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Aberrant behaviour plausibility in road traffic violations, errors and lapses

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Abstract. Road traffic crashes have been formidable concern for road safety engineer and different techniques have been applied to address such problems. Driving Behaviour is one of the pivotal issue that arises as in every country, state and region; though such issues play significant role in socio-economic development of country. The aim to conduct this study was to estimate driver traits and correlation between violation, errors, and lapses. Questionnaires are used to measure aberrant behaviour and its plausibility to be involved in road traffic crashes. A questionnaire was developed based on the Manchester Driving Behaviour Questionnaire to estimate the correlation. Data was collected from the capital city (Islamabad) of Pakistan. Statistical analysis was carried out to set up the correlation using the Pearson Correlation. It was estimated from the model results that violations are positively associated and correlated with lapses and errors. Lapses are positively associated and correlated to violations and errors. Errors are positively associated and correlated to lapses and violations.

1. Introduction

World population has increased drastically since past decades that resulted augmentation in population, vehicular traffic and enormous pressure on road infrastructure to pose more safety hazards than ever before. Population in the world escalated 4% from 2010 to 2013 and registered vehicles increased 16% within same duration that triggered vehicle miles travel (VMT). According to World Health Organization [1] over 1.25 million people die each year and 50 million people got fatally injured in road traffic accidents where 90% deaths occur in low and middle income countries. Road traffic accidents are the leading cause of death among 15 to 29 years aged people [1]. Various factors are considered which cause the road traffic crashes. They are divided into three categories: human factors (driver's behaviour, age, driving experience), environment related factors (roadway characteristics, weather condition) and vehicle related factors (vehicle condition). Singh [2] investigated the critical reason instigating the road traffic crashes. He evaluated more than 2 million crash events involving 4 million vehicles and 3.9 million drivers and found out that critical reason for crash to happen was driver in 94% of crashes. According to past literature, primary sources of Road Traffic Crashes (RTCs) include risky driving, over-speeding, ignoring use of safety restraints and increase traffic volumes on the section. Reducing risky driving can curtail the chances of crashes and injuries on road.

Therefore, extensive research efforts were carried out to understand the aberrant driving behaviour which provide better insight to investigate the reasons and enhance the road safety [3]. Among human factors, as reported by Evans [4]; driver behaviour is the most crucial, like what driver does has much



more prominent impact on safety than driver's execution like what driver can perform. Evans [5] suggested that improving road user's behaviour can enhance overall road safety on road networks. It is therefore, important to figure out the human factor and its association to RTCs especially in the developing countries in order to reduce risk and improve safety on the roads [4, 6, 7]. RTCs can be evaded by taking proactive safety measure as it is evident from past studies that human behaviour is major contributing factor in road traffic crashes and hence there is a lot of need to study cognitive behaviour that motivates drivers to be involved in Road traffic crashes. This study focused on drivers' errors, violation and lapses and tried to determine the correlation between these to better understand driver behaviour. The scope of study was capital city of Pakistan.

2. Literature review

Road traffic injuries are predictable and preventable, but good data are important to understand the ways in which road safety interventions and technology can be successfully transferred from developed countries where they have proven effective. Reason of road traffic accidents are complex but mostly depends over the characteristics of drivers, their experience and familiarity of road skill level [8]. The causes of motor vehicle collisions are complex, but broadly depend on characteristics of drivers. Skill level [8], inexperience [9] and risk taking behaviours [10] have been implicated in the collisions of young drivers compared to drivers in other age ranges. Investigations of vehicle collision records have also implicated excessive speed [11, 12], driving recklessly [12] and traffic violations [11].

Drivers often engage in behaviours that pose a risk to both themselves and to other road users. While many of these unsafe actions are active, conscious rule violations, others are the result of errors due to inexperience, momentary mistakes or inattention. Intentional or not, both rule violations and deficiencies in memory, judgment, or situational awareness can and do contribute to traffic collisions [13, 14]. Wickens *et al.* [15] analysed Driver Behaviour Questionnaires of 115 undergraduates of the university and found out the correlation among errors, lapses and violations. He found out that as the lapses increase, drivers tend to observe more errors and violations and vice versa. Strongest correlation was found out between errors and lapses which seems logical that as drivers observe more lapses while driving, they tend to perform more errors. Westerman and Haigney [16] have found the similar correlation among violation, lapses and errors [16]. Lucidi *et al.* [17] evaluated Driver Behaviour Questionnaires responded by 1008 high school students in Italy. He divided the students into three subgroups: risky drivers, worried drivers and careful drivers. After applying cluster analysis on data, results show that drivers in the subgroup of "careful drivers" committed less violations, lapses and errors than the drivers in subgroup of "risky drivers". Drivers in the subgroup of "worried drivers" showed medium profile than the other two subgroups. Whereas, drivers who belong to subgroup "risky drivers", showed risky profile. They committed more violations, errors and lapses than the other two groups of drivers. The above results show that violations, lapses and errors are interrelated with each other.

Blockey and Hartley [18] found out that young drivers commit more dangerous errors and dangerous violations than elder drivers. Females commit more dangerous errors than males and Males commit more dangerous violations than females. Because of this, there is a need for tools that can measure these behaviours and the frequency with which they are committed, and can determine which specifications predict traffic collision involvement. One of the most extensively used tool to evaluate the driver's behaviour is through Driver Behaviour Questionnaires [19, 20] which was initially developed by Reason *et al.* [21]. The original Driver Behaviour Questionnaire had 50 items which were categorized into errors, lapses and violations. Errors can be defined as those wrong plans which are unsuccessful to attain its desired purpose. Violations are defined as intentional behaviours that directly break traffic laws, for example drivers do not obey the speed limit and other traffic signals on the road. Whereas, lapses are not associated with any crash involvement. These are the mistakes which are due to the failure of memory, for example driver forgot to turn off the light when leaving the car.

Many researchers have studied the driver's behaviour and their involvement in crashes using Driver Behaviour Questionnaire. Stephens and Fitzharris [22] validated the Driver Behaviour Questionnaire on drivers in Australia and found out that Driver Behaviour Questionnaire is invariant to gender and drivers

group with age ranging from 26 to 64 years old. Rowe et al. [23] found out that errors and violations are significantly correlated and predictor of crash involvement. Koppel *et al.* [24] investigated that how errors, lapses and violations change over time among aged drivers. He evaluated the Driver Behaviour Questionnaire responded by older drivers (77 to 96 years old) and found out that errors showed the same frequency while lapses and violations showed a minimum decrease in frequency among older drivers. Curry *et al.* [25] investigated the crash rates among young drivers and found out that age at licensure and driving experience influence the crash rate and crash rate increases as young drivers transition from an intermediate to full licensure. Vahedi *et al.* [26] investigated aberrant driver behaviour among taxi drivers in Iran and found out that there is positive correlation in violations and accident involvement. Helman and Reed [27] validated that Driver Behaviour questionnaire is valid tool to measure the observed behaviour in real driving.

3. Methodology

To find the correlation between violation, errors and lapses, Pearson correlation coefficient was used. The Pearson product-moment correlation coefficient (referred as Pearson correlation coefficient) is a tool to measure the strength of linear association between two variables [28]. It has been developed by Karl Pearson in the 1895 [29] and it can take any value between -1.0 to +1.0, where negative value indicates negative association, positive value indicates positive association and 0.0 value indicates no correlation. It has been widely used in the field of science. Many researchers have used Pearson correlation coefficient to find to the linear association between variables while investigating driver behaviour questionnaires [30–33]. Pearson Correlation Coefficient is calculated by using the following formula:

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{(\sum(x-\bar{x})^2\sum(y-\bar{y})^2)^{1/2}} \quad (1)$$

This research comprised of working on primary data. In order to measure driving behaviour a questionnaire was developed from Manchester driving behaviour questionnaire and was tailored according to Pakistan's context. After the modification of questionnaire, a pilot survey was conducted with the faculty of National Institute of Transportation (NIT) Pakistan for further rectification. After which a final version of driving behaviour questionnaire was developed.

Questionnaire consisted of four section, in the first section it was about the demographic information about the drivers age, driving experience, education level, gender, previous involvement in road traffic crashes and on their previous driving experience and driving habits what are their likelihood to be involved in road traffic crash. Second section of the questionnaire comprised of the violation that how often do you disregard the use of seat belt while or crossing the intersection while traffic light turned red or overtake slow moving vehicle from wrong side (i.e. left side). Third section of the questionnaire was comprised on Errors that how often you forgot to see rear-view mirror before changing lane or pulling out or hitting vehicle while backing up. Thus, fourth section of the questionnaire encompasses the lapses that how often do you forgot your headlights on high beam on two-way road or fail to give right of way to overtaking vehicle. Questionnaire was translated into Urdu so that people who do not know English can answer the questionnaire.

Data was obtained through questionnaire survey from different parts of Islamabad and Rawalpindi. Drivers were given Driver Behaviour Questionnaire and were asked to rate their responses on Likert Scale from Never to Nearly all the time. Questionnaire was designed to gathered information about frequency of driver's involvement in Violations, Errors and Lapses. Data was collected on different times of the day i.e. peak and off peak hours. Data was collected from male as well as female drivers. Data included variables such as violation, errors and lapses. Statistical Package for Social Sciences (SPSS) version 16 had utilized for data analysis and present the results. Table 1 shows the descriptive statistics of the data obtained from the questionnaire. Whereas Figures 1 to 3 show the descriptive statistics of errors, lapses and violations respectively.

Table 1. Descriptive statistics.

	Mean	Std. Deviation	N
Violation	2.3813	.54783	250
Errors	2.4644	.43903	250
Lapses	2.5385	.41820	250

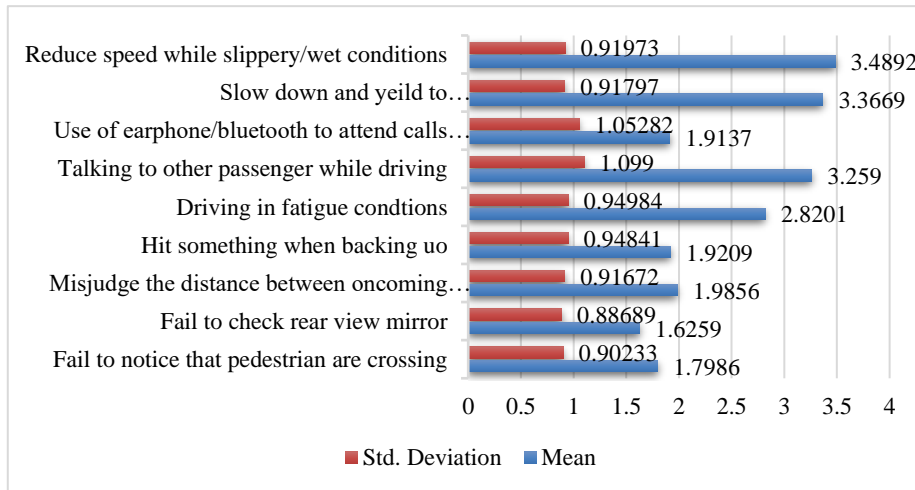


Figure 1. Driving error descriptive statistics.

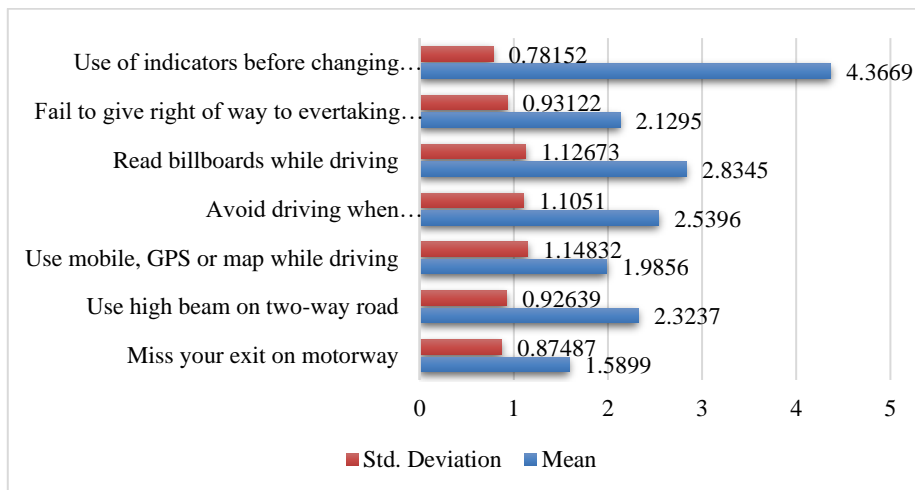


Figure 2. Driving lapses descriptive statistics.

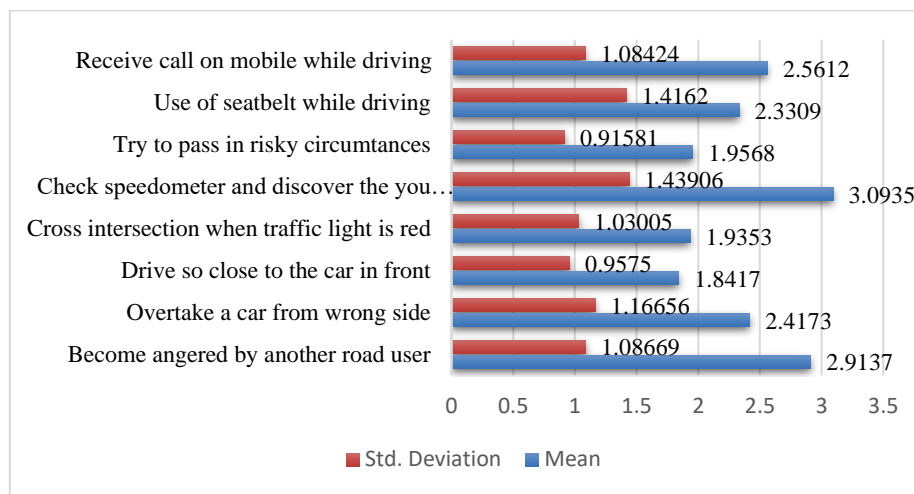


Figure 3. Traffic violations descriptive statistics.

4. Results and discussion

Data obtained from Driving Behaviour Questionnaire was translated into SPSS and Pearson correlation analysis was carried out to estimate the correlation between error, lapses and violation. Table 2 shows the correlations among violation, errors and lapses. It was estimated from the Pearson’s bivariate correlation analysis that traffic violations positively associated and correlated with lapses during driving ($r = .388^{**}$, $p < .01$). Correlation of traffic violations with driving errors was estimated to be positively associated and correlated ($r = .232^{**}$, $p < .01$). For instance, if a driver is more engaged in traffic violations its probability for lapses during driving is more as compare to errors. This is because of the reason that while drivers are violating any traffic rule they are more liable to make errors and lapses.

Table 2. Correlations among violation, errors and lapses.

		Violation	Errors	Lapses
Violation	Pearson Correlation	1	.232**	.388**
	Sig. (2-tailed)		.006	.000
	N	250	250	250
Errors	Pearson Correlation	.232**	1	.273**
	Sig. (2-tailed)	.006		.001
	N	250	250	250
Lapses	Pearson Correlation	.388**	.273**	1
	Sig. (2-tailed)	.000	.001	
	N	250	250	250

** Correlation is significant at the 0.01 level (2-tailed).

It was estimated from the Pearson’s bivariate correlation analysis that driver’s errors are positively associated and correlated with traffic violations during driving ($r = .232^{**}$, $p < .01$) and correlation of driver’s errors with driver’s lapses was also estimated to be positively associated and correlated ($r = .273^{**}$, $p < .01$). It can be estimated from the results obtained through statistical analysis that those drivers, who are engaged in errors, are more liable to lapses as compare to violations. For instance, if a driver has missed to notice that a pedestrian is crossing while turning to street from main road is more liable to make lapses like turning wipers instead of indicators. It was estimated from the Pearson’s bivariate correlation analysis that driver’s lapses are positively associated and correlated with traffic violations during driving ($r = .388^{**}$, $p < .01$) and correlation of driver’s lapses with driver’s errors was estimated to be positively associated and correlated ($r = .273^{**}$, $p < .01$). It can be determined from the results obtained that drivers involved in lapses are more likely to be involved in violations then errors.

For instance, if a driver has misjudged the exit on an expressway, he or she is more likely to involve in violation like overtaking from wrong direction.

5. Conclusion

Abrupt behaviour plays significant role in adoptability of traffic laws and regulations showing in hand leverage in errors, lapses and violations. Research outlined that the large number of accidents are not accidents by any means those are crashes that might be evaded, though, many types and causes of accidents are varying in nature. Similarly, accidents are typically described as misfortune or unexpected event with actually no obvious cause and this piece of research contribute to novel approach about driver behaviour. The research outlined that mainly three types of misconducts are identified that contributes to violation, lapses and errors and identified their correlation in arduous perspective. This correlation might occur due to rashness and inattentive behaviour of drivers. The results also estimated that if drivers are involving in traffic violations their likelihood to be involved in lapses and errors is evident. This study can be further enhanced by incorporating larger sample size and in various cities of Pakistan to measure comprehensive view about the driver behaviour in Pakistan.

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