The Effect of Culture on Gender Differences in Driver Risk Behavior through Comparative Analysis of 32 Countries

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ABSTRACT

We study the effect of culture on gender differences in road user risk behaviors. With the hypothesis that gender differences are not solely due to biological factors, and that the existence and magnitude of differences between gender groups vary according to cultural context, due to differentiated social expectations regarding gender roles, we made a secondary analysis of the ESRA2018 database, comprising 25,459 car drivers (53% male) surveyed by an online questionnaire in 32 countries we distributed in 8 cultural clusters. We analyzed the interactions between gender and culture in reported behavior, personal and social acceptability of 4 violations: drinking and driving, speeding, not wearing a seatbelt and the use of a cellphone while driving. Our results show significant gender differences on risky behaviors and attitudes and complex interactions between gender and culture, with men valuing crash risk behaviors more than women do in all cultural clusters observed. Interactions between gender and culture is more frequent on declared behaviors and personal acceptability than on perceived social acceptability and on drinking and driving and not wearing a seatbelt more than on speeding and the use of cellphone while driving. In addition, gender differences are greater in Western countries than in the Global South. We discuss these gender differences in road user behaviors, attitudes and perceptions as results of an interaction between biological and evolutionary factors and cultural and social factors. These results could be useful to better tailor road safety campaigns and education.

Keywords: Gender, Culture, Driver, Violation

INTRODUCTION

Road crashes are one of the leading causes of death worldwide and gender is one of the most important explanatory factors for the observed individual differences. The question that remains is whether these differences between males and females are related to biological factors or to social constructions. This issue is important because, if these differences are socially constructed, then policy measures can be put in place to try to mitigate them. To answer this question, we analyzed observable cultural variations in gender differences in behaviors and attitudes towards four crash risk driving behaviors (drinking and driving, speeding, driving without seatbelt, talking on a hand-held phone while driving) through a secondary analysis of the ESRA 2 database of 32 countries. The results show that gender differences do indeed vary according to cultural context, but men everywhere engage in riskier behaviors than women. This finding is in line with the validation of a dual risk factor for men. The social valuation of risky driving behavior as a sign of masculinity, particularly in Western countries, enhances the potential for innate biological differences between the two sexes. The challenge is to reduce this gap by getting drivers of both sexes to be more cautious, and less masculine, on the road.

LITERATURE REVIEW

Road crashes, in 8th place among the causes of death in the world (1), remain a significant public health issue, where the role of gender is undeniable. Males are more often involved in road crashes than females (2), while females represent 51% of the world's population, but only 24% of road deaths (3). In addition, gender differences in the risk of fatal crashes are highly dependent on age. Young men under the age of 25 account for 73% of all road deaths and are three times more involved in road crashes than women (4). However, this gender gap decreases with age, being greater for drivers aged 16 to 39 (with males drivers 1.6 to 2.5 times more likely to be at risk than females drivers) than for drivers aged 40 to 59 (with an increased risk of 1.2 to 1.3 times for males) (4,5). This gender gap disappears even among drivers over 60 years of age (5).

Some authors explain that gender differences in road crashes are mainly related to the fact that men drive more and over longer distances than women (6). Although male and female mobility patterns tend to converge in high-income countries, differences persist in all the countries in terms of complexity of activity patterns and the modes of travel used (7). However, the gender difference in fatal crashes persists, even when this difference in trip type and mileage is considered (8), particularly among younger drivers (9–11).

The observed gender differences in road crashes may also be partly explained by males greater involvement in risky and illegal behavior (12), their greater sensation-seeking (13) and the lower use of safety measures that could protect them (e.g. seat belts, helmets) (14). Young males, in particular, tend to engage more frequently than females in offending driving behaviors (speeding, not wearing seatbelts, drinking and driving) that may contribute to their increased crash risk (15–17).

Males - especially young males - perceive less risk than females in different driving situations (18) and declare more risky behavior on the road (19). Males are more likely to perceive themselves as immune to risks that threaten others than females, and to overestimate their driving skills (20). Males consider risky behavior as less serious than females (21), and feel less concerned about the personal consequences of risk (22) or of injuring someone (23). For example, nearly one-third of young males report taking risks for pleasure while driving, nearly four times more than females (24). Conversely, females feel more concerned by all road safety problems (25). They perceive greater risks in speeding (26), for example, and in using their phone while driving (27).

Classically, the tendency for males to take risks is explained by a combination of biological and evolutionary theories (28). Males are thought to have a higher rate of sensation seeking and take more risks than females because they produce more androgens (29) and/or because of their reproductive function (30). The most recent research thus attempts to show both the biological and social origins - innate and acquired - of gender differences in risk-taking. Brown (31) identifies a double risk factor for the male population. The male biological sex affects hormones, the effect of alcohol and neurocognitive development, whereas the masculine psychosocial gender role brings a cultural, social and individual value to risk-taking. Females in contrast have a double protective factor against the risk of crashes: being biologically female and also the feminine gender role that constitutes obstacles to the biological and social factors that explain risk-taking.

Indeed, some studies highlight the fact that gender differences on the road could be explained in terms of gender roles resulting from socialization (28). Gender roles and gender

stereotypes refer to a set of social beliefs about what a male and a female should be in a given society (28). For Simon and Corbett (32), gender differences in risky behaviors are simply a reflection of gender role differences, presenting the female role as passive, non-competitive and cautious while the male role is risk-taking, competitive and non-compliant. Norms of masculinity even prescribe a minimization of danger, coupled with reckless behavior (27). Males then engage in risky behaviors in order to demonstrate their masculinity, adopting typical behaviors and thus departing from feminine behaviors (33). Cars and driving are indeed integral parts of the construction of the masculine identity (34). They allow the expression of aggression and competition, both socially expected from men, while being perceived as natural male behaviors (35). Thus, some research shows that, regardless of age, sex differences in risk-taking are explained more by individuals' conformity to gender roles (masculinity and femininity) than by biological sex (36–38).

As Brown's work (31) suggests, gender differences in risk taking could be due to biological factors but could also vary across cultures and with socially expected female and male gender roles. As gender stereotypes and gender roles vary across cultures, the behaviors expected of males and females may also vary. For example, Lund and Rundmo (39) argue that the fact that females are more risk-sensitive and perceive a higher risk on the road than males is only valid in high-income countries. Indeed, in Ghana, the perception of risk is similar between males and females, because as inhabitants of developing countries, they are more accustomed to risk, which could affect their perceptions (40). Other studies observe that gender differences in several areas can be moderated by culture, and some find paradoxical results. For example, gender differences in personality traits, visuospatial skills or access to scientific disciplines are sometimes greater in high-income countries, with the highest level of gender equality policies, where the gender roles are less differentiated than in the Global South (41). According to the researchers, in individualistic cultures such as Western countries, individuals would be more likely to explain behavior that conforms to the social norms of their gender group as the expression of individual personal characteristics, rather than conformity to gender norms and social roles. Consequently, gender differences in attitudes and behaviors would be perceived more as free choices and therefore more acceptable in the most individualistic cultures (42).

There is a growing body of research analyzing differences in road user attitudes, perceptions, and behavior across cultures, comparing Global North and Global South countries (43–46). Studies emphasize the fact that 93% of deaths occur in low- and middle-income countries (4). Furthermore, there are variations between high- and low-income regions in gender differences in crash risk. In low-income regions, gender differences are more pronounced, with females having even fewer car crashes than in wealthier regions, when controlling for exposure (47). To our knowledge however, no study has yet attempted to analyze gender difference variations in driver behaviors and attitudes according to geographical and cultural context. Studies sometimes include an analysis of gender differences, but only on a country-by-country basis, or on the overall sample (48–51). Sometimes researchers analyze only the effect of culture on attitudes and behavior, controlling for the effect of gender (44,52,53). Only one study to date analyzes gender differences in several countries (22), but only on young driver behaviors and attitudes. However, again, gender analysis is only carried out on the overall sample and by country. No study to our knowledge has so far compared gender differences with regard to road risk attitudes and behaviors in different cultural contexts.

Comparing different cultural contexts will help to understand whether differences between males and females in road risk attitudes and behaviors are related solely to biological factors or also to psychosocial factors. If gender differences are also related to psychosocial factors, then these differences could vary across cultures, being more or less pronounced depending on the cultural context.

The objective of this study is therefore to explore whether gender differences in crash risk behavior self-reported by drivers are the same regardless of cultural context or vary according to it. Based on our review of the literature, we hypothesize that gender differences are not solely due to biological factors, and that the existence and magnitude of the differences between gender groups in terms of driver risk behaviors and attitudes vary according to cultural context, due to differentiated social expectations regarding gender roles.

METHODS

The purpose of this article is to explore the cultural variations of gender differences in reported risk behaviors while driving, by secondary analysis of the database from the ESRA project. The ESRA project (E-Survey of Road users' Attitudes) aimed at collecting comparable (inter)national data on road users' opinions, attitudes and behaviors with respect to road traffic

risks. It is a joint initiative of road safety institutes, research organizations, public services and private sponsors, across 46 countries. The initiative is funded by the partners' own resources. The first wave of the second edition of the ESRA survey (ESRA2) was carried out in 2018 and conducted in 32 countries across five continents.

Questionnaire

All of the ESRA2 30 partners[1] jointly developed a questionnaire in English, that each partner then translated into its own national language versions. The questionnaire explored several dimensions of individual behavior and beliefs: self-declared behaviors, acceptability (personal and social), perceived behavior control, risk perception, support for policy measures, opinions of traffic rules and penalties, and perception of enforcement. The questionnaire addresses several road safety issues: driving under the influence of alcohol and drugs, speeding, driving without wearing a seatbelt and child restraint systems, distraction and fatigue (including by using the cellphone and Internet access while driving).

Most of the survey questions used Likert scales that assume responses can be linearly measured. To determine reported behavior, we used a scale of 1 to 5 with 1 being never and 5 being almost always using a question such as: "Over the last 30 days, how often did you as a car driver drive without wearing your seatbelt?" To determine the social acceptability of specific behaviors we used a scale of 1 to 5 with 1 being unacceptable and 5 being acceptable using a question such as: "Where you live, how acceptable would most other people say it is for a car driver to not wear a seatbelt while driving?".

We also collected several demographic data: gender, year of birth, level of education, type of employment, frequency of use of different modes of transport. The age was then calculated and distributed into 6 groups (18-24y, 25-34y, 35-44y, 45-54y, 55-64y, 65y+).

All information on the questionnaire is available on www.esranet.eu. We describe the items observed and the corresponding scale at the beginning of the presentation of the results of each of our questions about risky driving behavior.

Procedure and sample

The ESRA survey is a self-administered, online questionnaire using an access panel of participants. Four market research agencies organized the fieldwork and administered the survey to a representative sample (at least N=1,000) of the national adult population (18+) in each participating country. They collected the data in November and December 2018. The ESRA2_2018 survey in total collected data from 35,036 road users (50.2% females) in 32 countries.

Data used for this secondary analysis and limitations

The aim of the ESRA project was not to explore gender differences between countries, but to collect comparable (inter)national data on road users' opinions, attitudes and behavior with respect to road traffic risks. This has several implications for the data available for the secondary analysis presented here to analyze the interactions between gender and culture on driver attitudes and behavior and some limitations of the analyses should be underlined.

First, for this secondary analysis, we have chosen to group these 32 countries into cultural clusters, using the clusters proposed by the GLOBE Project (54). This approach is more helpful for summarizing similarity and differences among countries that result from meaningful cultural dimensions than comparing societies one by one. These clusters are based on the positioning of 61 countries on 9 cultural dimensions (e.g., in-group collectivism, institutional collectivism, gender egalitarianism, power distance), derived from Hofstede's work (55). The 32 countries represented in the ESRA data were thus distributed for our study into 8 cultural clusters (presented in alphabetic order):

- Anglo group: Australia, Canada, Ireland, United Kingdom, USA;
- Asia group: India, Japan, Republic of Korea;
- East Europe: Czech Republic, Greece, Hungary, Poland, Serbia, Slovenia;
- Germanic group: Austria, Belgium, Germany, The Netherlands, Switzerland;
- Latin Europe: France, Italy, Portugal, Spain;
- Middle East and Maghreb: Egypt, Morocco, Israel;
- Nordic group: Denmark, Finland, Sweden
- Sub Saharan Africa: Kenya, Nigeria, South Africa.

Second, the survey targeted all road users: passenger vehicle drivers but also other road users including cyclists, pedestrians, and moped and motorcycle riders. To control for the effect

[1] https://www.esranet.eu/en/partners/

of mode of travel in this study, for this analysis we focused only on participants who reported driving a car (thermic, electric or hybrid), at least a few days a month during the past 12 months (72.66% of the sample: 74.9% of males and 64.8% of females). **Table 1** shows that the resulting sample consists of 25,459 individuals: 13,540 males and 11,919 females (53.18% and 46.82% of the sample respectively) equally distributed in the eight cultural groups studied.

Third, we did not consider all the attitudes and behaviors measured in the survey. This secondary analysis focuses only on the behaviors reported by participating drivers, and regarding only the four crash-risk behaviors that are addressed in each of the dimensions explored in the questionnaire (self-reported behaviors, attitudes, perceptions). Each of these behaviors is subject to a legal prohibition in all the countries surveyed: driving under the influence of alcohol, excessive speed outside built-up areas, non-use of safety belt and mobile phone use while driving.

Fourth, several variables that may interact with gender group and culture need to be controlled for. Age is likely to interact with gender on the variables measured and age distribution may vary between countries: we took this into account in the statistical analyses through the age category to control for its effect. Exposure (i.e. number kilometers driven) varies according to gender group, is likely to influence the variables measured (behavior, risk acceptance) and its level may vary according to the countries observed for both sexes. As exposure in terms of kilometers driven as a driver is unfortunately not available in the database, we have tried to consider its effect through driving frequency. This frequency is measured using a Likert-type scale, from 1 corresponding to using the vehicle as a driver at least 4 times a week to 3 corresponding to using the vehicle a few days a month. The interest of this variable was very limited, since information on distances travelled, type of network used, speed or type of vehicle was not available. The information is not precise: we cannot deduce from this variable the number of kilometers driven (an individual may drive more or less frequently on 5 km or 100 km trips), but it at least allows us to differentiate between participants who drive often and those who rarely drive.

Statistical analysis

To ensure an equal representation of countries, we gave an equal weight to each country regardless of their population's size. We weighted the data by genders and six age groups within each country based on population statistics from United Nations data (56).

In order to be able to control for the effect of age and frequency of driving, and to analyze the interactions between gender and cultural group, we carried out two-way analyses of covariance (ANCOVA) to study whether there were significant differences for each violation, in terms of reported behavior, social and personal acceptability between genders and cultural groups after controlling the effect of age and frequency of driving. Several studies support the robustness of the ANCOVA when normality assumptions are violated (for a review see (57)).

In each ANCOVA we analyzed the effect of two interindividual variables: gender group (2 modalities: males and females) and cultural cluster (8 modalities: Anglo, Asia, East Europe, Germanic, Latin Europe, Middle East, Nordic and Sub Saharan Africa). The age group (6 modalities:18-24, 25-34, 35-44, 45-54, 55-64, 65+) and the frequency of driving (3 modalities: at least 4 days a week, 1 to 3 days a week, a few days a month) were introduced in the analyses as covariables.

As 12 comparisons (3 items on each of the 4 violations) according to gender and culture were made, a Bonferroni correction was applied. At alpha .05, the level of $p<0.004$ (.05/12) was considered as the cut-off value for significance for ANCOVAs and for Post-Hoc tests. We described and discussed only statistically significant differences in the following section. To interpret the statistically significant main and interactions effects, pairwise comparisons were calculated.

For each statistically significant difference showed by the *F* test, we give eta squared (η^2) value as a measure of effect size. The rules of thumb given by Cohen to interpret this indicator of effect size is as follows: the statistically significant difference is considered as small when $\eta^2 \leq .01$, medium when $\eta^2 \leq .06$, and large when $\eta^2 \leq .14$ (58).

We analyzed the main effects and the interaction effects of gender group and cultural cluster. A statistically significant main effect of the gender group means that the difference between males and females is significant for the whole sample, regardless of the cultural cluster. A statistically significant main effect of the cultural cluster means that there is a significant difference between cultural clusters for the whole sample, regardless of gender groups. A significant interaction effect between gender and cultural cluster means that the difference between the two gender groups vary across cultural clusters. We described and discussed only statistically significant effects.

RESULTS

Drinking and driving

Participants were asked how often, in the past 30 days, they had driven a motor vehicle when they may have exceeded the legal blood alcohol content (BAC) limit, how acceptable they think most people would say it is, and how personally acceptable they feel it is to drive a motor vehicle after exceeding the legal BAC limit. **Table 2** presents the means, standard deviations and *F* values for the ANCOVAs calculated for the items related to drinking and driving.

Attitudes and behaviors concerning drinking and driving differed between gender groups and between cultural clusters. Indeed, ANCOVAs revealed small but statistically significant differences between the gender groups and between the cultural clusters on declared behaviors and on social and personal acceptability of drinking and driving. For the total sample, males declared higher frequency of drinking and driving, and higher social and personal acceptability than females. The participants from the Nordic cluster showed the least risky attitudes and behaviors while the participants from the Africa cluster showed the riskiest attitudes and behaviors regarding drinking and driving as Table 2 shows.

The differences between males and females in drinking and driving behavior and personal acceptance of speeding varied according to cultural clusters but difference between males and females in perceived social acceptance of drink and drive did not vary from one culture to another. ANCOVAs showed significant interactions between gender groups and cultural clusters on the declared behaviors and the personal acceptability of drinking and driving. Males declared riskier attitudes and behaviors for drinking and driving than females in Western countries whereas there were no statistically significant gender differences in the Asia cluster for the declared behaviors nor in the personal acceptability in the Middle East, African and Asian clusters.

In other words, males did have riskier behaviors and higher personal acceptance of drinking and driving than females in Western countries, but not in the Global South, whereas males perceived it was more socially acceptable to drink and drive than females in all the cultural clusters. Gender differences concerning drinking and driving vary with culture but not for all the variables observed: differences between males and females on personal acceptance and declared behaviors concerning drink and drive vary across cultures whereas gender differences in social acceptability of drink and drive do not vary across cultures.

Excessive speed

Participants were asked how often, in the past 30 days, they had driven faster than the speed limit outside built-up areas (but not on motorways/freeways), how acceptable they think most people would say it is and how personally acceptable they feel it is to speed outside built-up areas (but not on motorways/freeways). **Table 3** presents the means, standard deviations and *F* values for the ANCOVAs calculated for the items related to speeding.

Attitudes and behaviors concerning speeding differed between gender groups and between cultural clusters. Indeed, ANCOVAs revealed small but statistically significant differences between the gender groups and between the cultural clusters on declared behaviors and on social and personal acceptability concerning speeding. For the total sample, males declared more frequent speeding behaviors and higher social and personal acceptability of speeding than females. Moreover, participants from the Nordic and Germanic cultural clusters had the riskiest attitudes and behaviors in terms of speeding, while participants from African and Asian cultural clusters had the least risky behaviors and attitudes of all cultural clusters.

The differences between males and females in speeding behaviors and perceived social acceptance of speeding did not vary according to cultural clusters but difference between males and females in personal acceptance of speeding varied from one culture to another. Indeed, ANCOVAs revealed statistically significant interactions between gender group and cultural clusters on the personal acceptability of speeding, but not on the declared behaviors nor on the perceived social acceptability. The gender differences in personal acceptability of speeding were statistically significant for all the cultural clusters, except for the African cluster.

In other words, males perceived more than females that it was personally acceptable to speed in all clusters except for African countries. On the other hand, males exhibited riskier behaviors in speeding than females and higher perceived social acceptance for driving in all cultures. Only gender difference concerning personal acceptance of speeding varies with culture, whereas gender differences in declared speeding behaviors and in social acceptance do not vary across cultures.

Not wearing a seatbelt

Participants were asked how often, in the past 30 days, they had driven without wearing their seatbelt, how acceptable they think most people would say it is, and how personally acceptable they feel it is to not wear a seatbelt while driving. **Table 4** presents the means, standard deviations, and *F* values for the ANCOVAs calculated, for the items related to driving without wearing a seatbelt.

Attitudes and behaviors concerning driving without wearing a seatbelt differed between gender groups and between cultural clusters. Indeed, ANCOVAs revealed small but statistically significant differences between the gender groups and between the cultural clusters on declared behaviors and on social and personal acceptability of driving without a seatbelt. For the total sample, males were more likely than females to declare driving without a seatbelt and to perceive greater social and personal acceptability for not wearing a seatbelt. Moreover, participants from English-speaking countries were more concerned and less accepting of driving without wearing a seatbelt, whereas the participants from Middle East and African clusters accepted and reported not wearing a seatbelt the most, for both gender groups.

Differences between males and females in risky personal attitudes and behaviors concerning driving without a seatbelt varied from one cultural cluster to another, but not the difference between males and females in social acceptability of this risky behavior. Indeed, ANCOVAs revealed statistically significant interactions between gender groups and cultural clusters on the declared behaviors and personal acceptability, but not on the social acceptability of driving without a seatbelt. Males had significantly riskier personal acceptability and behaviors than females in the Anglo, Germanic, Nordic and East Europe clusters, but not in the Middle East and Asian cultural clusters.

In other words, males were more likely to drive without wearing a seatbelt and were more accepting of this risky behavior than females, in Western countries but not in the Global South. However, males perceived it was more socially acceptable to drive without wearing a seatbelt than females in all cultures. Gender differences concerning driving without wearing a seatbelt vary with culture but not for all the variables observed: differences between males and females on behaviors and personal acceptability of driving without a seatbelt vary across cultures whereas gender differences in perceived social acceptability of driving without a seatbelt do not vary across cultures.

Talking on a hand-held phone while driving

Participants were asked how often, in the past 30 days, they had talked on a hand-held phone while driving, how acceptable they think most people would say it is, and how personally acceptable they feel it is to talk on a hand-held phone while driving. **Table 5** presents the means, standard deviations and *F* values for the ANCOVAs, calculated for the items related to talking on a phone while driving.

Attitudes and behaviors concerning driving while talking on a hand-held phone differed between gender groups and between cultural clusters. Indeed, ANCOVAs revealed small but statistically significant differences between gender groups and between cultural clusters on declared behaviors and on social and personal acceptability. For the total sample, males declared greater use and acceptance of cellphone while driving and perceived it more as socially accepted than females. Moreover, Anglo cluster is the cluster that used and accepted the less the use of cellphone while driving, whereas Middle East and Africa cultural clusters showed the highest use and acceptability, for both gender groups (**Table 5**).

Differences between males and females did not vary from one cultural cluster to another concerning risky attitudes and behaviors towards use of cellphone while driving. ANCOVAs revealed no significant interaction between gender and cultural clusters on declared behaviors, or the social and personal acceptability of talking on a hand-held phone while driving.

In other words, gender differences in risky behaviors and attitudes towards using a phone while driving did not vary from one culture to another. Males were more likely to use phones while driving, were more accepting of and perceived it was socially acceptable to use cellphone while driving than females in all cultures. Gender differences concerning using cellphone while driving did not vary with culture: differences between males and females on behaviors and attitudes towards of cellphone use while driving do not vary across cultures.

DISCUSSION

The objective of this paper was to explore the cultural variations of gender differences in self-reported risk behaviors while driving, by secondary analysis of the ESRA2 database on 32

countries distributed in 8 cultural clusters. Based on our review of the literature, our hypothesis was that gender differences are not only due to biological factors and that the existence and magnitude of differences between males and females in terms of risk-taking behaviors and attitudes as drivers vary according to cultural contexts, due to differentiated social expectations about gender roles.

To test our hypothesis, we analyzed gender group influence, cultural group influence and their interaction, controlling for the effect of age and driving frequency, on four risk behaviors (drinking and driving, speeding, driving without a seat belt, and mobile phone use while driving).

Our results show differences between males and females on all behaviors and attitudes observed, and that the existence and magnitude of gender differences vary according to cultural clusters for some of the risky behaviors and attitudes measured. Compared to females, males declared higher personal acceptance of the four risky behaviors explored and these gender differences vary across cultures for three of the behaviors measured (drink and drive, speeding and driving without seatbelt), with greater differences between males and females in Western countries than in the Global South. Males also reported riskier behaviors than females on the four behaviors explored and these gender differences vary across cultures for two of these behaviors (drink and drive and driving without seatbelt), with greater differences between males and females in Western countries than in the Global South. In addition, males perceived greater social acceptance than females of the four risky behaviors explored but none of these gender differences vary across culture.

These variations, depending on cultural contexts, in the existence and extent of gender differences in terms of risky driving behavior and attitudes are consistent with our hypothesis, showing that gender differences are not only related to biological factors, but also to social and cultural factors. However, the results show that the relationships between gender differences and cultural factors are complex and that the existence and extent of gender differences in driver risk behavior does not always vary according to cultural contexts.

First of all, all the gender differences we observed were going in the same direction. Males reported they were more likely to violate the four specific traffic situations we asked about and were more likely to perceive such violations as socially and personally acceptable in all regions we studied. Thus, males always show a greater propensity for risk than females, whether or not we observe cultural variations in these gender differences. The more prevalent risk behaviors and attitudes of men in all regions for almost all behaviors support the explanation of more stable and generalized gender differences across cultures. This stability in the direction of the gender differences, common to all the cultural contexts studied, could show that gender differences are not only the result of culture but also seem to stem from biological, physiological and evolutionary factors. As mentioned above, this greater attractiveness of males to risk in all the cultural contexts studied could be explained by the influence of androgenic hormones leading to increased sensation seeking (29) or a means of positively distinguishing themselves in the competition between males to attract females (30). In this sense, these results support the idea from Brown et al. (31) of a double risk factor among males linked both to the biological sex and to the social and cultural gender.

Second, we found that gender differences do not always vary according to cultural contexts. These cultural variations did not uniformly affect all dimensions of behavior and all observed risks. Indeed, while gender differences were observed in all cases, they varied more frequently according to cultural contexts for personal acceptability and declared behavior than for social acceptability. In other words, culturally constructed gender roles appear to explain more gender differences in personal risk acceptance and behaviors than gender differences in perceptions of social risk acceptance. These results can be explained by the fact that the perception of social acceptance of risk measured the degree of acceptance of these risk behaviors that participants perceive among drivers where they live, i.e., the descriptive and prescriptive social norms. The results show that although men perceived this social norm as riskier than women, this gender gap did not vary according to gender roles in each cultural context. In contrast, measures of behavior and personal acceptance of risk asked individuals about what they thought and did themselves as drivers. This reflects a dual positioning on the part of individuals. They position themselves in relation to social norms regarding driving behavior (what each individual accepts and does as a driver in relation to what is acceptable to do where s/he lives), but they also position themselves in relation to social norms regarding gender roles (what each individual accepts and does as a man or woman in relation to what is acceptable to do as a man or

woman in their culture). Thus, gender roles would affect individual positioning more than perceptions of social norms.

In addition, we did not observe cultural variations in gender differences in all observed risk behaviors. Indeed, we found more interactions between gender group and cultural cluster on drinking and driving and seatbelt use than on speeding, and we found no interaction between gender and culture on any of the three dimensions measured for cellphone use while driving. Gender differences did exist for speeding and cellphone use while driving but they vary little or not at all according to cultural context. In addition, these violations were perceived as most acceptable in all the cultural clusters and most often reported by both genders than drinking and driving or driving without wearing a seatbelt. Hence, in all cultures, speeding and cellphone use while driving were risky behaviors more accepted by males than by females and were more accepted by individuals of both sexes than drinking and driving and driving without wearing a seatbelt, whose level of acceptance by each of the two gender groups varied according to cultural contexts. In other words, gender roles appear to have less influence on risk behaviors that are widely accepted in all cultures and by both gender groups, where gender differences seem to be primarily the expression of biological and evolutionary factors. Thus, gender roles appear to have more influence on individual positioning and for less widely accepted risk behaviors. Research is still needed to understand why speeding and cellphone use while driving are risky behaviors accepted by drivers from all cultural backgrounds and of both sexes, and to confirm that gender roles affect individual positioning less when social acceptance of the behavior is important.

Finally, the results show that gender differences were more pronounced in Western countries than in African and Eastern countries. This may seem paradoxical since Western countries have the highest level of gender equality policies, and the gender roles are less differentiated than in the Global South (41). As mentioned above, this could be due to the fact that in the Western countries, conforming to gender roles could be seen as an acceptable individual choice rather than a social obligation or to the fact that women could be more risk-adverse in societies that are safer and less accustomed to risk. Future studies should examine whether the extent of gender differences in reported behavior and attitudes could be moderated by the level of the global gender gap index or of car crash rate of the countries surveyed in the ESRA survey. Broader, further analysis on the ESRA2 data should be conducted, integrating more refined indicators of culture already available in the literature, such as those from the World Values Survey (WVS), exploring periodically the cultural values and changes using the Portrait Values Questionnaire (PVQ) from the Schwarz model (59), or the six dimensions of culture measured in more than 100 countries on the basis of Hofstede's model (60).

Furthermore, it seems important to consider that self-reported data are vulnerable to a number of biases (61,62), as misunderstanding of questions or recall error. The desirability bias, i.e. the tendency of respondents to provide answers which present a favorable image of themselves (over-reporting good behavior and/or under-reporting bad, or undesirable behavior) is more pronounced in women than in men (63). In the specific area of driving behavior, both male and female drivers may be reluctant to admit to illegal or disapproved driving behavior. Or, conversely, men may perceive a greater social desirability for reporting risky or illegal behavior that they may not have engaged in, in order to display "typically male" behavior. Further studies will need to control for this desirability bias, although it can also be seen as an effect of gender roles, also affecting observable behavior (64,65).

Finally, these initial results need to be confirmed and deepened through specific studies to investigate the interactions between gender and culture in drivers' perceptions, attitudes and risk behaviors, including the monitoring of key variables impacting on gender and culture interactions, such as exposure to risk. All these results show that the influence of gender roles on the behaviors and attitudes of men and women is complex: it varies according to the risky behaviors observed and its dimensions. Gender roles affect individual positions more than social perceptions and less accepted risky behaviors rather than those that are widely accepted socially. Our results show that cultural variations in gender differences in driving risky behaviors are not directly due to the conformity of all individuals to socially prescribed gender roles, but rather to the way in which each man and woman appropriates these gender roles (28).

CONCLUSIONS

Our aim was to show that gender differences are not only related to biological factors but also to cultural and social factors. Our results show that socially constructed gender roles affect

the individual positioning of drivers more than the perception of social norms and affect attitudes and behaviors less when risk behavior is widely socially accepted. Moreover, the greater acceptance of risky behavior by males is observed in all cultures. In addition, compliance with gender roles in risk behavior may be exacerbated in Western countries, where the level of road safety is higher and the need for compliance with traditional social roles is less emphasized. In addition to the effect of gender roles, it seems that male and female behavior is also due to biological and evolutionary factors.

Our results can contribute to education and awareness campaigns and events aimed at reducing risk behaviors. In order to reduce risk behaviors among subsets of the population at risk (particularly men, but also young drivers), it would be appropriate to target the psychological constructs impacting risk behaviors that are most influenced by gender roles. Our results suggest these actions be directed towards men and more widely to target the "male" values and social norms linked to risk behaviors, which influence individual behavior. A recent study (66) suggests that risky driving behaviors can be reduced by changing the “male” values and social norms that young male drivers associate with them. This finding represents an interesting avenue that should be investigated further in order to implement effective prevention measures based on social norms and gender roles. Finally, for greater effectiveness, road safety actions would also benefit from adopting a targeting strategy, since that individual differences about risky driving may depend on both gender and culture, as well as the type of risk behavior.

Culture can exacerbate these biological gender differences through social norms and beliefs about both sexes, such as the valuing of risk-taking by males. On the contrary, culture can constrain or reduce these differences, through the road safety policies put in place that more or less allow these gendered norms to be expressed through driving behaviors, or by helping individuals to challenge their compliance with the socially constructed aspect of these gender differences. In this sense, studies must continue to explore whether or not national policies to reduce the gender gap in education, economic, and political terms reduce differences in risk behavior between males and females. Indeed, the challenge in reducing this gap in risk behaviors is to get males to value risky behaviors less and to get females not to engage more in such behaviors.

AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: M.A. Granié, C. Lyon, U. Meesmann, R. Robertson, K. Torfs, W. Van der Berghe, W. Vanlaar, H. Woods-Fry; analysis and interpretation of results: M.A. Granié, C. Thévenet, F. Varet, M. Evennou, N. Oulid-Azouz, C. Lyon, K. Torfs, W. Vanlaar, W. Van der Berghe; draft manuscript preparation: M.A. Granié, C. Thévenet, F. Varet, C. Lyon, W. Vanlaar, H. Woods-Fry. All authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors do not have any conflict of interest to declare.

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Table 1 Distribution of the sample over the eight cultural clusters studied according to gender

	Cultural cluster								
Gender	Anglo	Asia	East Europe	Germanic	Latin Europe	Middle East	Nordic	Sub Saharan Africa	Total
Males	1866	1173	2453	2846	1731	1172	1116	1183	13540
Females	1906	901	1993	2664	1571	895	998	991	11919
% males	49.5	56.6	55.2	51.7	52.4	56.7	52.8	54.4	53.2

Table 2 Mean (and standard deviation) and *F* value (and eta²) for the ANCOVAs of the reported behavior, the social and the personal acceptability of drinking and driving according to gender and cultural cluster, age and driving frequency controlled

Cultural cluster	Gender	Reported behavior	Social acceptability	Personal acceptability
Anglo	Males	**1.26 (0.72)**	**1.34 (0.84)**	**1.26 (0.76)**
	Females	1.12 (0.49)	1.21 (0.64)	1.12 (0.49)
	Total	1.19 (0.62) [b]	1.27 (0.75) [b]	1.19 (0.64) [b]
Germanic	Males	**1.31 (0.56)**	**1.53 (0.71)**	**1.38 (0.62)**
	Females	1.14 (0.39)	1.4 (0.65)	1.22 (0.47)
	Total	1.23 (0.49) [b]	1.47 (0.68) [d]	1.3 (0.56) [c]
Nordic	Males	**1.17 (0.54)**	1.22 (0.59)	**1.19 (0.57)**
	Females	1.05 (0.31)	1.19 (0.52)	1.07 (0.33)
	Total	1.11 (0.45) [a]	1.21 (0.56) [a]	1.14 (0.48) [a]
Latin Europe	Males	**1.35 (0.73)**	**1.48 (0.85)**	**1.32 (0.69)**
	Females	1.14 (0.5)	1.36 (0.82)	1.18 (0.56)
	Total	1.24 (0.64) [b]	1.42 (0.84) [c]	1.25 (0.64) [c]
East Europe	Males	**1.23 (0.57)**	**1.46 (0.88)**	**1.24 (0.63)**
	Females	1.07 (0.32)	1.33 (0.78)	1.1 (0.38)
	Total	1.16 (0.48) [b]	1.4 (0.84) [c]	1.18 (0.54) [b]
Middle East and Maghreb	Males	**1.23 (0.62)**	1.53 (0.96)	1.28 (0.72)
	Females	1.13 (0.53)	1.44 (0.96)	1.3 (0.83)
	Total	1.18 (0.59) [b]	1.49 (0.96) [d]	1.29 (0.77) [c]
Sub Saharan Africa	Males	**1.38 (0.79)**	1.62 (1.07)	1.31 (0.77)
	Females	1.17 (0.6)	1.51 (1)	1.22 (0.7)
	Total	1.28 (0.72) [c]	1.57 (1.04) e	1.26 (0.74) [c]
Asia	Males	1.19 (0.59)	1.33 (0.83)	1.24 (0.71)
	Females	1.23 (0.74)	1.3 (0.86)	1.25 (0.79)
	Total	1.21 (0.66) [b]	1.32 (0.84) [b]	1.25 (0.74) [c]
Total	Males	**1.27 (0.64)**	**1.44 (0.85)**	**1.28 (0.68)**
	Females	1.13 (0.47)	1.34 (0.77)	1.17 (0.55)
	Total	1.2 (0.57)	1.39 (0.81)	1.23 (0.63)
F value (η^2)	Gender	279.67*** (.011)	58.71*** (.002)	127.31*** (.005)
	Culture	23.08*** (.006)	43.50*** (.012)	29.59*** (.008)
	Interaction	8.99*** (.002)	1.44	5.82*** (.002)

Note. Bonferroni correction was used for pairwise comparisons. For gender, mean values in bold within rows indicated scores significantly higher at p<.05. For cultural cluster, mean values with different superscripts (a–e) within rows were significantly different at p<.05. The scale used was 1 = never to 5 = almost always for behaviors and 1 = unacceptable to 5 = acceptable for acceptability. * α <.05, ** α <.01, *** α <.001

Table 3 Mean (and standard deviation) and *F* value (and eta²) for the ANCOVAs of the reported behavior, the social and the personal acceptability of speeding according to gender and cultural cluster, age and driving frequency controlled

Cultural cluster	Gender	Reported behavior	Social acceptability	Personal acceptability
Anglo	Males	**2.2 (1.16)**	**2.13 (1.22)**	**2 (1.18)**
	Females	1.98 (1.06)	1.92 (1.14)	1.69 (0.98)
	Total	2.09 (1.11) [b]	**2.03 (1.18)** [a]	1.85 (1.1) [b]
Germanic	Males	**2.44 (0.87)**	2.5 (0.93)	**2.37 (0.93)**

	Females	2.16 (0.82)	2.27 (0.89)	2.11 (0.87)
	Total	2.3 (0.85) [c]	2.39 (0.92) [c]	2.24 (0.91) [c]
Nordic	Males	**2.69 (1.21)**	**2.64 (1.18)**	**2.56 (1.24)**
	Females	2.36 (1.05)	2.41 (1.13)	2.17 (1.1)
	Total	2.54 (1.15) [d]	2.53 (1.16) [d]	2.37 (1.19) [d]
Latin Europe	Males	**2.3 (1.09)**	**2.26 (1.14)**	**2.13 (1.09)**
	Females	1.95 (1.04)	2.08 (1.16)	1.86 (1.01)
	Total	2.13 (1.08) [b]	2.17 (1.15) [b]	2 (1.06) [b]
East Europe	Males	**2.33 (1.03)**	**2.33 (1.19)**	**2.12 (1.12)**
	Females	1.94 (0.94)	2.08 (1.15)	1.8 (0.96)
	Total	2.15 (1.01) [b]	2.21 (1.18) [b]	1.97 (1.07) [b]
Middle East and Maghreb	Males	**2.06 (1.08)**	2.3 (1.27)	**2.06 (1.18)**
	Females	1.77 (1.01)	2.17 (1.32)	1.8 (1.11)
	Total	1.93 (1.06) [a]	2.24 (1.29) [b]	1.94 (1.16) [b]
Sub Saharan Africa	Males	**1.99 (1.01)**	1.99 (1.18)	1.66 (1)
	Females	1.75 (0.95)	1.99 (1.23)	1.56 (0.94)
	Total	1.88 (0.99) [a]	1.99 (1.2) [a]	1.61 (0.98) [a]
Asia	Males	**2.08 (1.08)**	**2.14 (1.14)**	**2 (1.06)**
	Females	1.77 (0.99)	1.87 (1.04)	1.75 (0.98)
	Total	1.94 (1.05) [a]	2.02 (1.11) [a]	1.89 (1.03) [b]
Total	Males	**2.28 (1.06)**	**2.29 (1.15)**	**2.12 (1.11)**
	Females	1.97 (0.98)	2.09 (1.12)	1.85 (0.99)
	Total	2.13 (1.04)	2.2 (1.14)	1.99 (1.06)
F value (η^2)	Gender	404.18*** (.016)	128.26*** (.005)	325.08*** (.013)
	Culture	126.71*** (.034)	119.15*** (.032)	186.92*** (.049)
	Interaction	2.60	2.29	3.26* (.001)

Note. Bonferroni correction was used for pairwise comparisons. For gender, mean values in bold within rows indicated scores significantly higher at p<.05. For cultural cluster, mean values with different superscripts (a–d) within rows were significantly different at p<.05. The scale used was 1 = never to 5 = almost always for behaviors and 1 = unacceptable to 5 = acceptable for acceptability. * α <.05, ** α <.01, *** α <.001

Table 4 Mean (and standard deviation) and *F* value (and eta²) for the ANCOVAs of the reported behavior, the social and the personal acceptability of not wearing a seatbelt according to gender and cultural cluster, age and driving frequency controlled

Cultural cluster	Gender	Reported behavior	Social acceptability	Personal acceptability
Anglo	Males	**1.29 (0.79)**	**1.43 (0.92)**	**1.35 (0.86)**
	Females	1.16 (0.59)	1.32 (0.76)	1.21 (0.65)
	Total	1.23 (0.7) [a]	1.38 (0.84) [a]	1.28 (0.76) [a]
Germanic	Males	**1.35 (0.68)**	**1.75 (0.84)**	**1.58 (0.76)**
	Females	1.22 (0.54)	1.6 (0.78)	1.4 (0.64)
	Total	1.29 (0.62) [a]	1.67 (0.81) [c]	1.49 (0.71) [b]
Nordic	Males	**1.37 (0.84)**	**1.69 (0.97)**	**1.6 (0.97)**
	Females	1.16 (0.56)	1.48 (0.81) [b]	1.32 (0.72)
	Total	1.27 (0.73) [a]	1.59 (0.91)	1.46 (0.87) [b]
Latin Europe	Males	**1.31 (0.76)**	1.59 (0.94)	**1.47 (0.86)**
	Females	1.19 (0.6)	1.53 (0.98)	1.34 (0.73)
	Total	1.25 (0.69) [a]	1.56 (0.96) [b]	1.41 (0.81) [b]
East Europe	Males	**1.47 (0.83)**	**1.94 (1.18)**	**1.62 (0.99)**
	Females	1.35 (0.75)	1.81 (1.17)	1.42 (0.78)
	Total	1.41 (0.8) [b]	1.88 (1.18) [c]	1.53 (0.91) [b]
Middle East and Maghreb	Males	1.6 (1)	1.89 (1.16)	1.58 (0.98)
	Females	1.5 (1.03)	1.76 (1.25)	1.53 (1.01)
	Total	1.55 (1.01) [c]	1.83 (1.2) [c]	1.56 (0.99) [b]
Sub Saharan Africa	Males	**1.9 (1.07)**	**1.95 (1.21)**	1.49 (0.85)
	Females	1.64 (1.03)	1.75 (1.19)	1.4 (0.85)
	Total	1.78 (1.06) [d]	1.86 (1.2) [c]	1.44 (0.85) [b]

Asia	Males	1.38 (0.79)	1.66 (1.03)	1.52 (0.85)
	Females	1.42 (0.93)	1.63 (1.07)	1.47 (0.9)
	Total	1.4 (0.85) [b]	1.65 (1.05) [b]	1.5 (0.87) [b]
Total	Males	**1.44 (0.84)**	**1.73 (1.04)**	**1.53 (0.89)**
	Females	1.3 (0.74)	1.6 (0.99)	1.37 (0.76)
	Total	1.37 (0.8)	1.67 (1.02)	1.45 (0.83)
F value (η^2)	Gender	142.35*** (.006)	74.41*** (.003)	172.85*** (.007)
	Culture	100.02*** (.027)	71.83*** (.019)	31.72*** (.009)
	Interaction	5.17*** (.001)	2.46	3.43* (.001)

Note. Bonferroni correction was used for pairwise comparisons. For gender, mean values in bold within rows indicated scores significantly higher at p<.05. For cultural cluster, mean values with different superscripts (a–d) within rows were significantly different at p<.05. The scale used was 1 = never to 5 = almost always for behaviors and 1 = unacceptable to 5 = acceptable for acceptability. * α <.05, ** α <.01, *** α <.001

Table 5 Mean (and standard deviation) and *F* value (and eta²) for the ANCOVAs of the reported behavior, the social and the personal acceptability of making a phone call while driving according to gender and cultural cluster, age and driving frequency controlled

Cultural cluster	Gender	Reported behavior	Social acceptability	Personal acceptability
Anglo	Males	1.4 (0.87)	1.56 (1.04)	**1.43 (0.94)**
	Females	1.33 (0.77)	1.5 (0.94)	1.32 (0.76)
	Total	1.37 (0.82) [a]	1.53 (0.99) [a]	1.37 (0.86) [a]
Germanic	Males	**1.54 (0.78)**	1.72 (0.83)	1.47 (0.69)
	Females	1.4 (0.67)	1.64 (0.8)	1.4 (0.65)
	Total	1.47 (0.73) [c]	1.68 (0.82) [b]	1.44 (0.67) [b]
Nordic	Males	1.61 (0.95)	1.88 (1.03)	**1.69 (1)**
	Females	1.51 (0.87)	1.85 (1.05)	1.53 (0.88)
	Total	1.56 (0.91) [d]	1.87 (1.04) [d]	1.61 (0.95) [c]
Latin Europe	Males	**1.47 (0.79)**	1.65 (0.95)	**1.42 (0.76)**
	Females	1.35 (0.75)	1.62 (1.03)	1.3 (0.69)
	Total	1.41 (0.77) [b]	1.63 (0.99) [b]	1.36 (0.73) [a]
East Europe	Males	**1.68 (0.88)**	1.88 (1.13)	**1.49 (0.81)**
	Females	1.53 (0.84)	1.89 (1.13)	1.37 (0.72)
	Total	1.61 (0.87) [e]	1.89 (1.13) [d]	1.44 (0.77) [b]
Middle East and Maghreb	Males	1.71 (0.96)	2.03 (1.14)	1.6 (0.94)
	Females	1.66 (0.97)	2.01 (1.28)	1.62 (1.03)
	Total	1.68 (0.96) [f]	2.02 (1.2) [e]	1.61 (0.98) [c]
Sub Saharan Africa	Males	**2.02 (1.05)**	1.87 (1.12)	1.49 (0.84)
	Females	1.85 (1.12)	1.86 (1.15)	1.45 (0.89)
	Total	1.94 (1.08) [g]	1.86 (1.14) [d]	1.47 (0.86) [b]
Asia	Males	1.57 (0.85)	1.82 (1.05)	1.62 (0.91)
	Females	1.52 (0.94)	1.71 (1.08)	1.54 (0.92)
	Total	1.55 (0.89) [d]	1.77 (1.07) [c]	1.58 (0.91) [c]
Total	Males	**1.6 (0.89)**	1.78 (1.03)	**1.51 (0.85)**
	Females	1.49 (0.84)	1.73 (1.04)	1.41 (0.79)
	Total	1.55 (0.87)	1.76 (1.03)	1.46 (0.82)
F value (η^2)	Gender	65.24*** (.003)	9.24* (.0001)	54.24*** (.002)
	Culture	69.64*** (.022)	46.50*** (.017)	36.24*** (.011)
	Interaction	1.92	.752	1.63

Note. Bonferroni correction was used for pairwise comparisons. For gender, mean values in bold within rows indicated scores significantly higher at p<.05. For cultural cluster, mean values with different superscripts (a–g) within rows were significantly different at p<.05. The scale used was 1 = never to 5 = almost always for behaviors and 1 = unacceptable to 5 = acceptable for acceptability. * α <.05, ** α <.01, *** α <.001