The relationships between cultural variables, law enforcements and driver behaviours across 37 nations

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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
of investigating the underlying reasons between the stated relationships to decrease the
number of TFRs globally. It is reasonable to expect that, at the national level, the culture of a
country might have influences on driver behaviours (i.e., violations).

1.1 Economy

Traffic fatality rates (TFRs) show regional differences, with the majority of TFRs
occurring in low and middle-income countries. To illustrate, TFRs in low and middle-income
countries are twice as high as in high-income countries and constitute 90% of global road
traffic fatalities, although the number of vehicles registered in these countries accounts for
only 54% of the registered vehicles in the world (WHO, 2015).

The economic situation of a country is the most important factor in explaining the
differences in TFRs (Jacobs & Cutting, 1986). Studies conducted at the national level have
shown significant relationships between economy, and TFRs (e.g., de Winter & Dodou, 2016;

Additionally, the literature suggests that high-income level is associated with higher
perceived law enforcements and governance, which are important variables for traffic
enforcements (Gaygısız, 2010; Solmazer, Üzümcüoğlu, & Özkan, 2016). In another study
that focused on driver behaviors and accidents in 41 nations, findings showed that economy
is negatively related to violations and number of accidents (de Winter & Dodou, 2016). In the
light of the findings, it can be assumed that economic status of a country might influence the
quality of road infrastructure, law enforcements, and traffic culture in the given context,
which can directly and/or indirectly affect TFRs. Hence, economy is included as a control
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
experience, which are about pleasure, exciting life and varied life. The second concern is to “guarantee that people behave in a responsible manner that preserves the social fabric” and is represented by two value dimensions: hierarchy and egalitarianism. In societies with a hierarchical orientation, people have different roles based on their positions, whereas in egalitarian societies, people perceive all members as equal and care about others’ welfare. The third concern is about the relationship between an individual and the natural and social environment, and is related to two value dimensions: mastery and harmony. In harmonic societies, people do not manipulate the natural and social environment but rather adjust themselves; in mastery societies, on the other hand, people give importance to manipulating the natural and social environment in order to achieve “active self-assertion” (Schwartz, 2006).

1.3. Culture and traffic related outcomes

The relationships between individual level variables and traffic related behaviors and outcomes are well known in the literature. The literature also includes studies focusing on how to change driver behaviors at individual level. However, road traffic injuries are listed as the ninth leading cause of fatalities across the world (WHO, 2015). The high numbers of people die on the roads make road traffic accidents a global problem.

Each year approximately 1.25 million people die on the roads (WHO, 2015). In order to develop strategies to tackle with the worldwide road traffic problems, a global perspective is required. However, the studies evaluating the driver behaviors and road traffic related outcomes with a global perspective are limited. In the literature, there are several studies that have examined the differences in driver behaviours among countries, and the relationship between cultural variables and traffic-related outcomes at the national level. For instance, Özkan et al. (2006) investigated the cross-cultural differences in driver behaviours among six
countries (i.e., Finland, Great Britain, Greece, Iran, the Netherlands and Turkey). Drivers from Great Britain, the Netherlands, Finland and Iran reported higher numbers of ordinary violations than drivers from Turkey and Greece, whereas drivers from Greece, Turkey and Iran reported higher numbers of aggressive violations than drivers from Finland, Great Britain and the Netherlands. The findings also revealed significant results for the mediating role of driver behaviours on the relationship between culture/country and accident rates. Wallén Warner, Özkan, Lajunen, and Tzamalouka (2011) examined speeding violations among Finnish, Swedish, Turkish, and Greek drivers, and showed that Turkish and Greek drivers reported higher numbers of aggressive violations and fewer speeding violations than Finnish and Swedish drivers. Similarly, in another study conducted among four country clusters (i.e. Norwegians, Sub-Saharan Africa, Near-East (Turkey and Iran) and Russia/India) showed that Norwegians reported safer driver behaviours than other clusters (Nordfjærn, Şimşekoğlu, & Rundmo, 2014).

In addition to studies comparing driver behaviours between different countries, there are also studies that have investigated the relationship between cultural variables and TFRs (i.e. national level). Özkan and Lajunen (2007) investigated the direct effect of culture on unintentional fatalities after controlling for economy by using data from 27 countries. Among Hofstede’s cultural dimensions, only uncertainty avoidance had positive relationships with traffic safety component of unintentional fatalities. Among Schwartz’s value dimensions, embeddedness was negatively and egalitarianism was positively associated with TFRs. Gaygısız (2010) examined the same relationships in a larger sample and found that, among Hofstede’s cultural dimensions, only power distance was positively related to TFRs. Within Schwartz’s dimensions, embeddedness, hierarchy and mastery had positive relationships and intellectual autonomy and egalitarianism had negative relationships with TFRs. The variation in results might be due to use of different samples and different indicators for TFRs. In
In general, it might be suggested that some of the cultural variables and TRFs are related. In the present study, the relationships between cultural variables and violations (i.e. speed violations and non-speed violations) are investigated.

1.4. Law enforcements and driver behaviours

Speeding, drink driving, and not using a helmet, seat-belt or child restraint are key risk factors that have influences on TFRs and road traffic injuries. Among the world, only 28 countries have comprehensive traffic laws which include all these five factors (WHO, 2013). The associations between driver behaviours and fines/tickets about some of the stated risk factors have been examined in previous studies (e.g. Lawpoolsri, Li, & Braver, 2007; Martinussen, Møller, & Prato, 2014; Mesken, Lajunen, & Summala, 2002; Nordfjærn, Jørgensen, & Rundmo, 2012). Among the risk factors, speeding is the most frequently studied type of violation. For instance, Mesken, Lajunen, and Summala (2002) conducted a study with 1126 Finnish drivers and used DBQ with an extended violations scale. Results indicated that speeding tickets were positively associated with speeding and interpersonal violations. Lawpoolsri, Li, and Braver (2007) conducted a longitudinal study with Maryland licensed drivers and found that drivers with speeding citations had a higher risk of receiving speeding citations again. Based on the findings in the literature, it can be claimed that, the mediating roles of perceived law enforcements of the five key risk factors on the relationship between culture and TFRs have been also investigated, and results suggest that culture has indirect effects on TFRs through speed, helmet and child restrain enforcements (Solmazer et al., 2016). Similarly, the effect of culture and number of roadside alcohol breath tests on drink driving was also examined. One of the cultural variables that have significant positive relationship with drink driving was “behave properly”. It is an item of the
conformism dimension, meaning showing compliance to expectations of significant others’ than to law. The relationship between enforcement (i.e. number of roadside alcohol breath tests) and drink-driving was negative, indicating that enforcements have an important role in preventing drink-driving (Cestac, Kraïem, & Assailly, 2016). It should be noted that, in both studies, the effect of negative relationships between enforcements and outcome variables were low to moderate. Based on the literature findings, it might be plausible to expect weak relationships between perceived law enforcements and violations.

1.5. Aim of the study

Although the existence of regional differences in both driver behaviours and TFRs is well documented, the number of studies focusing on possible underlying causes of these differences is limited. Culture has significant relationships with both traffic law enforcements and TFRs, and driver behaviours are also associated with TFRs. In the present exploratory study, we aimed to examine the relationships between cultural variables, traffic law enforcements and driver behaviours (i.e. violations) at the national level.

2. Method

2.1. Sample

In the present study, Hofstede’s five cultural dimensions (i.e., power distance, uncertainty avoidance, individualism, masculinity, and long-term orientation), Schwartz’s seven value dimensions (i.e., harmony, embeddedness, hierarchy, mastery, affective autonomy, intellectual autonomy, and egalitarianism), perceived enforcement of five laws related to road behaviours (i.e., national speed law, national drink-driving law, national motorcycle helmet
law, national seat-belt law, and national child restraint law), GDP per capita, road traffic
fatality rates, and two components of self-reported violations were used as study variables at
the national level. The data of Hofstede’s cultural dimensions were taken from Hofstede’s
book (Hofstede, Hofstede, & Minkov, 2010). The data of Schwartz’s cultural values were
taken from Schwartz (S. Schwartz, personal communication, May 8, 2014). GDP per capita
rankings were taken from the World Data Bank (2015). The law enforcement scores and road
traffic fatality rates were taken from the WHO (2013). Lastly, the scores of violations were
taken from de Winter and Dodou (July 8, 2016). All datasets were retrieved from open
source databases or by personal communication.

2.2. Data collection

Economy: GDP per capita in 2013 was obtained from the World Bank (World Bank, 2015).
GDP per capita is gross domestic product divided by midyear population, and data are in
current U.S. dollars (for details please see World Bank, 2015).

Hofstede’s cultural dimensions: Hofstede’s cultural dimensions’ country scores were taken
from his book (Hofstede, Hofstede, & Minkov, 2010). The data were collected from IBM
employees between 1967 and 1973. In 2010 (Hofstede et al., 2010), cultural dimensions
scores for 76 countries are presented. The scores are based on replications and extensions of
the previous IBM study (see Hofstede, Hofstede, & Minkov, 2010 for details of the scores).

Schwartz’s cultural values: Schwartz’s value dimensions per country were taken from with
personal communication (personal communication, May 8, 2014). Schwartz developed a
survey including a list of single values; then he formulated the seven cultural value
orientations for 80 countries. The data was collected between 1988 and 2000. The sample
was consisted of elementary school teachers and college students (see Schwartz, 2006 for
details of the scores).
Driver Behaviors – Violations: The seven-item DBQ scores for self-reported violations (i.e. Vangered, Vmotorway, Vresident, Vfollowing, Vrace, Vhorn, and Vphone) were taken from a study conducted by de Winter and Dodou (2016) across 41 countries. In their study, a principal component analysis was conducted at the national level for the seven items, and the results suggested two violation factors: speeding violations (i.e., Vresident and Vmotorway) and non-speeding violations (an aggregate of aggressive violations, tailgating, and using a mobile phone without a hands-free kit: Vphone, Vfollowing, Vhorn, Vangered and Vrace). Factors and their items are presented in Table 1. Based on the principal component analysis provided by de Winter and Dodou (2016), violations are included as two separate dimensions in the current study: speeding violations and non-speeding violations.

The law enforcements and fatality rates: The perceived enforcement of five laws related to road behaviours was taken from the Global Status Report on Road Safety (WHO, 2013). WHO conducted four steps to collect data on perceived enforcement of given laws. First, National Data Coordinators received training for the project from WHO. Second, National Data Coordinators assigned road safety experts for their own countries (up to eight experts per country). In the third step, the experts completed the questionnaire individually before a consensus meeting facilitated by the National Data Coordinators took place. They responded the question “how effective you think enforcement is at a NATIONAL level in your country” (0: not effective at all; 10: highly effective) for each of the five traffic law enforcements. All responses were discussed by the experts and the National Data Coordinators during the meeting. Lastly, after the consensus meeting, the groups reported the best response that represents the current situation of their country.

Fatality rates were taken from the same report. Ministries of Health of countries submit their death registration information to WHO regularly and WHO has certain criteria for the quality of this death registration data (WHO, 2015b). A regression model was used to
estimate total road traffic deaths for the countries without death registration data at least 80%
complete and with populations greater than 150 000. Detailed information about the
estimations and data collection can be reached via (WHO, 2015b).

3. Results

3.1. The relationships among study variables

The number of countries for each study variable, means (M), standard deviations (SD) and
correlations among study variables (i.e. GNP per capita, Hofstede’s cultural dimensions,
Schwartz’s value dimensions, perceived enforcements of traffic laws, and driver behaviours)
are presented in Table 3.

Non-speeding violations factor had significant negative correlation with GDP per capita.
Among Hofstede’s cultural dimensions, non-speeding violations factor had a significant
positive correlation with power distance and a significant negative correlation with
individualism. Among Schwartz’s value dimensions non-speeding violations factor had
significant positive correlations with embeddedness and hierarchy and negative correlations
with affective autonomy, intellectual autonomy, and egalitarianism. Additionally, non-speeding violations had significant negative correlations with all of the five traffic law
enforcements. Speeding violations factor had significant positive correlations with speed enforcement and drink-driving enforcement.

3.2. Hierarchical regression analyses

In order to test the relationships between cultural variables, perceived law enforcements and driver behaviours, several hierarchical regression analyses were conducted. In all analyses, GDP per capita was entered in the first step as the control variable. It should be noted that all analyses were conducted for both the speeding violations and non-speeding violations factors separately.

3.2.1. The relationships between Hofstede’s cultural dimensions and driver behaviours

Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding violations factor and non-speeding violations factor). As shown in Table 4, GDP per capita was significantly and negatively related to non-speeding violations factor. After controlling for the effects of GDP per capita, only individualism was significantly and negatively associated with non-speeding violations factor.

3.2.2. The relationships between Schwartz’s value dimensions and driver behaviours

Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding violations factor and non-speeding violations factor). As presented in Table 5, GDP per capita was significantly and negatively related to non-speeding violations factor. After
controlling for GDP per capita, embeddedness and egalitarianism were significantly and positively related to non-speeding violations factor.

3.2.3. The relationships between perceived law enforcements and driver behaviours

Hierarchical regression analyses were conducted for each outcome variable (i.e. speeding violations factor and non-speeding violations factor). However, none of the results yielded significant results.

3.2.4. Additional analyses

de Winter and Dodou (2016) investigated the relationship between self-reported traffic violations and TFRs and reported strong correlations between non-speeding violations (i.e., Vangered, Vfollowing, Vrace, Vhorn and Vphone) and TFRs per registered vehicle. In order to test the mediating role of driver behaviours (i.e. speeding violations and non-speeding violations) on the relationship between culture and TFRs (taken from WHO, 2015), 12 bootstrap analyses with 1000 replications were conducted including Hofstede’s five cultural dimensions and Schwartz’s seven value dimensions. In all analyses, GDP per capita was controlled.

To investigate the relations and to identify the mediating paths, PROCESS macro Model 4 developed by Hayes (2013) was used. Model 4 allows testing the effects of multiple mediators and it does not assume a normal distribution to test the indirect effect. As suggested by Hayes (2013), all path coefficients represent unstandardized values to reduce Type-1 errors. Additionally, the PROCESS macro uses bootstrapping approach, which is
useful to control the effects of Type 1 error rates (Hayes, 2013). In previous versions of mediation analysis, such as Baron and Kenny (1986), there were causal steps approach which has to be satisfied to run the analysis. In PROCESS macro, the limitations of the causal steps approach are overcome and Hayes (2013) suggests that the indirect effect of X on Y through M(mediator) can be significant without an association between X and Y (for more details see Hayes, 2009; 2013). In the current study, first, multiple mediation model was used to test the indirect effects of Hofstede’s cultural dimensions on fatality rates through speeding and non-speeding violations. Second, the indirect effect of Schwartz’s cultural on TFR through speeding and non-speeding violations were tested. The results revealed only two significant indirect effects.

As shown in Figure 1, long-term orientation was significantly associated with TFRs ($B = -1.069$, SE = .497, $p = .039$) and the indirect effect of long-term orientation on TFRs through non-speeding violations was significant (indirect effect = -.273, SE = .234, CI = -1.082 to -.006).

As shown in Figure 2, embeddedness was significantly associated with non-speeding violations ($B=.101$, SE = .029, $p = .002$) and the indirect effect of embeddedness on TFRs through non-speeding violations was significant (indirect effect = 51.484, SE = 38.164, CI = 2.634 to 151.761).
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 (Gaygısiz, 2010; Solmazer et al., 2016), and as the number of non-speeding violations increased, the number of TFRs also increased (de Winter & Dodou,
Based on these findings, it might be suggested that individualism has a positive effect on road traffic safety by reducing number of violations. In addition to the hierarchical regression analysis, the mediating role of violations on the relationship between culture and TFRs were investigated. Among Hofstede’s cultural dimensions, only long-term orientation had an indirect effect on TFRs through non-speeding violations. The results suggested that as societies have higher long-term orientations, the number of non-speeding violations decreases, which in turn decrease TFRs. Hofstede (2001) discussed that societies with long-term orientation are good at putting effort to the future, and they give importance to savings and investments. It might be suggested that societies that value their future perceive rules as something to follow rather than violate. Solmazer et al. (2016) suggested that the relationship between long-term orientation and TFRs is mediated by speed, helmet and child restraint enforcements, and long-term orientation has positive effects on road traffic safety. In countries with long-term orientation, traffic law enforcements are perceived as high (Solmazer et al., 2016). Hence, it might be suggested that enforcements are efficient to avoid violations in societies where people focus on their future rather than past and present. Taking into consideration the results of the analyses about Hofstede’s dimensions, although the results were not significant for speeding violations, similar interpretations can be done for the positive effect of individualism and long-term orientation on road traffic safety.

Among Schwartz’s dimensions, embeddedness and egalitarianism had significant positive associations with non-speeding violations factor. This is unexpected, as societies high in egalitarianism perceive all people as equal and also care other people’s welfare (Schwartz, 2006). Previous studies suggested negative relationships between egalitarianism and TFRs (Gaygısız, 2010; Solmazer et al., 2016), which indicate the positive effect of egalitarianism on TFRs (Solmazer et al., 2016); however a similar inference cannot be made
for violations. It might be suggested that, in these countries, people do not perceive non-speeding violations as breaking rules, which might be harmful both for the self and others.

Although Hofstede (2001) and Schwartz (2006) have differences in their definitions, some of their concepts show similarities. To illustrate, individualism versus collectivism is about how people in a given society define their self-image (I versus we) and in societies with high embeddedness, people give importance to their social connections and identify themselves with their groups. Hence, it is not surprising to find a negative relationship between individualism and non-speeding violations and a positive relationship between embeddedness and non-speeding violations. Taken together, identifying the self with the group, which is about collective perspective might not be have positive influence on traffic safety.

In the additional analyses, the mediating role of violations on the relationship between Schwartz’s value dimensions and TFRs were also investigated, and results suggested an indirect effect of embeddedness on TFRs through the non-speeding violations factor. Embeddedness was also a cultural variable that has indirect effects on TFRs through some of the traffic law enforcements (Solmazer et al., 2016). In the present study, results suggested that societies high in embeddedness might not follow rules about non-speeding violations, which in turn increases TFRs. The findings did not yield significant results for speeding violations, which needs further exploration. Societies high in embeddedness give importance to identification with their social groups and show respect to traditions. In these countries, following the rules might not be a requirement and individuals might think rules are not the same for everyone (Gaygısız, 2010), which might explain the higher numbers of violations.

In the present study, Hofstede’s cultural dimensions and Schwartz’s values are treated separately since they measure culture with different frameworks. Schwartz’s values are about
guiding principles in life (Schwartz, 1994) and Hofstede’s cultural dimensions are about the shared meanings, rituals, norms and traditions (Hofstede, 2001). When their relationships with violations are examined, none of them have significant relationships with speeding violations. Among Hofstede’s five cultural dimensions, only individualism and among Schwartz’s values only egalitarianism and embeddedness have significant relationships with non-speeding violations. Hence, it might not be possible to conclude that one of them is better than the other to explain violations in driving context. Ng, Lee, and Soutar (2007) claimed that, Schwartz’s values might be superior to Hofstede’s cultural dimensions (based on analysis of cultural distance) in trade context; but it might show differences in different contexts (e.g. traffic context). Additionally, they suggested that two cultural frameworks are not congruent. However, considering the significant relationships in the current study, it might not be possible to claim whether these two frameworks are congruent or not in traffic context.

Overall, the results were significant only for non-speeding violations factor, and, the results for the speeding violations factor did not yield significant results. Although Hofstede (2001) suggested a significant relationship between uncertainty avoidance and speed limits, the results of the present study did not reveal significant results for speeding violations. de Winter and Dodou (2016) stated that the developmental status of countries is related to non-speeding violations but not with speeding violations. The results of the factor analysis suggested that non-speeding and speeding are two distinct types of violations, and hierarchical regression analyses results supported that these two types of violations have different associations with other study variables. Excessive speed and inappropriate speed can be considered as one of the most important road safety problems in majority of countries. Additionally, speed accounts for one third of accidents with fatalities and also affects the severity of accidents (OECD, 2006). It can be claimed that speeding has direct effects on the
severity of accidents and that it is a main cause of accidents, whereas non-speeding violations might be secondary factors related with accidents. To illustrate, speeding in Vresident and Vmotorways might directly cause accidents; and Vphone, Vfollowing, Vhorn, Vangered, and Vrace might cause distraction while driving, and distracted driving is also an important cause of accidents; however, speed has a strong relationship with severity of accidents. The risk of fatality of a pedestrian is less than 20% when a car crashes at 50 km/h, whereas it increases to 60% when the speed of a car is 80 km/h (WHO, 2016). Although speeding has direct associations with the severity of accidents and is considered as one of the main causes of accidents, the results did not revealed significant associations between culture, enforcements or speeding. The possible explanation might be the differences in speed limits between countries. de Winter and Dodou (2016) argued that, speed limits must exist to violate; and if there are limits, drivers have to be aware of it. The violations and enforcements about speeding need more research to understand whether the underlying factors of speeding are based on personal choices rather than cultural effects.

It has been argued that lowering the speed limit saves lives; however, if drivers perceived the speed limit as low, this may cause an increase in speed variances, which in turn will cause more road traffic accidents (McCarthy, 2001). Culture might also affect perceived acceptable speed limits of individuals in a society. In addition to road type and design, the reasons of drivers’ speeding behaviours should also be considered in setting new speed limits. For instance, drivers might feel safer due to developments in technology and road design, but the changes in drivers’ risk perceptions might cause speeding. Drivers also tend to exceed speed limit by observing other drivers’ attitudes in traffic (Haglund & Aberg, 2000). Enforcement intensification might reduce this belief and decrease the number of drivers who exceed speed limits.
The present study has some methodological limitations. Culture is a broad and a complex term, which makes it difficult to measure. Hofstede (2001) and Schwartz (2006) provided one of the most comprehensive definitions and measured culture by using different dimensions. Although there are criticisms about compressing culture into a few dimensions (Holden, 2004), and about face, convergent and discriminant validity of Hofstede’s framework (e.g. Venaik & Brewer, 2016; Ng et al., 2007), these two frameworks are widely used. Hofstede collected data from IBM employees whereas Schwartz collected data from teachers and students. Hence, the sample representativeness of these two frameworks are different from each other (Ng et al., 2007), which might be considered as a limitation. It should be noted that, findings of the present study, which used aggregated level data (i.e., at the national level), should not be used to evaluate individual level causal effects, to prevent the ecological fallacy (Hofstede, 2001, p. 16). Traffic law enforcements that were included in the study reflect subjective judgments since they are based on experts’ evaluations. Hence, they are not measured with objective measures and might include some biases. As Solmazer et al. (2016) suggested, additional studies need to be conducted to test the representativeness of the data. Instead of perceived enforcement of speed laws, data relying on observational studies might be more objective. Additionally, the road traffic fatality rates do not represent exact numbers; but based on estimations (WHO, 2015b). Lastly, the findings should be interpreted with caution because of the relatively small sample size. Although the present study has some limitations, it is the first research that investigated the relationship between cultural variables and violations among countries.

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REFERENCES


### Table 1. DBQ Items included in the analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Question in the survey/ Items in the factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vangered</td>
<td>How often do you do the following?: Becoming angered by a particular type of driver, and indicate your hostility by whatever means you can.</td>
</tr>
<tr>
<td>Vmotorway</td>
<td>How often do you do the following? Disregarding the speed limit on a motorway.</td>
</tr>
<tr>
<td>Vresident</td>
<td>How often do you do the following? Disregarding the speed limit on a residential road.</td>
</tr>
<tr>
<td>Vfollowing</td>
<td>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.</td>
</tr>
<tr>
<td>Vrace</td>
<td>How often do you do the following? Racing away from traffic lights with the intention of beating the driver next to you.</td>
</tr>
<tr>
<td>Vhorn</td>
<td>How often do you do the following? Sounding your horn to indicate your annoyance with another road user.</td>
</tr>
<tr>
<td>Vphone</td>
<td>How often do you do the following? Using a mobile phone without a hands free kit.</td>
</tr>
<tr>
<td>Speed</td>
<td>Vresident, Vmotorway</td>
</tr>
<tr>
<td>Non-speed</td>
<td>Vphone, Vrace, Vhorn, Vangered, Vfollowing</td>
</tr>
</tbody>
</table>

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)
|   | 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 | -.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  | 5.5   | .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  | -.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” | -.02 | -.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)

<table>
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<tr>
<th>Dependent Variable</th>
<th>Step</th>
<th>Independent variables</th>
<th>$R^2$</th>
<th>Adj $R^2$</th>
<th>$R^2$ change</th>
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*<p.05; **p<.01; ***p<.001
Table 4. Hierarchical regression analyses (Schwartz’s value dimensions and non-speeding violations)

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*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