   drivers reported higher numbers of aggressive violations and fewer speeding violations than

112   Finnish and Swedish drivers. Similarly, in another study conducted among four country

113   clusters (i.e. Norwegians, Sub-Saharan Africa, Near-East (Turkey and Iran) and Russia/India)

114   showed that Norwegians reported safer driver behaviours than other clusters (Nordfjærn,

115   Şimşekoğlu, & Rundmo, 2014).

116   In addition to studies comparing driver behaviours between different countries, there

117   are also studies that have investigated the relationship between cultural variables and TFRs

118   (i.e. national level). Özkan and Lajunen (2007) investigated the direct effect of culture on

119   unintentional fatalities after controlling for economy by using data from 27 countries. Among

120   Hofstede's cultural dimensions, only uncertainty avoidance had positive relationships with

121   traffic safety component of unintentional fatalities. Among Schwartz's value dimensions,

122   embeddedness was negatively and egalitarianism was positively associated with TFRs.

123   Gaygısız (2010) examined the same relationships in a larger sample and found that, among

124   Hofstede's cultural dimensions, only power distance was positively related to TFRs. Within

125   Schwartz's dimensions, embeddedness, hierarchy and mastery had positive relationships and

126   intellectual autonomy and egalitarianism had negative relationships with TFRs. The variation

127   in results might be due to use of different samples and different indicators for TFRs. In

128   general, it might be suggested that some of the cultural variables and TRFs are related. In the

129   present study, the relationships between cultural variables and violations (i.e. speed violations

130   and non-speed violations) are investigated.

131   **1.4. Law enforcements and driver behaviours**

132   Speeding, drink driving, and not using a helmet, seat-belt or child restraint are key

133   risk factors that have influences on TFRs and road traffic injuries. Among the world, only 28

134   countries have comprehensive traffic laws which include all these five factors (WHO, 2013).

135   The associations between driver behaviours and fines/tickets about some of the stated risk

136   factors have been examined in previous studies (e.g. Lawpoolsri, Li, & Braver, 2007;

137   Martinussen, Møller, & Prato, 2014; Mesken, Lajunen, & Summala, 2002; Nordfjærn,

138   Jørgensen, & Rundmo, 2012). Among the risk factors, speeding is the most frequently

139   studied type of violation. For instance, Mesken, Lajunen, and Summala (2002) conducted a

140   study with 1126 Finnish drivers and used DBQ with an extended violations scale. Results

141   indicated that speeding tickets were positively associated with speeding and interpersonal

142   violations. Lawpoolsri, Li, and Braver (2007) conducted a longitudinal study with Maryland

143   licensed drivers and found that drivers with speeding citations had a higher risk of receiving

144   speeding citations again. Based on the findings in the literature, it can be claimed that,

145   enforcements for speeding might not be effective.

146   The mediating roles of perceived law enforcements of the five key risk factors on the

147   relationship between culture and TFRs have been also investigated, and results suggest that

148   culture has indirect effects on TFRs through speed, helmet and child restrain enforcements

149   (Solmazer et al., 2016). Similarly, the effect of culture and number of roadside alcohol breath

150   tests on drink driving was also examined. One of the cultural variables that have significant

151   positive relationship with drink driving was "behave properly". It is an item of the

152 conformism dimension, meaning showing compliance to expectations of significant others'

153 than to law. The relationship between enforcement (i.e. number of roadside alcohol breath

154 tests) and drink-driving was negative, indicating that enforcements have an important role in

155 preventing drink-driving (Cestac, Kraïem, & Assailly, 2016). It should be noted that, in both

156 studies, the effect of negative relationships between enforcements and outcome variables

157 were low to moderate. Based on the literature findings, it might be plausible to expect weak

158 relationships between perceived law enforcements and violations.

159 **1.5. Aim of the study**

160   Although the existence of regional differences in both driver behaviours and TFRs is

161 well documented, the number of studies focusing on possible underlying causes of these

162 differences is limited. Culture has significant relationships with both traffic law enforcements

163 and TFRs, and driver behaviours are also associated with TFRs. In the present exploratory

164 study, we aimed to examine the relationships between cultural variables, traffic law

165 enforcements and driver behaviours (i.e. violations) at the national level.

166 **2. Method**

167 **2.1. Sample**

168 In the present study, Hofstede's five cultural dimensions (i.e., power distance, uncertainty

169 avoidance, individualism, masculinity, and long-term orientation), Schwartz's seven value

170 dimensions (i.e., harmony, embeddedness, hierarchy, mastery, affective autonomy,

171 intellectual autonomy, and egalitarianism), perceived enforcement of five laws related to road

172 behaviours (i.e., national speed law, national drink-driving law, national motorcycle helmet

173   law, national seat-belt law, and national child restraint law), GDP per capita, road traffic

174   fatality rates, and two components of self-reported violations were used as study variables at

175   the national level. The data of Hofstede's cultural dimensions were taken from Hofstede's

176   book (Hofstede, Hofstede, & Minkov, 2010). The data of Schwartz's cultural values were

177   taken from Schwartz (S. Schwartz, personal communication, May 8, 2014). GDP per capita

178   rankings were taken from the World Data Bank (2015). The law enforcement scores and road

179   traffic fatality rates were taken from the WHO (2013). Lastly, the scores of violations were

180   taken from de Winter and Dodou (July 8, 2016). All datasets were retrieved from open

181   source databases or by personal communication.

182   **2.2. Data collection**

183   *Economy:* GDP per capita in 2013 was obtained from the World Bank (World Bank, 2015).

184   GDP per capita is gross domestic product divided by midyear population, and data are in

185   current U.S. dollars (for details please see World Bank, 2015).

186   *Hofstede's cultural dimensions:* Hofstede's cultural dimensions' country scores were taken

187   from his book (Hofstede, Hofstede, & Minkov, 2010). The data were collected from IBM

188   employees between 1967 and 1973. In 2010 (Hofstede et al., 2010), cultural dimensions

189   scores for 76 countries are presented. The scores are based on replications and extensions of

190   the previous IBM study (see Hofstede, Hofstede, & Minkov, 2010 for details of the scores).

191   *Schwartz's cultural values:* Schwartz's value dimensions per country were taken from with

192   personal communication (personal communication, May 8, 2014). Schwartz developed a

193   survey including a list of single values; then he formulated the seven cultural value

194   orientations for 80 countries. The data was collected between 1988 and 2000. The sample

195   was consisted of elementary school teachers and college students (see Schwartz, 2006 for

196   details of the scores).

197   ***Driver Behaviors – Violations:*** The seven-item DBQ scores for self-reported violations (i.e.

198   Vangered, Vmotorway, Vresident, Vfollowing, Vrace, Vhorn, and Vphone) were taken from

199   a study conducted by de Winter and Dodou (2016) across 41 countries. In their study, a

200   principal component analysis was conducted at the national level for the seven items, and the

201   results suggested two violation factors: speeding violations (i.e., Vresident and Vmotorway)

202   and non-speeding violations (an aggregate of aggressive violations, tailgating, and using a

203   mobile phone without a hands-free kit: Vphone, Vfollowing, Vhorn, Vangered and Vrace).

204   Factors and their items are presented in Table 1. Based on the principal component analysis

205   provided by de Winter and Dodou (2016), violations are included as two separate dimensions

206   in the current study: speeding violations and non-speeding violations.

207   ***The law enforcements and fatality rates:*** The perceived enforcement of five laws related to

208   road behaviours was taken from the Global Status Report on Road Safety (WHO, 2013).

209   WHO conducted four steps to collect data on perceived enforcement of given laws. First,

210   National Data Coordinators received training for the project from WHO. Second, National

211   Data Coordinators assigned road safety experts for their own countries (up to eight experts

212   per country). In the third step, the experts completed the questionnaire individually before a

213   consensus meeting facilitated by the National Data Coordinators took place. They responded

214   the question "how effective you think enforcement is at a NATIONAL level in your country"

215   (0: not effective at all; 10: highly effective) for each of the five traffic law enforcements. All

216   responses were discussed by the experts and the National Data Coordinators during the

217   meeting. Lastly, after the consensus meeting, the groups reported the best response that

218   represents the current situation of their country.

219   Fatality rates were taken from the same report. Ministries of Health of countries

220   submit their death registration information to WHO regularly and WHO has certain criteria

221   for the quality of this death registration data (WHO, 2015b). A regression model was used to

222   estimate total road traffic deaths for the countries without death registration data at least 80%

223   complete and with populations greater than 150 000. Detailed information about the

224   estimations and data collection can be reached via (WHO, 2015b).

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226   Insert Table 1

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228   **3. Results**

229   **3.1. The relationships among study variables**

230   The number of countries for each study variable, means (*M*), standard deviations (*SD*) and

231   correlations among study variables (i.e. GNP per capita, Hofstede's cultural dimensions,

232   Schwartz's value dimensions, perceived enforcements of traffic laws, and driver behaviours)

233   are presented in Table 3.

234   ----------

235   Insert Table 2

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237   Non-speeding violations factor had significant negative correlation with GDP per capita.

238   Among Hofstede's cultural dimensions, non-speeding violations factor had a significant

239   positive correlation with power distance and a significant negative correlation with

240   individualism. Among Schwartz's value dimensions non-speeding violations factor had

241   significant positive correlations with embeddedness and hierarchy and negative correlations

242   with affective autonomy, intellectual autonomy, and egalitarianism. Additionally, non-

243   speeding violations had significant negative correlations with all of the five traffic law

244   enforcements. Speeding violations factor had significant positive correlations with speed

245   enforcement and drink-driving enforcement.

246   **3.2. Hierarchical regression analyses**

247   In order to test the relationships between cultural variables, perceived law enforcements and

248   driver behaviours, several hierarchical regression analyses were conducted. In all analyses,

249   GDP per capita was entered in the first step as the control variable. It should be noted that all

250   analyses were conducted for both the speeding violations and non-speeding violations factors

251   separately.

252   *3.2.1. The relationships between Hofstede's cultural dimensions and driver behaviours*

253   Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding

254   violations factor and non-speeding violations factor). As shown in Table 4, GDP per capita

255   was significantly and negatively related to non-speeding violations factor. After controlling

256   for the effects of GDP per capita, only individualism was significantly and negatively

257   associated with non-speeding violations factor.

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259   Insert Table 3

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261   *3.2.2. The relationships between Schwartz's value dimensions and driver behaviours*

262   Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding

263   violations factor and non-speeding violations factor). As presented in Table 5, GDP per

264   capita was significantly and negatively related to non-speeding violations factor. After

265 controlling for GDP per capita, embeddedness and egalitarianism were significantly and

266 positively related to non-speeding violations factor.

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268   Insert Table 4

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270 *3.2.3. The relationships between perceived law enforcements and driver behaviours*

271 Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding

272 violations factor and non-speeding violations factor). However, none of the results yielded

273 significant results.

274 *3.2.4. Additional analyses*

275 de Winter and Dodou (2016) investigated the relationship between self-reported traffic

276 violations and TFRs and reported strong correlations between non-speeding violations (i.e.,

277 Vangered, Vfollowing, Vrace, Vhorn and Vphone) and TFRs per registered vehicle. In order

278 to test the mediating role of driver behaviours (i.e. speeding violations and non-speeding

279 violations) on the relationship between culture and TFRs (taken from WHO, 2015), 12

280 bootstrap analyses with 1000 replications were conducted including Hofstede's five cultural

281 dimensions and Schwartz's seven value dimensions. In all analyses, GDP per capita was

282 controlled.

283   To investigate the relations and to identify the mediating paths, PROCESS macro

284 Model 4 developed by Hayes (2013) was used. Model 4 allows testing the effects of multiple

285 mediators and it does not assume a normal distribution to test the indirect effect. As

286 suggested by Hayes (2013), all path coefficients represent unstandardized values to reduce

287 Type-1 errors. Additionally, the PROCESS macro uses bootstrapping approach, which is

288 useful to control the effects of Type 1 error rates (Hayes, 2013). In previous versions of

289 mediation analysis, such as Baron and Kenny (1986), there were causal steps approach which

290 has to be satisfied to run the analysis. In PROCESS macro, the limitations of the causal steps

291 approach are overcome and Hayes (2013) suggests that the indirect effect of X on Y through

292 M(mediator) can be significant without an association between X and Y (for more details see

293 Hayes, 2009; 2013). In the current study, first, multiple mediation model was used to test the

294 indirect effects of Hofstede's cultural dimensions on fatality rates through speeding and non-

295 speeding violations. Second, the indirect effect of Schwartz's cultural on TFR through

296 speeding and non-speeding violations were tested. The results revealed only two significant

297 indirect effects.

298   As shown in Figure 1, long-term orientation was significantly associated with TFRs

299 (B = -1.069, SE = .497, p = .039) and the indirect effect of long-term orientation on TFRs

300 through non-speeding violations was significant (indirect effect = -.273, SE = .234, CI = -

301 1.082 to -.006).

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303   Insert Figure 1

304   ----------

305   As shown in Figure 2, embeddedness was significantly associated with non-speeding

306 violations (B=.101, SE = .029, p = .002) and the indirect effect of embeddedness on TFRs

307 through non-speeding violations was significant (indirect effect = 51.484, SE = 38.164, CI =

308 2.634 to 151.761).

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310   Insert Figure 2

311   ----------

4. Discussion

The aim of the present study is to examine the driver behaviours (i.e., speeding violations and non-speeding violations) in relation to cultural variables (i.e., Hofstede's cultural dimensions and Schwartz's value dimensions) and traffic law enforcements after controlling for economy (i.e., GDP per capita).

The differences in TFRs and traffic law enforcements among countries are well-known (see WHO, 2015). de Winter and Dodou (2016) showed that there are differences in driver behaviours (i.e., violations) among countries and driver behaviours are associated with TFRs. Previous studies (e.g. Gaygısız, 2010; Özkan & Lajunen, 2007; Solmazer et al., 2016) showed significant associations between cultural variables and TFRs. The present study suggested that some of the cultural variables (i.e., Hofstede's cultural dimensions and Schwartz's value dimensions) are related with violations.

Among Hofstede's cultural dimensions, only individualism had significant negative relationship with the non-speeding violations factor. In other words, societies high in individualism showed lower numbers of non-speeding violations. Non-speeding violations factor consisted of violations related to aggressive violations such as phone use, racing, horn use, anger, and following (see Table 1). The functional differences of horn use might be considered to interpret the results. For instance, horn can be used to both warn a driver (Dula & Geller, 2003; Khanal & Sarkar, 2014) or as a sign of aggression (Shinar, 1998). Hence, violating horn rule might save lives in a country, whereas it might be risky in another country by being a sign of aggression. The previous findings showed that individualistic societies had lower numbers of TFRs (Gaygısız, 2010; Solmazer et al., 2016), and as the number of non-speeding violations increased, the number of TFRs also increased (de Winter & Dodou,

335   2016). Based on these findings, it might be suggested that individualism has a positive effect

336   on road traffic safety by reducing number of violations.

337   In addition to the hierarchical regression analysis, the mediating role of violations on

338   the relationship between culture and TFRs were investigated. Among Hofstede's cultural

339   dimensions, only long-term orientation had an indirect effect on TFRs through non-speeding

340   violations. The results suggested that as societies have higher long-term orientations, the

341   number of non-speeding violations decreases, which in turn decrease TFRs. Hofstede (2001)

342   discussed that societies with long-term orientation are good at putting effort to the future, and

343   they give importance to savings and investments. It might be suggested that societies that

344   value their future perceive rules as something to follow rather than violate. Solmazer et al.

345   (2016) suggested that the relationship between long-term orientation and TFRs is mediated

346   by speed, helmet and child restraint enforcements, and long-term orientation has positive

347   effects on road traffic safety. In countries with long-term orientation, traffic law

348   enforcements are perceived as high (Solmazer et al., 2016). Hence, it might be suggested that

349   enforcements are efficient to avoid violations in societies where people focus on their future

350   rather than past and present. Taking into consideration the results of the analyses about

351   Hofstede's dimensions, although the results were not significant for speeding violations,

352   similar interpretations can be done for the positive effect of individualism and long-term

353   orientation on road traffic safety.

354   Among Schwartz's dimensions, embeddedness and egalitarianism had significant

355   positive associations with non-speeding violations factor. This is unexpected, as societies

356   high in egalitarianism perceive all people as equal and also care other people's welfare

357   (Schwartz, 2006). Previous studies suggested negative relationships between egalitarianism

358   and TFRs (Gaygısız, 2010; Solmazer et al., 2016), which indicate the positive effect of

359   egalitarianism on TFRs (Solmazer et al., 2016); however a similar inference cannot be made

360 for violations. It might be suggested that, in these countries, people do not perceive non-

361 speeding violations as breaking rules, which might be harmful both for the self and others.

362   Although Hofstede (2001) and Schwartz (2006) have differences in their definitions,

363 some of their concepts show similarities. To illustrate, individualism versus collectivism is

364 about how people in a given society define their self-image (I versus we) and in societies

365 with high embeddedness, people give importance to their social connections and identify

366 themselves with their groups. Hence, it is not surprising to find a negative relationship

367 between individualism and non-speeding violations and a positive relationship between

368 embeddedness and non-speeding violations. Taken together, identifying the self with the

369 group, which is about collective perspective might not be have positive influence on traffic

370 safety.

371   In the additional analyses, the mediating role of violations on the relationship between

372 Schwartz's value dimensions and TFRs were also investigated, and results suggested an

373 indirect effect of embeddedness on TFRs through the non-speeding violations factor.

374 Embeddedness was also a cultural variable that has indirect effects on TFRs through some of

375 the traffic law enforcements (Solmazer et al., 2016). In the present study, results suggested

376 that societies high in embeddedness might not follow rules about non-speeding violations,

377 which in turn increases TFRs. The findings did not yield significant results for speeding

378 violations, which needs further exploration. Societies high in embeddedness give importance

379 to identification with their social groups and show respect to traditions. In these countries,

380 following the rules might not be a requirement and individuals might think rules are not the

381 same for everyone (Gaygısız, 2010), which might explain the higher numbers of violations.

382   In the present study, Hofstede's cultural dimensions and Schwartz's values are treated

383 separately since they measure culture with different frameworks. Schwartz's values are about

384   guiding principles in life (Schwartz, 1994) and Hofstede's cultural dimensions are about the

385   shared meanings, rituals, norms and traditions (Hofstede, 2001). When their relationships

386   with violations are examined, none of them have significant relationships with speeding

387   violations. Among Hofstede's five cultural dimensions, only individualism and among

388   Schwartz's values only egalitarianism and embeddedness have significant relationships with

389   non-speeding violations. Hence, it might not be possible to conclude that one of them is

390   better than the other to explain violations in driving context. Ng, Lee, and Soutar (2007)

391   claimed that, Schwartz's values might be superior to Hofstede's cultural dimensions (based

392   on analysis of cultural distance) in trade context; but it might show differences in different

393   contexts (e.g. traffic context). Additionally, they suggested that two cultural frameworks are

394   not congruent. However, considering the significant relationships in the current study, it

395   might not be possible to claim whether these two frameworks are congruent or not in traffic

396   context.

397   Overall, the results were significant only for non-speeding violations factor, and, the

398   results for the speeding violations factor did not yield significant results. Although Hofstede

399   (2001) suggested a significant relationship between uncertainty avoidance and speed limits,

400   the results of the present study did not reveal significant results for speeding violations. de

401   Winter and Dodou (2016) stated that the developmental status of countries is related to non-

402   speeding violations but not with speeding violations. The results of the factor analysis

403   suggested that non-speeding and speeding are two distinct types of violations, and

404   hierarchical regression analyses results supported that these two types of violations have

405   different associations with other study variables. Excessive speed and inappropriate speed

406   can be considered as one of the most important road safety problems in majority of countries.

407   Additionally, speed accounts for one third of accidents with fatalities and also affects the

408   severity of accidents (OECD, 2006). It can be claimed that speeding has direct effects on the

409 severity of accidents and that it is a main cause of accidents, whereas non-speeding violations

410 might be secondary factors related with accidents. To illustrate, speeding in Vresident and

411 Vmotorways might directly cause accidents; and Vphone, Vfollowing, Vhorn, Vangered, and

412 Vrace might cause distraction while driving, and distracted driving is also an important cause

413 of accidents; however, speed has a strong relationship with severity of accidents. The risk of

414 fatality of a pedestrian is less than 20% when a car crashes at 50 km/h, whereas it increases to

415 60% when the speed of a car is 80 km/h (WHO, 2016). Although speeding has direct

416 associations with the severity of accidents and is considered as one of the main causes of

417 accidents, the results did not revealed significant associations between culture, enforcements

418 or speeding. The possible explanation might be the differences in speed limits between

419 countries. de Winter and Dodou (2016) argued that, speed limits must exist to violate; and if

420 there are limits, drivers have to be aware of it. The violations and enforcements about

421 speeding need more research to understand whether the underlying factors of speeding are

422 based on personal choices rather than cultural effects.

423   It has been argued that lowering the speed limit saves lives; however, if drivers

424 perceived the speed limit as low, this may cause an increase in speed variances, which in turn

425 will cause more road traffic accidents (McCarthy, 2001). Culture might also affect perceived

426 acceptable speed limits of individuals in a society. In addition to road type and design, the

427 reasons of drivers' speeding behaviours should also be considered in setting new speed

428 limits. For instance, drivers might feel safer due to developments in technology and road

429 design, but the changes in drivers' risk perceptions might cause speeding. Drivers also tend to

430 exceed speed limit by observing other drivers' attitudes in traffic (Haglund & Aberg, 2000).

431 Enforcement intensification might reduce this belief and decrease the number of drivers who

432 exceed speed limits.

433   The present study has some methodological limitations. Culture is a broad and a

434   complex term, which makes it difficult to measure. Hofstede (2001) and Schwartz (2006)

435   provided one of the most comprehensive definitions and measured culture by using different

436   dimensions. Although there are criticisms about compressing culture into a few dimensions

437   (Holden, 2004), and about face, convergent and discriminant validity of Hofstede's

438   framework (e.g. Venaik & Brewer, 2016; Ng et al., 2007), these two frameworks are widely

439   used. Hofstede collected data from IBM employees whereas Schwartz collected data from

440   teachers and students. Hence, the sample representativeness of these two frameworks are

441   different from each other (Ng et al., 2007), which might be considered as a limitation. It

442   should be noted that, findings of the present study, which used aggregated level data (i.e., at

443   the national level), should not be used to evaluate individual level causal effects, to prevent

444   the ecological fallacy (Hofstede, 2001, p. 16). Traffic law enforcements that were included in

445   the study reflect subjective judgments since they are based on experts' evaluations. Hence,

446   they are not measured with objective measures and might include some biases. As Solmazer

447   et al. (2016) suggested, additional studies need to be conducted to test the representativeness

448   of the data. Instead of perceived enforcement of speed laws, data relying on observational

449   studies might be more objective. Additionally, the road traffic fatality rates do not represent

450   exact numbers; but based on estimations (WHO, 2015b). Lastly, the findings should be

451   interpreted with caution because of the relatively small sample size. Although the present

452   study has some limitations, it is the first research that investigated the relationship between

453   cultural variables and violations among countries.

454   **Acknowledgment**

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Table 1. DBQ Items included in the analysis

Variable	Question in the survey/ Items in the factor
Vangered	How often do you do the following?: Becoming angered by a particular type of driver, and indicate your hostility by whatever means you can.
Vmotorway	How often do you do the following? Disregarding the speed limit on a motorway.
Vresident	How often do you do the following? Disregarding the speed limit on a residential road.
Vfollowing	How often do you do the following? Driving so close to the car in front that it would be difficult to stop in an emergency.
Vrace	How often do you do the following? Racing away from traffic lights with the intention of beating the driver next to you.
Vhorn	How often do you do the following? Sounding your horn to indicate your annoyance with another road user.
Vphone	How often do you do the following? Using a mobile phone without a hands free kit.
Speed	Vresident, Vmotorway
Non-speed	Vphone, Vrace, Vhorn, Vangered, Vfollowing

Note: Response options: −1 = No response; 1 = Never; 2= Hardly ever; 3 = Occasionally; 4 = Quite often; 5 = Frequently; 6 = Nearly all the time

Adapted from de Winter and Dodou (2016)

Table 2. Correlations among study variables

		#	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.	GDP	37	18272	17055	1																			
2.	PD	32	64.88	20.07	-.74**	1																		
3.	Idv	32	42.41	22.84	.78**	-.62**	1																	
4.	Mas	32	88	50.97	-.11	-.09	.12	1																
5.	UA	32	72.78	20.61	-.06	.01	-.11	-.01	1															
6.	LTO	36	47.39	19.24	.01	-.03	.21	-.25	.01	1														
7.	Ha	34	4.09	.26	.30	-.31	.17	.02	.44*	.11	1													
8.	Emb	34	3.73	.34	-.78**	.65**	-.57**	.11	-.37*	-.15	-.55**	1												
9.	Hie	34	2.24	.41	-.51**	.40*	-.30	-.02	-.26	.00	-.50**	.55**	1											
10.	Mast	34	3.92	.15	-.17	.17	-.30	-.05	.12	.03	-.28	.04	.29	1										
11.	AA	34	3.51	.41	.70**	-.59**	.51**	-.18	.14	.33	.12	-.77**	-.29	.17	1									
12.	IA	34	4.41	.34	.71**	-.44*	.52**	-.14	.32	.20	.59**	-.86**	-.60**	-.23	.65**	1								
13.	Ega	34	4.7	.30	.63**	-.49**	.28	-.14	.22	-.26	.55**	-.70**	-.54**	-.16	.38*	.59**	1							
14.	SE	35	5.86	1.83	.54**	-.43*	.57**	-.33	.29	.44**	.42*	-.58**	-.33	-.14	.57**	.67**	.27	1						
15.	DDE	34	5.94	2.01	.52**	-.46*	.47*	-.15	.56**	.27	.37*	-.52**	-.28	.03	.50**	.61**	.23	.73**	1					
16.	HE	35	6.4	2.34	.52**	-.41*	.41*	-.24	.17	.21	.42*	-.58**	-.26	-.30	.50**	.60**	.43*	.66**	.52**	1				
17.	SBE	35	6.06	1.88	.31	-.22	.38*	-.27	.21	.21	.30	-.33	-.06	-.24	.37*	.40*	.11	.71**	.46**	.70**	1			
18.	CRE	26	5.23	2.30	.65**	-.58**	.61**	-.10	-.25	.34	.35	-.63**	-.34	-.26	.57**	.59**	.36	.65**	.61**	.61**	.55**	1		
19.	Speed	37	.50	.05	.21	-.07	.14	-.33	.06	.09	-.11	-.06	-.16	.19	.20	.20	.03	.33*	.48**	.20	.19	.32	1	
20.	N_speed	37	.51	.06	-.67**	.47**	-.74**	-.05	-.15	-.22	-.33	.74**	.44**	.06	-.58**	-.62**	-.36*	-.44**	-.36*	-.45**	-.34*	-.62**	-.04	1
21.	TFR	37	77.58	172.18	-.34*	.23	-.35	.12	-.16	-.12	-.27	.53**	.27	.11	-.49**	-.56**	-.20	-.50**	-.57**	-.45**	-.49**	-.37	-.07	.46**

Note. GDP is based on World Bank. PD = Power Distance; Idv = Individualism; Mas = Masculinity; UA = Uncertainty Avoidance; LTO = Long-term Orientation; Ha = Harmony; Emb = Embeddedness; Hie = Hierarchy; Mast = Mastery; AA = Affective Autonomy; IA = Intellectual Autonomy; Ega = Egalitarianism; SE = Speed Enforcement; DDE = Drink-driving Enforcement; HE = Helmet Enforcement; SBE = Seat Belt Enforcement; CRE = Child Restraint Enforcement; N_speed = Non-speed; TFR: Traffic Fatality Rates. *p.05; **p<.01

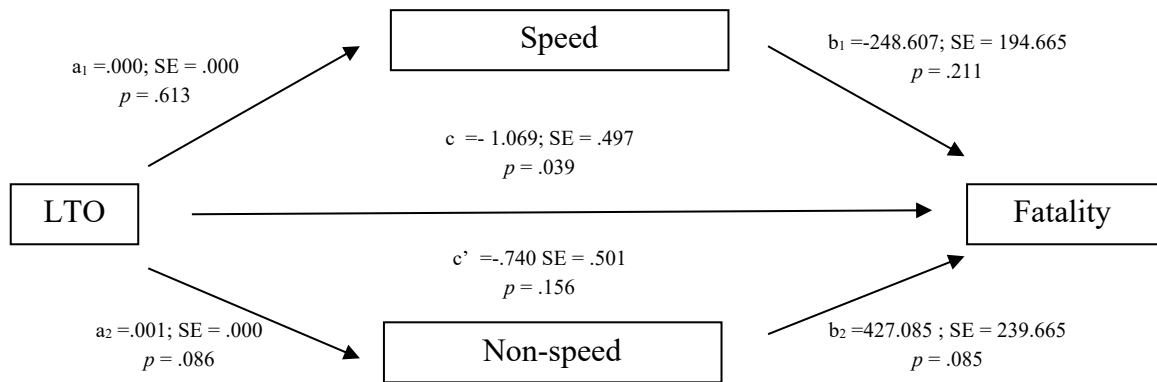**Table 3.** Hierarchical regression analyses (Hofstede's cultural dimensions and non-speeding violations)

| Dependent Variable	Step	Independent variables	R^2	Adj R^2	R^2 change	F	β	t
Non-speeding	1	GDP	.44	.42	.44	23.42***	-.66***	-4.84
	2	GDP	.63	.54	.19	7.11**	-.31	-1.19
		Power distance					-.14	-.76
		Individualism					-.61*	-2.74
		Masculinity					-.03	-.21
		Uncertainty avoidance					-.23	-1.91
		Long term orientation					-.01	-.08

*<p.05; **p<.01; ***p<.001

Table 4. Hierarchical regression analyses (Schwartz's value dimensions and non-speeding violations)

Dependent variable	Step	Independent variables	R^2	Adj R^2	R^2 change	F	β	t
Non-speed	1	GDP	.37	.35	.37	19.01**	-.61***	-4.36
	2	GDP	.63	.51	.26	5.33**	-.19	-.82
		Harmony					.04	.20
		Embeddedness					1.14**	3.06
		Hierarchy					.13	.79
		Mastery					.05	.33
		Affective autonomy					.15	.59
		Intellectual autonomy					.22	.79
		Egalitarianism					.43*	2.17

*<p.05; **p<.01; ***p<.001

Fig. 1. Mediation analysis of long-term orientation, violations, and fatality rates
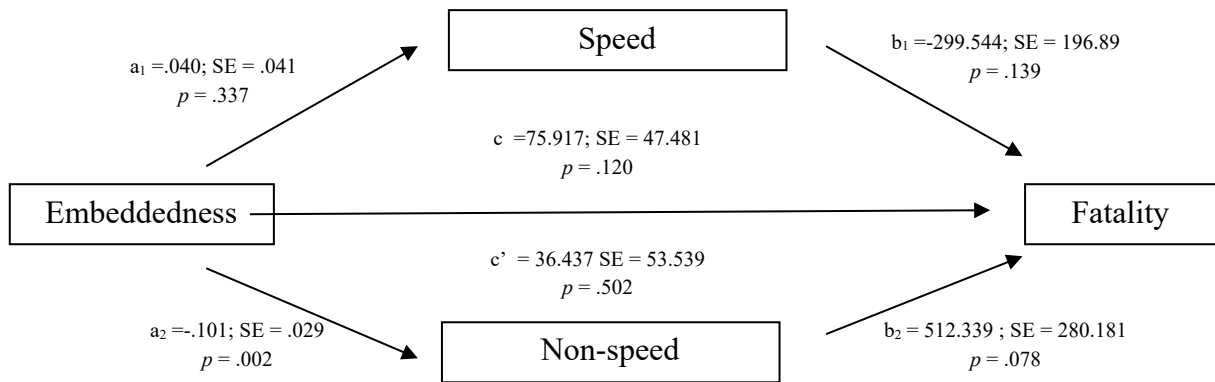
Fig. 2. Mediation analysis of embeddedness, violations, and fatality rates