

# Cross-cultural differences in driver aggression, aberrant, and positive driver behaviors

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## A B S T R A C T

The present study investigated differences in driver aggression for self and others within countries and cultural differences between driver aggression, aberrant, and positive driver behaviors across five countries (Estonia, Greece, Kosovo, Russia, and Turkey). It was pre-dicted that drivers from these five countries differ significantly in terms of driver aggression for self and others, aberrant, and positive driver behaviors. In the study, 743 participants completed the questionnaire package, including the Driver Aggression Indicators Scale (DAIS), the short version of the Driver Behavior Questionnaire (DBQ) with items from the Positive Driver Behavior Scale, and the Demographic Information Form. Paired samples T-tests were conducted to examine the differences in driving aggression between self and others in the five countries. The results indicated that, except for Russian drivers, drivers reported that other drivers had higher driver aggression than themselves. To examine the cross-cultural differences, analysis of covariance (ANCOVA) tests were conducted for the two dimensions of the DAIS (hostile aggression and revenge, and aggressive warnings) and the three dimensions of the DBQ with items from the Positive Driver Behavior Scale (errors, violations, and positive driver behaviors). Cross-country item-based comparisons were then made for the DAIS and the DBQ. The ANCOVA results showed significant differences in both item-based and subscale comparisons. Russian drivers were significantly different from other drivers in terms of hostile aggression and the revenge subscales of the DAIS and positive driver behaviors. Turkish drivers were significantly different from other drivers in several items of the DBQ, including errors and violations. The findings suggest that culture-specific strategies might be conducted for traffic-related anger management. Furthermore, differences in errors and violations among the five countries may be due to cultural differences. Positive driver behaviors might be better promoted in countries by drawing on their distinct cultural road safety strategies.

### Keywords:

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## 1. Introduction

Each year, 1.35 million people die in road traffic accidents worldwide, which remains intolerably high (WHO, 2018). Human factors account for 90% of traffic accidents (Evans, 2004; Lewin, 1982; Rumar, 1985), with two main problems creating a global problem for road safety. The first significant problem for the last forty years has been driver aggression (e.g. Parry, 1968; Whitlock, 1971), which has become a worldwide problem in the last two decades (Sârbescu, Stanojević, & Jovanović, 2014). Driver aggression is associated with traffic violations (Novaco, 1991) and traffic collisions (Matthews, Dorn, & Glendon, 1991), making it a danger for all road users, whether directly or indirectly (Hennessy & Wiesenthal, 2001). The second main road safety issue due to human factors is aberrant driving behaviors (Zhang, Chan, & Zhang, 2015). While these two issues create global problems for road safety, Özkan and Lajunen (2005) describe another universal type: “positive driver behaviors”. These involve helping and being kind to other road users while driving.

According to the accident statistics from the *Global Status Report on Road Safety* (WHO, 2018), 6.1 of Estonian, 9.2 of Greek, 18 of Russian, and 12.3 of Turkish people died per 100,000 people because of traffic accidents in 2016 while the National Police of Kosovo database indicated that 129 Kosovars died in traffic accidents in 2015 (Ramadani et al., 2017). Özkan, Lajunen, Parker, Sümer, and Summala (2010) argue that different road death rates between countries may reflect national differences in drivers' aggressive behaviors. Similarly, Warner and Åberg (2014) point out that aberrant driving behaviors may be evaluated differently between countries. Driver aggression is defined as intentional driving behaviors that aim to harm other road users (Lajunen, Parker, & Stradling, 1998, p.108). Conversely, positive driver behaviors are related to being intentionally “helpful” and “polite” (Özkan & Lajunen, 2005). Positive driver behaviors, which can be considered as a mirror image of driver aggression, deserve more emphasis in cross-cultural studies.

Since road deaths vary across cultures, the effects of driver behaviors should be examined through cross-cultural comparisons. According to Shinar (2017), differences in driving styles from different countries should be expected due to large cultural variations. The present study mainly focused on cross-cultural comparisons in driver aggression, aberrant, and positive driver behaviors across five countries (Estonia, Greece, Kosovo, Russia, and Turkey) to understand the possible effects of cross-cultural differences on driver behaviors.

### 1.1. Driver aggression

Lajunen et al. (1998, p.108) define driver aggression as “any form of driving behavior that is intended to injure or harm other road users physically or psychologically”. Dula and Geller (2003) note that this may be expressed physically or emotionally against any road user. Aggressive driving includes several behaviors against other road users, such as harming, threatening, dominating, or expressing annoyance (Deffenbacher, Richards, & Lynch, 2004). These behaviors may extend from low to high levels of aggressiveness (Özkan et al., 2010). For instance, flashing lights or honking are less aggressive forms whereas physical attacks or ramming another car are more serious forms of aggressiveness (Özkan et al., 2010).

Another issue related to driver aggression concerns perceptions of other drivers' aggressive behaviors. Vallieres, Bergeron, and Vallerand (2005) report that drivers engage in more aggressive driving behaviors when they perceive that other drivers are aggressive. Furthermore, when other drivers are perceived as having aggressive intentions, drivers tend to make significant and negative attributions regarding their behavior (O'Brien, Shaw, Lennon, & Watson, 2012). Møller and Haustein (2018) found that drivers interpret the underlying reasons for behaviors depending on who performs them. They also found that most participants evaluate themselves as victims of road anger rather than aggressors. While explaining their own behaviors in relation to situational factors, they attribute other drivers' aggressive behaviors to a “lack of ability to control their anger”. One of the aims of the present study is thus to compare how drivers in five countries evaluate themselves in terms of driver aggression and how they perceive other drivers' aggression. Driver aggression against other drivers may depend on culture-specific factors. Hence the current study also aims to investigate how driver aggression varies across five countries (Estonia, Greece, Kosovo, Russia, and Turkey).

### 1.2. Aberrant and positive driver behaviors

In the road safety literature, the common tool to measure aberrant driving behaviors is the Driver Behavior Questionnaire (DBQ), which has good construct and predictive validity (Reason, Manstead, Stradling, Baxter, & Campbell, 1990; De Winter & Dodou, 2010). The DBQ is based on the distinction between errors and violations, which are assumed to have ‘different psychological origins’ that require ‘different modes of remediation’ (Reason et al., 1990). Deliberate and deviant driving behaviors are termed violations whereas errors are unintentional behaviors related to drivers' cognitive capacity or deficiencies measured by the DBQ (Özkan & Lajunen, 2005).

The DBQ has become a popular measurement tool across cultures (De Winter & Dodou, 2010), with several studies indicating cross-cultural differences between errors and violations (Lajunen, Parker, & Summala, 2004; Özkan, Lajunen, Chliaoutakis, Parker, & Summala, 2006; Üzümcüoğlu, Özkan, Wu, & Zhang, 2019). For instance, Warner, Özkan, Lajunen, and Tzamalouka (2011) found that Turkish and Iranian drivers committed errors more frequently than Finnish, British, and Dutch drivers.

Apart from aberrant and aggressive driving behaviors, other driving behaviors cannot be categorized as errors or violations (Özkan & Lajunen, 2005). These behaviors have been investigated as 'positive driver behaviors' (Özkan & Lajunen, 2005). These include several behavior types, such as taking care of the traffic environment and other road users, and being polite and helpful to others independently of safety (Özkan & Lajunen, 2005). Moreover, these positive behaviors can improve the country's traffic climate and driving environment. Özkan and Lajunen (2005) found that driver aggression and positive behaviors are negatively correlated in Turkey, while positive driver behaviors are negatively related to errors and violations. Several studies have shown that positive driving behaviors help to smooth driving (Adell et al., 2011). Patient and careful drivers tend to drive safely and are less likely to be involved in accidents (Poó, Taubman-Ben-Ari, Ledesma, & Díaz-Lázaro, 2013). In contrast, errors and violations are significant predictors of accident involvement (De Winter & Dodou, 2010). Aberrant and positive driver behaviors can be observed simultaneously in traffic situations (Shen, Qu, Ge, Sun, & Zhang, 2018). To create safer traffic systems, it is necessary to understand driver behaviors (Kaçan et al., 2019), specifically by examining errors, violations, and positive behaviors in a cultural context. The present study therefore aims to examine cross-cultural differences in terms of aberrant and positive driver behaviors.

### 1.3. The objectives of the present study

The present study included two objectives. The first was to investigate differences between driver aggression by oneself and others within each country through item-based comparisons of DAIS responses. The other objective was to make a cross-cultural comparison of the five countries (Estonia, Greece, Kosovo, Russia, and Turkey) in terms of driver aggression, aberrant driving behaviors, and positive driver behaviors.

## 2. Method

### 2.1. Participants and procedure

The questionnaire package was completed by 743 participants from the five different countries as part of a project named Traffic Safety Culture (TraSaCu), funded by the European Union Horizon 2020 Research and Innovation Program. The project aimed to contribute to a cultural approach towards "road traffic safety research and accident prevention" (TraSaCu, 2015a, 2015b). Data collection involved several steps. Firstly, ethical permission for the questionnaire package was taken from Middle East Technical University Ethics Committee. Then, the responsible members for each partner country translated the questionnaire package into the local language (Estonian, Greek, Albanian, Russian, and Turkish respectively). After translation, each responsible member distributed the local language version of the questionnaire package using an online survey program named Qualtrics that provided a unique link for each language version. Finally, participants were asked to complete the surveys, which comprised the DAIS, a short version of the DBQ, the PDBS (Positive Driver Behavior Scale), and a demographic information form for age, gender, and driving record. Participants had to meet several inclusion criteria, specifically having a driving license and being an active driver. Participants were gained informed consent and assured about the anonymity and confidentiality of their responses. Table 1 shows the demographic characteristics for the overall and country samples.

### 2.2. Measures

#### 2.2.1. Driver aggression Indicators scale (DAIS)

The DAIS, developed by Lajunen and Parker (2001) in English, was first used by Rämets (2003) in Finnish. The scale measures the reported frequency of specific driver aggression behaviors and the reported frequency of their exposure to the same

**Table 1**  
Participants' demographic characteristics.

Variables	Total	EST	GR	KS	RU	TR
<i>N</i>	743	120	285	113	135	90
Female	253 (34.1%)	57 (47.5%)	112 (39.3%)	25 (22.1%)	21 (15.6%)	37 (41.1%)
Male	490 (65.9%)	63 (52.5%)	173 (60.7%)	88 (77.9%)	114 (84.4%)	53 (58.9%)
<i>Age (years)</i>						
SD	13.45	13.64	10.18	11.66	6.04	8.55
Mean	36.6	47.68	42.18	35.95	22.4	27.22
Min-Max	17–76	24–76	18–72	18–72	17–50	20–64
<i>Traveling frequency in a week (day)</i>						
SD	1.08	1.01	0.87	1.08	1.81	1.17
Mean	4.33	4.08	4.45	4.20	4.85	3.70

Note. EST = Estonia, GR = Greece, KS = Kosovo, RU = Russia, TR = Turkey.

behaviors by other drivers. Thus, participants complete the survey twice to measure the frequency of their own aggressive behaviors and other drivers' aggressive behaviors against them. The 13 items fall into two subscales: hostile aggression and revenge (HAR) (9 items) and aggressive warnings (AW) (4 items). Responses to each statement are made using a 5-point Likert-type scale from 1 (never) to 5 (nearly all the time). Extremely aggressive behaviors associated with HAR include physical threats whereas AW includes aggressive warning actions like hand gestures. The two-dimensional structure of the DAIS was validated by [Özkan and Lajunen \(2004\)](#) as part of a project named "Culture, Safety Culture, Safety Culture in Turkey and Europe". This factor structure was also used in the present study.

### 2.2.2. Driver behavior questionnaire (DBQ) and positive driver behavior scale (PDBS)

The DBQ was developed to assess aberrant driver behaviors by [Reason et al. \(1990\)](#) by measuring violations (deliberate deviant behaviors) and errors (unwilled deficiencies with regard to cognitive capacity or psychomotor skills of the driver) ([Özkan & Lajunen, 2005](#)). Responses are made on a 6-point Likert-type scale from 1 (never) to 6 (always). [Özkan and Lajunen \(2005\)](#) developed the PDBS to measure the frequency of behaviors related to "taking care of smooth traffic flow or paying attention to other road users". Responses are made on a 6-point Likert-type scale (1 = never, 6 = always). For the TraSaCu project, 19 items were used from the two scales, based on the Mini DBQ ([Martinussen, Lajunen, Møller, & Özkan, 2013](#)). These were the items that members of the partner countries found most representative of aberrant and positive driver behaviors. There were 8 items from the error subscale, 7 items from the violations subscale, and 4 items from the PDBS.

### 2.3. Statistical analyses

To determine whether the mean scores from the DAIS for self and other differed significantly, paired samples T-tests were conducted for the participants from the five countries. A series of ANCOVA were then conducted for the total DAIS (13 items for self and other) and the two subscales (HAR and AW), the 15 DBQ items (for errors and violations), and the 4 items from the PDBS. This enabled differences between driver behavior in the five countries to be examined while controlling for age, gender, and frequency of traveling as a driver in a passenger car. To compare the ANCOVA results across countries, Bonferroni Correction was used. The alpha level was computed as 0.005 by dividing the significance level (0.05) into the comparison number (10) ([Weisstein, 2018](#)).

## 3. Results

### 3.1. Comparison of self and other drivers in terms of DAIS items within each country

The paired DIAS variables for aggression by self versus others were analyzed by paired samples T-tests. [Table 2](#) presents the cross-country differences in evaluations of self and other drivers' aggression. For both Greek and Turkish drivers, there were significant differences between self and other for all items. For Estonian drivers, there were significant differences between responses for self and other for all items except "Physically attacked" and "Threatened physically". For Kosovar drivers, all differences were significant except for "Hugged the rear bumper". Russian drivers showed a significant difference between self and other only for "Cut in", "Hugged the rear bumper", and "Prevented or obstructed maneuvering the vehicle".

### 3.2. Comparison of DAIS items and subscales for evaluating self and other drivers between the five countries

The ANCOVA results indicated that item 10 ("Hugged the rear bumper") and item 13 ("Sounded horn") had medium effect sizes (see [Table 3](#)). Russian drivers had significantly higher scores than the other countries' drivers on item 6 ("Physically attacked"), item 9 ("Threatened physically"), and item 10 ("Hugged the rear bumper"). The ANCOVA results also showed that item 13 ("Sounded horn") was the only one with a large effect size. There were significant differences between countries on 13 items (see [Table 4](#)). Russian drivers had a significantly lower score on item 1 ("Cut in"). The AW subscale was the only one with a large effect size when evaluating other drivers. For the HAR subscale, Russian drivers differed significantly from drivers in all other countries Turkey. There was also a significant difference between Estonian and Greek drivers on the AW subscale. There was a significant difference between Estonian and Russian drivers in terms of perceiving other drivers as engaging in aggressive warning acts, they were significantly different from Greek, Kosovar, and Turkish drivers (see [Table 5](#)).

### 3.3. Comparison of DBQ and PDBS items, and three subscales between the five countries

The item-based comparisons indicated that item 5 ("Attempt to drive away from the traffic lights in third gear") had the highest Eta square, with Estonian, Russian, and Turkish drivers being significantly different from Greek and Kosovar drivers. Turkish drivers had significantly higher scores than other drivers for item 8 ("Forget where you left your car in a car park"), item 9 ("Overtake a slow driver on the inside"), and item 13 ("Become angered by a certain type of driver and indicate your hostility by whatever means you can"). Russian drivers had significantly lower scores than other drivers on item 18 ("When parking your car, take into account other road users' needs for space") and item 19 ("Pay attention to a puddle not to splash

**Table 2**

Comparison of self and other in terms of DAIS items within the five countries.

	Estonia			Greece			Kosovo			Russia			Turkey		
	Self M (SD)	Other M (SD)	t (df)	Self M (SD)	Other M (SD)	t (df)	Self M (SD)	Other M (SD)	t (df)	Self M (SD)	Other M (SD)	t (df)	Self M (SD)	Other M (SD)	t (df)
1.Cut in	2.29 (0.68)	3.59 (0.79)	-15.60 (119)**	1.96 (0.76)	3.47 (0.95)	-22.06 (284)**	1.89 (0.56)	3.50 (1.01)	-15.99 (112)**	1.90 (0.92)	2.38 (1.18)	-4.35 (1 3 4)**	1.68 (0.89)	3.02 (1.27)	-9.81 (89)**
2.Swore/verbally abused	1.59 (0.73)	1.87 (0.76)	-4.11 (119)**	1.93 (0.88)	2.81 (0.92)	-13.42 (284)**	1.56 (8.68)	2.51 (0.94)	-9.70 (112)**	2.06 (1.12)	2.04 (1.09)	0.14 (1 3 4)	2.11 (1.08)	2.71 (1.31)	-3.88 (89)**
3.Made a hand gesture	1.58 (0.67)	2.10 (0.68)	-7.30 (119)**	1.78 (0.85)	2.70 (1.01)	-13.79 (284)**	2.05 (0.86)	2.89 (0.91)	-8.32 (112)**	1.93 (1.02)	2.03 (1.10)	-1.05 (1 3 4)	2.09 (0.94)	3.07 (1.12)	-7.15 (89)**
4.Threatened verbally	1.13 (0.38)	1.31 (0.58)	-4.00 (119)**	1.35 (0.72)	2.29 (1.09)	-14.48 (284)**	1.35 (0.61)	2.07 (0.99)	-7.75 (112)**	1.64 (1.00)	1.60 (0.95)	0.46 (1 3 4)	1.33 (0.73)	2.13 (1.26)	-6.00 (89)**
5.Rammed a vehicle	1.02 (0.13)	1.08 (0.26)	-2.72 (1 1 9)*	1.09 (0.39)	1.28 (0.65)	-4.93 (284)**	1.33 (0.63)	1.83 (0.86)	-6.34 (112)**	1.48 (0.89)	1.42 (0.86)	0.82 (1 3 4)	1.19 (0.52)	1.56 (0.97)	-4.28 (89)**
6.Physically attacked	1.01 (0.09)	1.03 (0.16)	-1.00 (119)	1.09 (0.42)	1.27 (0.64)	-4.47 (284)**	1.12 (0.40)	1.24 (0.66)	-2.38 (112)*	1.44 (0.90)	1.53 (0.95)	-1.12 (1 3 4)	1.26 (0.55)	1.89 (1.12)	-6.15 (89)**
7.Chased	1.05 (0.22)	1.15 (0.38)	-2.76 (119)*	1.22 (0.53)	1.53 (0.73)	-6.94 (284)**	1.23 (0.66)	1.39 (0.75)	-1.97 (112)*	1.56 (1.00)	1.64 (1.08)	-0.92 (1 3 4)	1.54 (0.86)	2.13 (1.14)	-4.86 (89)**
8.Fashed lights	1.90 (0.75)	2.25 (0.70)	-5.00 (119)**	2.42 (0.94)	2.97 (0.90)	-7.77 (284)**	1.98 (0.95)	2.72 (0.92)	-7.81 (112)**	2.24 (1.12)	2.31 (1.12)	-0.76 (1 3 4)	2.76 (1.17)	3.47 (1.22)	-4.99 (89)**
9.Threatened physically	1.00 (0.00)	1.02 (0.13)	-1.42 (119)	1.09 (0.39)	1.33 (0.72)	-5.91 (284)**	1.16 (0.51)	1.40 (0.82)	-2.89 (112)*	1.47 (0.89)	1.55 (0.98)	-1.12 (1 3 4)	1.22 (0.56)	1.80 (1.12)	-4.98 (89)**
10.Hugged the rear bumper	1.29 (0.53)	2.05 (0.94)	-9.55 (119)**	1.15 (0.49)	1.44 (0.77)	-6.72 (284)**	1.23 (0.60)	1.35 (0.74)	-1.60 (112)	1.68 (0.96)	1.87 (1.08)	-1.96 (1 3 4)*	1.28 (0.62)	1.62 (1.01)	-3.44 (89)**
11.Prevented or obstructed from maneuvering the vehicle	1.23 (0.48)	1.61 (0.69)	-5.98 (119)**	1.31 (0.63)	1.91 (1.04)	-10.09 (284)**	1.39 (0.63)	2.00 (0.95)	-6.84 (1 1 2)**	1.64 (0.93)	1.92 (1.13)	-3.15 (1 3 4)*	1.61 (0.83)	2.54 (1.25)	-6.45 (89)**
12.Drove slowly in order to annoy the driver behind	1.14 (0.37)	1.55 (0.79)	-5.56 (119)**	1.47 (0.72)	2.36 (1.06)	-12.65 (284)**	1.37 (0.73)	2.33 (1.02)	-9.40 (112)**	1.62 (0.89)	1.81 (1.14)	-1.92 (1 3 4)	1.86 (1.06)	2.38 (1.28)	-3.27 (89)*
13.Sounded horn	1.87 (0.62)	2.18 (0.64)	-4.36 (119)**	2.29 (0.96)	3.23 (1.07)	-11.66 (284)**	2.42 (1.12)	3.26 (1.12)	-7.70 (112)**	2.12 (1.07)	2.27 (1.21)	-1.47 (1 3 4)	2.83 (1.03)	3.44 (1.11)	-4.23 (89)**

\*p &lt; .05, \*\* p &lt; .001.

**Table 3**

DAIS item means for self after controlling for age, gender, and frequency of traveling as a driver in a passenger car, and ANCOVA results in the five countries.

		Estonia	Greece	Kosovo	Russia	Turkey	F	$\eta_p^2$
1.	Cut in	2.39 <sup>a</sup>	2.01 <sup>b</sup>	1.90 <sup>bc</sup>	1.79 <sup>bc</sup>	1.55 <sup>c</sup>	9.29 <sup>***</sup>	0.05
2.	Swore/verbally abused	1.72 <sup>a</sup>	2.01 <sup>a</sup>	1.55 <sup>a</sup>	1.94 <sup>a</sup>	1.88 <sup>a</sup>	6.02 <sup>***</sup>	0.03
3.	Made a hand gesture	1.70 <sup>a</sup>	1.86 <sup>a</sup>	2.05 <sup>a</sup>	1.82 <sup>a</sup>	1.84 <sup>a</sup>	2.32	0.01
4.	Threatened verbally	1.16 <sup>a</sup>	1.39 <sup>abc</sup>	1.35 <sup>abc</sup>	1.63 <sup>b</sup>	1.19 <sup>ac</sup>	6.10 <sup>***</sup>	0.03
5.	Rammed a vehicle	1.04 <sup>a</sup>	1.12 <sup>ab</sup>	1.32 <sup>bc</sup>	1.45 <sup>c</sup>	1.12 <sup>ab</sup>	9.15 <sup>***</sup>	0.05
6.	Physically attacked	1.02 <sup>a</sup>	1.12 <sup>a</sup>	1.12 <sup>a</sup>	1.45 <sup>b</sup>	1.14 <sup>a</sup>	8.24 <sup>***</sup>	0.04
7.	Chased	1.11 <sup>a</sup>	1.26 <sup>ab</sup>	1.22 <sup>ab</sup>	1.53 <sup>b</sup>	1.39 <sup>ab</sup>	4.23 <sup>**</sup>	0.01
8.	Flashed lights	1.97 <sup>a</sup>	2.47 <sup>b</sup>	1.98 <sup>a</sup>	2.25 <sup>ab</sup>	2.51 <sup>ab</sup>	9.21 <sup>***</sup>	0.05
9.	Threatened physically	1.01 <sup>a</sup>	1.12 <sup>a</sup>	1.15 <sup>a</sup>	1.47 <sup>b</sup>	1.13 <sup>a</sup>	9.37 <sup>***</sup>	0.05
10.	Hugged the rear bumper	1.30 <sup>a</sup>	1.16 <sup>a</sup>	1.23 <sup>a</sup>	1.70 <sup>b</sup>	1.21 <sup>a</sup>	13.14 <sup>***</sup>	0.07
11.	Prevented or obstructed from maneuvering the vehicle	1.30 <sup>a</sup>	1.34 <sup>a</sup>	1.39 <sup>a</sup>	1.57 <sup>a</sup>	1.52 <sup>a</sup>	0.12	0.01
12.	Drove slowly in order to annoy the driver behind	1.16 <sup>a</sup>	1.49 <sup>bd</sup>	1.37 <sup>abc</sup>	1.59 <sup>bcd</sup>	1.84 <sup>d</sup>	7.49 <sup>***</sup>	0.04
13.	Sounded horn	1.92 <sup>a</sup>	2.32 <sup>bc</sup>	2.42 <sup>bc</sup>	2.03 <sup>ab</sup>	2.83 <sup>c</sup>	11.31 <sup>***</sup>	0.06

Note: Bonferroni correction was used for pairwise comparisons. Different superscripts within rows are statistically different at  $p < .005$  or better. \*\*\* $p < .001$ ; \*\* $p < .005$ .

**Table 4**

DAIS item means for other drivers after controlling for age, gender, and frequency of traveling as a driver in a passenger car, and ANCOVA results in the five countries.

		Estonia	Greece	Kosovo	Russia	Turkey	F	$\eta_p^2$
1.	Cut in	3.67 <sup>a</sup>	3.50 <sup>ab</sup>	3.50 <sup>ab</sup>	2.25 <sup>c</sup>	2.30 <sup>b</sup>	25.71 <sup>***</sup>	0.12
2.	Swore/verbally abused	1.91 <sup>a</sup>	2.84 <sup>b</sup>	2.51 <sup>bc</sup>	1.99 <sup>a</sup>	2.65 <sup>bc</sup>	27.22 <sup>***</sup>	0.13
3.	Made a hand gesture	2.16 <sup>a</sup>	2.71 <sup>b</sup>	2.90 <sup>b</sup>	1.95 <sup>a</sup>	3.10 <sup>b</sup>	25.66 <sup>***</sup>	0.12
4.	Threatened verbally	1.34 <sup>a</sup>	2.33 <sup>b</sup>	2.06 <sup>bc</sup>	1.60 <sup>ac</sup>	1.99 <sup>bc</sup>	25.42 <sup>***</sup>	0.12
5.	Rammed a vehicle	1.15 <sup>a</sup>	1.33 <sup>a</sup>	1.82 <sup>b</sup>	1.31 <sup>a</sup>	1.49 <sup>ab</sup>	13.94 <sup>***</sup>	0.07
6.	Physically attacked	1.14 <sup>a</sup>	1.34 <sup>ab</sup>	1.23 <sup>a</sup>	1.41 <sup>ab</sup>	1.69 <sup>b</sup>	5.25 <sup>***</sup>	0.03
7.	Chased	1.26 <sup>a</sup>	1.60 <sup>bc</sup>	1.38 <sup>ab</sup>	1.51 <sup>ab</sup>	2.00 <sup>c</sup>	9.17 <sup>***</sup>	0.05
8.	Flashed lights	2.34 <sup>ac</sup>	3.01 <sup>b</sup>	2.72 <sup>ab</sup>	2.21 <sup>c</sup>	3.36 <sup>b</sup>	26.98 <sup>***</sup>	0.13
9.	Threatened physically	1.14 <sup>a</sup>	1.41 <sup>a</sup>	1.39 <sup>a</sup>	1.43 <sup>a</sup>	1.57 <sup>a</sup>	3.2 <sup>**</sup>	0.02
10.	Hugged the rear bumper	2.11 <sup>a</sup>	1.47 <sup>bc</sup>	1.35 <sup>c</sup>	1.80 <sup>ab</sup>	1.56 <sup>abc</sup>	15.01 <sup>***</sup>	0.08
11.	Prevented or obstructed from maneuvering the vehicle	1.69 <sup>a</sup>	1.94 <sup>a</sup>	2.00 <sup>ab</sup>	1.78 <sup>a</sup>	2.53 <sup>b</sup>	7.22 <sup>***</sup>	0.04
12.	Drove slowly in order to annoy the driver behind	1.54 <sup>a</sup>	2.33 <sup>b</sup>	2.33 <sup>b</sup>	1.75 <sup>c</sup>	2.54 <sup>b</sup>	19.20 <sup>***</sup>	0.10
13.	Sounded horn	2.28 <sup>a</sup>	3.28 <sup>b</sup>	3.25 <sup>b</sup>	2.10 <sup>c</sup>	3.42 <sup>b</sup>	44.11 <sup>***</sup>	0.19

Note: Bonferroni correction was used for pairwise comparisons. Different superscripts within rows are statistically different at  $p < .005$  or better. \*\*\* $p < .001$ ; \*\* $p < .005$ .

**Table 5**

DAIS subscale means for self and other drivers after controlling for age, gender, and frequency of traveling as a driver in a passenger car, and ANCOVA results in the five countries.

	Estonia	Greece	Kosovo	Russia	Turkey	F	$\eta_p^2$
HAR (self)	1.28 <sup>a</sup>	1.34 <sup>a</sup>	1.34 <sup>a</sup>	1.58 <sup>b</sup>	1.34 <sup>ab</sup>	5.31 <sup>**</sup>	0.03
AW (self)	1.83 <sup>a</sup>	2.16 <sup>b</sup>	2.00 <sup>ab</sup>	2.01 <sup>ab</sup>	2.26 <sup>ab</sup>	6.41 <sup>***</sup>	0.03
HAR (other)	1.67 <sup>ac</sup>	1.92 <sup>bc</sup>	1.90 <sup>abc</sup>	1.65 <sup>c</sup>	2.04 <sup>ab</sup>	7.92 <sup>***</sup>	0.04
AW (other)	2.17 <sup>a</sup>	2.96 <sup>b</sup>	2.85 <sup>b</sup>	2.10 <sup>a</sup>	3.12 <sup>b</sup>	43.82 <sup>***</sup>	0.19

Note. HAR = Hostile Aggression and Revenge, AW = Aggressive Warnings; Bonferroni correction was used for pairwise comparisons. Different superscripts within rows are statistically different at  $p < .005$  or better. \*\*\* $p < .001$ ; \*\* $p < .005$ .

water on pedestrians or other road users"). These results are presented in Table 6. The ANCOVA results indicate that the PDBS had a medium effect size. Kosovar drivers differed significantly from Estonian, Greek, and Russian drivers in terms of errors while Turkish drivers differed significantly from Greek and Russian drivers on violation scores. Regarding positive driver behaviors, Russian drivers were significantly different from Estonian, Greek, and Turkish drivers (see Table 7).

#### 4. Discussion

This study examined the differences between self-reported perceptions of aggression by oneself and other drivers in five countries. It aimed to reveal cross-cultural differences in driver aggression (specifically, hostile aggression and revenge, and aggressive warnings), aberrant (specifically, errors and violations), and positive driver behaviors in Estonian, Greek, Kosovar, Russian, and Turkish drivers. As the first cross-cultural study to compare positive driver behaviors across countries, this is the first study to take a holistic approach to driver aggression, aberrant, and positive driver behaviors between countries.

**Table 6**

DBQ and the PDBS item means after controlling for age, gender, and frequency of traveling as a driver in a passenger car, and ANCOVA results in the five countries.

	Estonia	Greece	Kosovo	Russia	Turkey	<i>F</i>	$\eta_p^2$
1. Get into the wrong lane approaching a roundabout or a junction	1.94 <sup>a</sup>	1.65 <sup>b</sup>	1.83 <sup>ab</sup>	1.81 <sup>ab</sup>	2.10 <sup>a</sup>	5.86 <sup>***</sup>	0.03
2. Fail to notice that pedestrians are crossing when turning into a side street from the main road	1.58 <sup>a</sup>	1.69 <sup>a</sup>	1.94 <sup>a</sup>	1.66 <sup>a</sup>	1.82 <sup>a</sup>	3.08 <sup>**</sup>	0.02
3. Sound your horn to indicate your annoyance to another road user	1.91 <sup>a</sup>	2.34 <sup>bc</sup>	2.57 <sup>bc</sup>	2.14 <sup>ab</sup>	2.83 <sup>c</sup>	9.44 <sup>***</sup>	0.05
4. Miss "Give Way" signs, and narrowly avoid colliding with traffic having right of way	1.22 <sup>a</sup>	1.41 <sup>ab</sup>	1.77 <sup>c</sup>	1.42 <sup>ab</sup>	1.77 <sup>bc</sup>	10.31 <sup>***</sup>	0.05
5. Attempt to drive away from the traffic lights in third gear	1.29 <sup>a</sup>	2.10 <sup>b</sup>	1.92 <sup>b</sup>	1.20 <sup>a</sup>	1.33 <sup>a</sup>	27.83 <sup>***</sup>	0.13
6. Attempt to overtake someone that you hadn't noticed to be signaling a left turn	1.10 <sup>a</sup>	1.33 <sup>ab</sup>	1.56 <sup>b</sup>	1.42 <sup>ab</sup>	1.55 <sup>b</sup>	7.16 <sup>***</sup>	0.04
7. Become angered by another driver and give chase with the intention of giving him/her a piece of your mind	1.14 <sup>a</sup>	1.31 <sup>ab</sup>	1.61 <sup>b</sup>	1.65 <sup>b</sup>	1.49 <sup>ab</sup>	6.62 <sup>***</sup>	0.04
8. Forget where you left your car in a car park	1.85 <sup>a</sup>	1.73 <sup>a</sup>	1.70 <sup>a</sup>	1.57 <sup>a</sup>	2.49 <sup>b</sup>	12.45 <sup>***</sup>	0.06
9. Overtake a slow driver on the inside	1.66 <sup>a</sup>	1.98 <sup>a</sup>	1.94 <sup>a</sup>	1.61 <sup>a</sup>	2.69 <sup>b</sup>	13.65 <sup>***</sup>	0.07
10. Race away from traffic lights with the intention of beating the driver next to you	1.93 <sup>a</sup>	1.34 <sup>b</sup>	1.35 <sup>b</sup>	1.83 <sup>a</sup>	1.72 <sup>ab</sup>	15.08 <sup>***</sup>	0.08
11. Misread the signs and exit from a roundabout on the wrong road	1.75 <sup>a</sup>	1.47 <sup>a</sup>	1.54 <sup>a</sup>	1.41 <sup>a</sup>	1.59 <sup>a</sup>	3.57 <sup>**</sup>	0.02
12. Cross a junction knowing that the traffic lights have already turned against you	1.86 <sup>a</sup>	1.22 <sup>b</sup>	1.42 <sup>bc</sup>	1.52 <sup>ab</sup>	1.81 <sup>ac</sup>	20.24 <sup>***</sup>	0.10
13. Become angered by a certain type of driver and indicate your hostility by whatever means you can	1.38 <sup>a</sup>	1.73 <sup>a</sup>	1.80 <sup>a</sup>	1.63 <sup>a</sup>	2.42 <sup>b</sup>	12.49 <sup>***</sup>	0.06
14. Underestimate the speed on an oncoming vehicle when overtaking	1.56 <sup>a</sup>	1.51 <sup>a</sup>	2.06 <sup>b</sup>	1.77 <sup>ab</sup>	1.86 <sup>ab</sup>	9.14 <sup>***</sup>	0.05
15. Disregard the speed limit on a motorway	2.89 <sup>a</sup>	2.68 <sup>a</sup>	2.95 <sup>a</sup>	1.93 <sup>b</sup>	1.89 <sup>b</sup>	12.21 <sup>***</sup>	0.06
16. Try to use your high beams less frequently so you don't disturb the oncoming drivers	4.12 <sup>a</sup>	4.97 <sup>b</sup>	4.32 <sup>abc</sup>	4.08 <sup>a</sup>	5.08 <sup>bc</sup>	11.48 <sup>***</sup>	0.06
17. Avoid close following not to disturb the car driver in front	4.76 <sup>a</sup>	4.97 <sup>a</sup>	4.39 <sup>ab</sup>	3.85 <sup>b</sup>	5.15 <sup>a</sup>	12.74 <sup>***</sup>	0.07
18. When parking your car, take into account other road users' needs for space	5.37 <sup>a</sup>	5.37 <sup>a</sup>	4.99 <sup>a</sup>	4.52 <sup>b</sup>	5.25 <sup>a</sup>	7.87 <sup>***</sup>	0.04
19. Pay attention to a puddle not to splash water on pedestrians or other road users	5.25 <sup>a</sup>	5.30 <sup>a</sup>	5.33 <sup>a</sup>	4.51 <sup>b</sup>	5.22 <sup>a</sup>	7.67 <sup>***</sup>	0.04

Note: Bonferroni correction was used for pairwise comparisons. Different superscripts within rows are statistically different at  $p < .005$  or better. \*\*\* $p < .001$ ; \*\* $p < .005$ .

**Table 7**

DBQ subscale means after controlling for age, gender, and frequency of traveling as a driver in a passenger car, and ANCOVA results in the five countries.

	Estonia	Greece	Kosovo	Russia	Turkey	<i>F</i>	$\eta_p^2$
ER	1.54 <sup>ac</sup>	1.61 <sup>ac</sup>	1.79 <sup>b</sup>	1.53 <sup>a</sup>	1.82 <sup>cb</sup>	8.21 <sup>***</sup>	0.04
VIO	1.82 <sup>ab</sup>	1.80 <sup>a</sup>	1.95 <sup>ab</sup>	1.76 <sup>a</sup>	2.12 <sup>b</sup>	5.25 <sup>***</sup>	0.03
PB	4.87 <sup>a</sup>	5.15 <sup>a</sup>	4.76 <sup>ab</sup>	4.24 <sup>b</sup>	5.18 <sup>a</sup>	14.02 <sup>***</sup>	0.07

Note: ER = Errors, VIO = Violations, PB = Positive Behaviors; Bonferroni correction was used for pairwise comparisons. Different superscripts within rows are statistically different at  $p < .005$  or better. \*\*\* $p < .001$ ; \*\* $p < .005$ .

Drivers from the five countries were compared individually for reported aggression by self and others using paired samples T-tests. The results indicated that drivers evaluated themselves as being less aggressive than other drivers in all countries except for Russian drivers. Related to this, an EOS Gallup (2003) survey of drivers in 23 countries indicated that 65 percent of Russian drivers reported being "the subject of aggressive behaviors from other drivers". This might explain the higher level of aggression reported by Russian drivers in the present study.

Attribution theory, specifically the causal attributional model of social conduct, can help explain this difference in perceived self and other driver aggression. According to [Weiner \(1986, 1995\)](#), responsibility for a behavior is more attributed to "the other" when "the other" is perceived to have more control over the situation. Thus, drivers may evaluate other drivers as more aggressive than themselves. Regarding the lack of difference reported by Russian drivers, cultural factors in traffic contexts should be examined. Russian drivers may think that they have more responsibility on the road. Their perspectives could be further investigated by semi-structured interviews. Greek and Turkish drivers reported being less aggressive than other drivers for all DAIS items. [Warner et al. \(2011\)](#) suggest that high congestion and absence of lane markings in wide roads can create a chaotic traffic environment. Such an environment may in turn make drivers evaluate other drivers as being more aggressive instead of taking more responsibility themselves.

To identify the differences in driver aggression, aberrant, and positive driver behaviors between the five countries, ANCOVA was used after controlling for age, gender, and frequency of traveling as a driver in a passenger car. [Zhang, Qu, Ge, Sun, and Zhang \(2017\)](#) report that age influences driving behaviors while many studies have found a negative correlation between age and aggressive driving ([Dahlen & White, 2006](#); [Krahé, 2005](#); [Krahé and Fenske, 2002](#); [Perepjolkina and Reñge, 2011](#); [Wickens, Mann, Stoduto, Ialomiteanu, & Smart, 2011](#)). Similarly, [Wickens et al. \(2012\)](#) argue that gender is an impor-

tant factor to understand driver anger and aggression. Several studies have found that male drivers engage in riskier driving behaviors, have more driving violations, receive more traffic tickets, and are involved in more collisions than female drivers (Åberg & Rimmo, 1998; Arnett, Offer, & Fine, 1997; Blockey & Hartley, 1995; Lawton, Parker, Manstead, & Stradling, 1997; Parker, Reason, Manstead, & Stradling, 1995). Finally, weekly traveling frequency was included since exposure to different traffic conditions may lead to feeling more control over the vehicle, which could in turn lead to underestimating risky driving behaviors (Elander, West, & French, 1993).

Regarding the drivers' own aggression, the ANCOVA results revealed significant differences across countries for particular DAIS items. Specifically, Russian drivers had significantly higher scores than drivers in the other four countries for item 6 ("Physically attacked"), item 9 ("Threatened physically"), and item 10 ("Hugged the rear bumper"). Regarding other drivers' aggression, the ANCOVA results revealed several differences for specific DAIS items. However, drivers from different countries did not differ on item 9 ("Threatened physically"). Regarding the DAIS subscales, the ANCOVA results showed that countries differed concerning aggressive driving. The aggressive warnings subscale had the largest effect size for evaluating other drivers.

In general, Turkish drivers showed more aggressive driving behaviors than those in the other countries, such as for "Sounded horn" when evaluating themselves and other drivers. However, Lajunen et al. (2004) suggest that driving behaviors may be interpreted differently in different cultures. For instance, hooting is associated with aggression in Scandinavia whereas it may give different messages in other countries, such as "thanking other drivers" in Southern Europe and Iran (Özkan et al., 2006). Turkish drivers also had the highest scores for the three DAIS subscales when evaluating other drivers. Özkan, Lajunen, Parker, Sümer, and Summala (2011) argue that conflicts in interpersonal relationships and production of anger are the main factors among Turkish drivers. Furthermore, Özkan et al. (2011) relate the expression of aggression towards other drivers to traffic culture norms in Turkey, based on Turkish drivers' common knowledge about aggressive driving. For instance, they may associate police supervision with not obeying traffic rules rather than aggressive driving (Özkan et al., 2011).

The ANCOVA results for the DBQ and the PDBS items revealed several differences between the countries regarding errors, violations, and positive behaviors. Specifically, Estonian, Russian, and Turkish drivers had significantly lower scores than Greek and Kosovar drivers on item 5 ("Attempt to drive away from the traffic lights in third gear"). While this may reflect different car types, the present study did not collect data on this. Turkey had the highest score for "Forget where you left your car in a car park". According to Global Health Observatory data for Road Safety (WHO, 2015a), there has been a 16% increase in registered vehicles between 2010 and 2013. In Turkey, there were 17,939,447 registered vehicles in 2013 (WHO, 2015b), which may be why so many drivers forget where they parked their car. Turkey also had the highest scores for "Overtake a slow driver on the inside" and "Become angered by a certain type of driver and indicate your hostility by whatever means you can". Along with the findings for driving anger, these results indicate that interventions should focus on decreasing aggressive driving in Turkey.

Kosovar drivers had higher error scores than Estonian, Greek, and Russian drivers in terms of errors. According to Ramadani et al. (2017), Kosovo lacks proper implementation of road security measures, appropriate land use planning, and an increasing number of cars. This creates increased insecurity in traffic due to the absence of proper road infrastructure. Driving violations are deliberate behaviors and deviance whereas errors are unintentional (Özkan & Lajunen, 2005). Therefore, problems of road infrastructure might be associated more with errors among Kosovar drivers.

Russian drivers reported significantly lower scores than drivers from the other countries for two positive behaviors: "When parking your car, take into account other road users' needs for space" and "Pay attention to puddle not to splash water on pedestrians or other road users". According to WHO (2015b), speeding is a major problem in Russia, with drivers paying insufficient attention to other road users.

The ANCOVA findings also revealed similarities between countries. For example, Greek and Estonian drivers did not differ significantly in their DBQ subscale scores (errors, violations, and positive driver behaviors). According to the Road Safety Country Overview of European Commission (2015) for Estonia and Greece, tailgating is an important problem in both countries. Since a similar problem can occur in different cultures, it suggests that other factors may be involved, such as degree of enforcement of traffic laws.

#### 4.1. Limitations of the present study

The first limitation concerns the validity of self-report data since the study required participants to complete surveys on driver aggression and aberrant driving behaviors that may not be accepted in their countries. Another limitation is the small sample size. Furthermore, there may be differences in using certain traffic-related signs in these five countries. For instance, hooting may have different meanings, as mentioned above. Therefore, cultural differences should be considered when comparing countries. Lastly, this study ignored gender differences, so future research could compare genders specifically.

#### 4.2. Conclusion

Zhang and Chan (2016) claim that there is a close relationship between driver aggression and aberrant driving behaviors. The present study aimed to investigate how countries differed from each other on driver aggression, aberrant, and positive driver behaviors. To reduce aggressive and aberrant driving behaviors, culture-specific strategies are required. Shinar (2017,



p.353) suggests that these cross-cultural behavioral variations can be described from the macro-level to the micro-level. That is, personality traits are also significant determinants of driver aggression. Trait tendencies therefore need further investigation to understand driver behaviors in different cultures. National policies can then be established through careful consideration of the characteristics of each country's traffic environment. According to Shinar (2017, p.350), the driving environment has a "relatively stable" effect on the expression of aggression. For instance, drivers in one culture may accept frustration and not show any aggression whereas traffic congestion might increase it. However, the present study collected limited information about the driving environment. Future studies could therefore gather detailed information about traffic congestion and traffic density to understand what factors trigger aggression, aberrant, and positive driver behaviors. Finally, this study has made an important contribution by comparing five countries in terms of positive driving behaviors since these are considered "mirror images of driver aggression". Although reducing risky driving behaviors is important to provide road safety, policymakers should also promote positive driving behaviors. Cross-cultural comparisons regarding positive driving behaviors enables countries to establish a safer traffic environment for all road users.

## 5. Author's Note

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## CRedit authorship contribution statement

**Özlem Ersan:** Conceptualization, Methodology, Writing - original draft. **Türker Özkan:** Conceptualization, Supervision. **Gentianë Xheladini:** Data collection.

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