IJTE, Vol. 9, No. 3, Winter 2022, pp. 667-679

Research Paper

Driving Experience of Commercial vehicle Drivers-A Factor for Behavioral Modelling – Indian Highways

Shabana Thabassum [1,*], Dr. Molugaram Kumar[2]

Received: 2021/02/16 *Accepted: 2022/01/29*

Abstract

One of the pivotal aspects traffic engineering comprehends is the study of the behavior of vehicle drivers in a traffic stream because it contributes much towards safe driving and the prevention of accidents on roads. It provides supportive enlightenments to Engineering, Enforcement, and Education (EEE) measures in identifying and developing solutions for problems relating to safety on roads in India. A study is on truck drivers plying their vehicles on two-lane undivided rural roads (National Highways). This study is to model and analyze their behavior Vis a Vis their experience under prevailing roadways and traffic conditions in India. We used the modified Manchester Driver Behavior Questionnaire (DBQ) with site-specific and local conditions on a group of truck drivers plying their vehicles on a two-lane undivided carriageway at NH-161, NH-16, NH-844, and NH-319 in India, to analyze the driving practice of commercial vehicle drivers for this study. We applied the concept of factor analysis and Analysis Of Variance (ANOVA) for modelling. Models demonstrated a strong relationship between driving experience Vis a Vis the number of violations. It showed that increased driving experience decreased the quantum of errors and lapses. The study revealed that drivers having driving experience of 2-5 years are more prone to traffic violations than others as such they require free or/and forced educative grooming for safety while driving under the EEE concept. Drivers, having less experience, showed fewer proclivities for committing mistakes than others as they, being new to driving, concentrate more on safe driving.

Keywords: Driver Behavior Questionnaire, Factor analysis, ANalysis Of Variance, Road Side Interview (RSI) technique

[*] Corresponding author. E-mail: shabana.t27@gmail.com

[1]Ph.D. Candidate, Dept.of Civil Engineering, University college of Engineering, Osmania University, Hyderabad.

[2] Professor, Dept. of Civil Engineering, University college of Engineering, Osmania University, Hyderabad.

1. Introduction

Road network has a key role to play in the development of an area. It has a significant impact on the pace, structure, and pattern of a nation's development. Nowadays, Road transport has become an integral part of human life. Everybody is a road user in one aspect or the other. The present transport system has curtailed the distance but it has developed many grave risks to human life. The continuous accretion of traffic on roads is a matter of great concern as it poses many serious hazards to the life of road users. It has become a cause of injury and death for human beings across the whole world, killing more than 1.35 million globally, as reported in the Global Status report on Road Safety 2018, with 90% of these casualties taking place in developing countries. In India itself, about 80,000 people die in road crashes every year. It is 13% of the total fatality all over the world. For a large number of these crashes, the man behind the steering wheel is mainly responsible. In most cases, crashes occur either due to careless or unmindful behavior of drivers on roads. Hence, road safety education is as essential as other basic skills of survival [Morth report, 2019].

In India, transport, being a critical infrastructure, has a great impact on its economic development. However, as there is economic growth in the country, the number of commercial vehicles on roads is increasing day by day. At the same time, the number of non-expert truck drivers is also escalating exponentially. Road safety is an issue of National concern but considering its magnitude and gravity and the consequent impact on the economy, public health, and general welfare, it has gained greater importance [Morth report, 2010]. As most of the drivers are novice, uneducated, unskilled, inexperienced, oblivious of the vehicle conditions, and not cognizant of traffic rules and regulations, the Driver factor has become the main cause of a majority of traffic accidents. In a large number i.e. Half of the truck accidents [Lawton R., et.al. 1997] the human factor is responsible. This makes understanding, analyzing, and realistically modelling human driver behavior extremely important for ensuring augmentative safety on roads. Frequent truck accidents are occurring on National highways in India. The Ministry of Road Transport and Highways at the Centre, consulting and collaborating with States, Vehicle manufacturers, and NGO's is endeavoring to start training vehicle drivers. The necessary trainings to the drivers in India are imparted by Model Driving Training Centers, with state of art infrastructure, have been established in the form of the Institute of Driving Training and Research, Regional Driving Training Centers, and Driving Training Centre.

Government of India is planning to establish driving training centers in all the districts of the country, for regular refresher-training programs for heavy commercial vehicle drivers. This step on the part of the government will go a long way in improving safety conditions on Indian roads effectively.

A report on road accidents, in India, in 2019, published by the Transport Research wing under the Ministry of Road Transport & Highways, The Government of India, has revealed that, in 2019, States and Union Territories (UTs) reported a total of 4,49,002 road accidents. Therein 1,51,113 persons died, and 4,51,361 persons were injured. The number of 4,49,002 accidents and 1,51,113 deaths in 2019 translates into an average of 1,230 accidents and 414 deaths per day and nearly 51 accidents and 17 deaths per hour. National and State highways, which accounted for about 5% of the total road network, witnessed a disproportionately large share of accidents of 55% and accident-related

fatalities of 63% during the year 2019 and thus naturally became the focus of attention. Most of these accidents were due to higher vehicle speed. In the case of more than 90% of the crashes examined, errors on the drivers' part contributed mainly. In all the road accidents that occurred on National highways in 2019, the share of heavy commercial vehicle drivers is about 11%. Driving on the wrong side/lane discipline and driving in a drunken condition are the two traffic rule violations that collectively account for nearly 10% to 12% of road accidents and 9 % to 10% of road accident deaths on different categories of National Highways.

Manifold are the reasons for road accidents as that result from the interplay of diverse factors. These factors fall under the categories of Human error, Road environment, and Conditions of roads. These factors act interactively leading to road accidents. Therefore safe systems approach should form the basis of all strategies for framing countermeasures to avoid accidents. It simultaneously recognizes the importance of traffic legislation for promoting safe road user behavior, safe road designs (lane width, shoulder presence, number of lanes, median, vehicle design), and safe vehicle design that come under EEE measures. Considering the total road accidents and deaths caused by them, the share of over speeding comes to 47.9 % and 44.2 %, respectively. Accidents and deaths caused due to "Intake of alcohol/drugs" within the category of drivers' fault accounted for 4.2% and 6.4%, respectively [Morth report, 2015]. The truck-driver behavior analysis models give details about the driving styles and patterns of users according to their experience, and driver behavior prediction models give details of information about the driver's driving; whether it is safe or not.

In India, 80% of the National Highways are still with the configuration of two-lane undivided carriageway passing through rural areas. This study is to know about the behavior Vis a Vis the experience of truck drivers in a traffic stream as one major factor of their behavior and to suggest actions to Engineering, Enforcement, and Education (EEE) measures in identifying road safety problems in India and develop solutions for them. The current study comprises Road Side Interview (RSI) technique with the support of the Manchester Driver Behavior Questionnaire (DBQ) employing site-specific and local conditions to a group of truck drivers on two-lane undivided carriageways at different locations within the country and analyzing their driving behavioral pattern taking into consideration their driving experience as a factor.

2. Driver Behavior - Engineering, Enforcement and Education (EEE) measures

It has long been a fact that though driving in a relatively error-free manner accomplishes safe driving, yet Intentional violations and risk-taking are also significant determinants on which road safety depends. More than 70% of driving accidents occur due to human error. Several researchers have attempted to explore various errors and their attribution to traffic accidents. [Hakamies and Blomquist, 2006] classified the direct causes of accidents into four categories: incapacity of action, observation error, estimation error, and driving error. Errors are by-products of human information processing or cognitive functioning of human beings [Parker, D. et al. 2007]. Individual differences in cognitive ability can lead to different types and rates of errors that people commit in the same situations [Broadbent, D. E., et al. 1982]. Some studies have demonstrated that accident and traffic violation rates are lower for trained riders than for untrained riders.

Others reported those higher for trained riders [Allison Daniello, et. al. 2009]. [Hollnagel, E., et al. 1999] stated that studies on human error mainly focused on taxonomy development rather than predicting error occurrence. Cognitive failures are failures in perception, memory, and motor functioning, in which the action does not match the intention.

Engineering, Enforcement, and Education (EEE) measures to provide education to commercial drivers comprise the various measures followed by the Indian Government to bring down the accidents. Educational maneuvers are specially to extend support to road users. The driver behavioral modeling is an aid in enforcing educational measures in terms of driver education and providing safety drives. Educating the road users about various safety measures to use the roadway facilities is vitally essential.

3. Manchester Driver Behavior Questionnaire (MDBQ)

[Brown, I. D., 2011] discussed how roadside observation of drivers' errors provides a valid index of their relative riskiness and overall accident frequency. Field testing of hypotheses developed from theories of driver's error is considered far more valid and arguably a more cost-effective method of improving road safety than relying on post hoc subjective assessments of error contributions to accident statistics. Manchester Driver Behavior Questionnaire (DBQ) consists of 50 items describing a variety of errors and violations during driving [Reason, J. et al. 1990]. The Driver Behavior Questionnaire (DBQ) mainly forms a predictor of self-reported road traffic accidents. Since the publication of Reason's research results in 1990, there exist many studies conducted on the behavior of drivers in different countries. The associations between crash, violation, and error factors of the DBQ are spuriously high due to bias reporting [Wahlberg, et al. 2011]. A study on truck drivers' behavior in New Zealand found that the DBQ structure and the relation of its subscales with accidents are different from those of the studies on regular car drivers [Sullmann et al. 2002]. It is worth noting that several studies used the English and Spanish versions of the 28-item DBQ questionnaire. The original questionnaire is modified based on the site and local condition of the study areas and is divided into errors, lapses, and violations to validate the driver's experience. Further violations are categorized into aggressive and ordinary violations (including the ignorance of the rules without any aggressive incentive) [Lawton, R., et al. 1997] shown in Table 1. Violations represent the style in which the driver chooses to drive and habits established after years of driving. Respondents had to specify, how often each deviation occurred to them during their driving on a scale of 1 to 5 where 1 is very rarely to never & 5 is nearly all the time.

Table 1. Driver Behavior Questionnaire (DBQ)

Type	S. No.	Description
Errors	E1	Misjudging the speed of the oncoming vehicle when passing through an adjacent vehicle.
	E2	Attempt to pass a vehicle that you had not noticed was signaling its intention to turn right.
	E3	Drive especially close or flash the light in front as a signal for that driver to go faster.
	E4	Misjudge the road surface characteristics and when braking find the distance to stop to be longer or shorter than you expected
	E5	Without checking the vehicle condition like brakes and accelerator etc.
Lapses	L1	Try to overtake without first checking your mirror, and then get hooted at by the vehicle behind which has already begun overtaking maneuvers.

Type	S. No.	Description
	L2	Deliberately disregard the speed limits late at night or very early in the morning
	L3	Exceed the speed limit to catch up or avoid being late
Ordinary Violations	OV1	Become impatient with a slow driver and try to overtake
	OV2	Overtake a slow-moving vehicle on the opposite direction lane or hard shoulder
	OV3	Forget to dip the lights when driving during dark hours and is reminded by other drivers flashing their lights.
	OV4	Long journey driving without intermediate brakes.
	OV5	Using the cellular phone/Electric devices while driving.
Aggressive Violations	AV1	Stuck behind a slow-moving vehicle and frustration driven you to try to overtake in risky circumstances.
	AV2	Drive back from a gathering, even though you realize that you may be over the legal blood-alcohol limit.
	AV3	Get involved in unofficial 'races' with other drivers.
	AV4	Sound your horn unnecessarily and try to disturb other road users

4. Data collection and Study Methodology

We adopted the Road Side Interview (RSI) technique as the field method for collecting data for the study. Two-lane undivided carriageways with or without paved shoulders of National Highway-161 near Sultanpur in Telangana, NH-16 near Ranasthalam in Andhra Pradesh, NH-844 near Palacode in Tamilnadu, and NH-319 near Semari in Bihar constitute the study stretches under consideration. We selected appropriate locations to conduct interviews without affecting the movement of other vehicles with the help of traffic police. The answers to the prescribed questionnaire collected on the spot. A sample of well above 60% drivers was targeted to obtain fair representative data. We carried out a survey of volume count simultaneously to assess the sample size. This survey is limited to Trucks (2 Axle / 3 Axle / Multi Axle) in the freight vehicle category as these are long-distance traveling vehicles. These drivers work in different cargo companies and travel long hours on highways to transport cargo. The team enquired from drivers whether they were interested in participating in this research. Most of the drivers agreed to participate in the study

without applying force to make their responses reliable. Figure-1 shows photographs illustrating the survey, the team collected samples totaling 2009 during the survey and distributed these according to the driving experience of the truck drivers. In this case, the mean age of the drivers is 33.2 years and the mean experience is 4.83 years. The methodology for carrying out the present research work is in the shape of a flow chart in Figure 2.

Figure 1. Roadside Interview Questionnaire survey

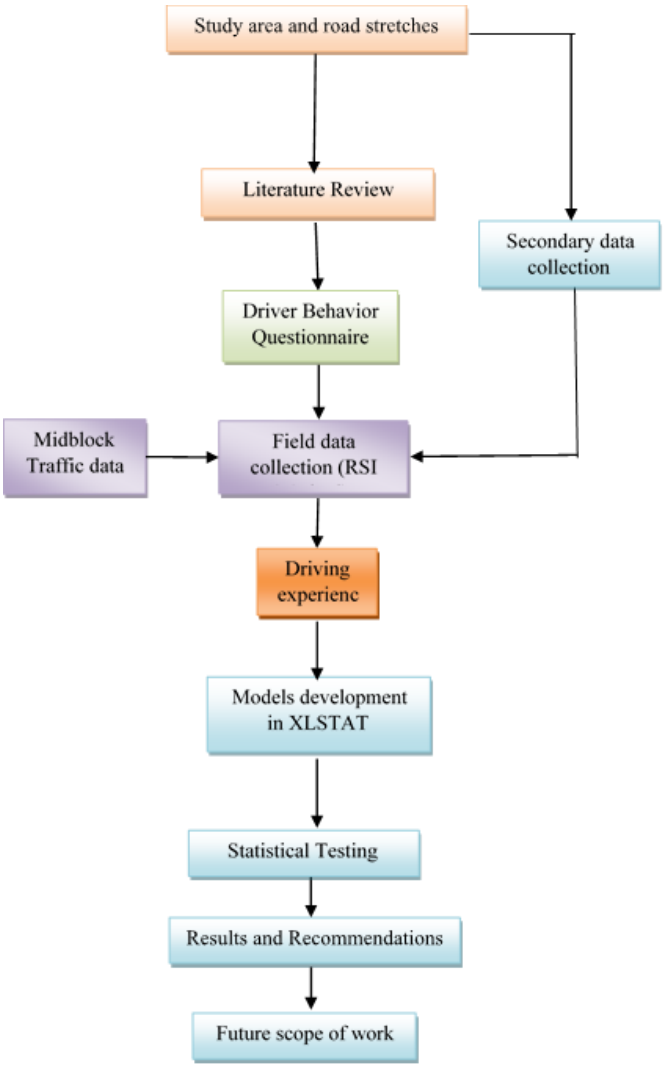

Figure 2. Study methodology flow chart

Table 2. Sample characteristics

Variable	Group	Driving Experience in Years	NH-161		NH-16		NH-844		NH-319	
			Number	%	Number	%	Number	%	Number	%
Driving Experience (years)	E_1	> 1.0	84	19%	104	20%	49	8%	17	4%
	E_2	1.0 to 2.0	165	37%	49	10%	205	34%	16	4%
	E_3	2.0 to 5.0	75	17%	169	33%	138	23%	138	31%
	E_4	5.0 to 10.0	78	17%	64	13%	69	11%	109	25%
	E_5	10.0 to 15.0	27	6%	94	18%	105	17%	96	22%
	E_6	15.0 to 20.0	15	3%	19	4%	35	6%	49	11%
	E_7	< 20.0	6	1%	12	2%	3	0%	19	4%

5. Factor analysis

Factor analysis is a tool to curtail the number of explanatory variables bringing them to fewer factors (Groups). This technique extracts maximum common variance from all variables and puts them into a common score. This study uses factor analysis to determine the questionnaire's structure and to check the variance of different questionnaire groups. We ensured that the questionnaire structure is truthful and questions in each group correlate with each other to form one factor of analysis.

We used the ANOVA (Analysis Of Variance) model to understand significant differences between various questionnaire groups. The mean and standard deviation (SD) of the DBQ questions at four surveyed locations is calculated and given in Table 3 and Figure 2. The table shows that the most frequent mistake committed by drivers is "Attempt to pass a vehicle that he hadn't noticed was signaling its intention to turn right" (mean value 3.745) and the lowest mistake is "using the cellular phone/Electric devices while driving" (mean value 1.702).

Table 3. Means and standard deviation of DBQ

Type	S. No.	NH-161		NH-16		NH-844		NH-319	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Errors	E1	3.442	0.876	3.143	0.825	2.569	0.795	2.896	0.832
	E2	3.216	0.733	2.586	0.635	3.415	0.745	3.745	0.704
	E3	2.920	0.834	2.360	0.578	2.640	0.806	3.158	0.739
	E4	2.651	0.849	3.250	0.451	2.951	0.665	3.695	0.655
	E5	2.111	0.852	2.408	0.958	2.260	0.917	3.405	0.698
Lapses	L1	3.302	0.953	2.853	0.992	3.078	0.875	3.042	0.940
	L2	2.880	0.926	2.940	0.874	2.910	0.869	2.956	0.890
	L3	2.789	0.823	2.107	0.756	2.448	0.812	2.587	0.797
Ordinary Violations	OV1	3.213	0.861	3.108	0.692	3.161	0.658	2.986	0.789
	OV2	2.893	0.922	3.004	0.867	2.949	0.569	2.586	0.786

Type	S. No.	NH-161		NH-16		NH-844		NH-319	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
	OV3	2.458	0.714	2.155	0.569	2.306	0.642	2.106	0.642
	OV4	2.533	0.736	2.693	0.895	3.108	0.816	1.958	0.921
	OV5	1.702	0.921	1.962	0.913	1.832	0.825	2.008	0.886
Aggressive Violations	AV1	2.840	0.758	2.152	0.875	2.496	0.816	2.752	0.816
	AV2	2.460	0.840	2.559	0.748	2.510	0.699	2.169	0.735
	AV3	2.293	0.918	2.653	0.785	2.896	0.852	2.365	0.852
	AV4	2.109	0.642	1.865	0.801	3.177	0.892	3.525	0.982

Figure 3. Survey response mean values

Factor analysis highlights the existence of underlying factors common to the quantitative variables measured in a set of observations. It is a statistical method used to describe variability among observed and correlated variables in terms of a potentially lower number of unobserved variables called factors and to ensure that the variables used to measure the behavioral concept are measuring the concept intended. In order to understand the factor structure of DBQ, the questions were tested by the Varimax rotation method [Kontogiannis et al., 2002; Lajunen et al. 2004]. Cronbach's alpha coefficient, also known as α coefficient is used to evaluate the internal consistency (and hence reliability) of the questions asked in this study. The overall result of Cronbach's alpha test is 0.712 and individually varying from 0.52 to 0.88 for different questionnaire groups and the Kaiser-Meyer-Olkin test of sampling accuracy is 0.873. These values are satisfactory as they are much more than 0.5. The analysis showed that four factors are with eigenvalues more than one and shows the significance of grouping of questions in 4 different groups. Figure 4 shows the factor pattern of the questionnaire for which the squared cosine is the largest. The mean scores of DBQ factors in terms of driving experience is shown in Figure 5.

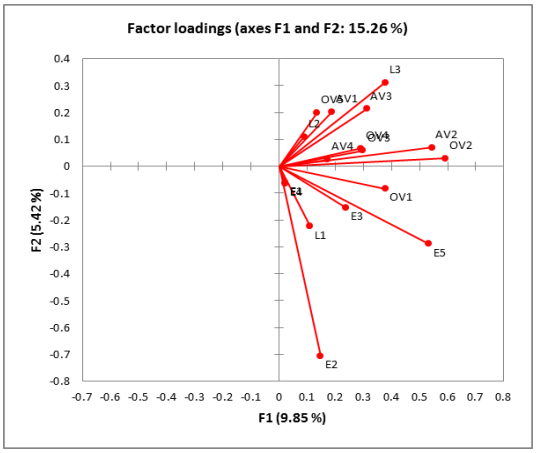

Figure 4. Factor loadings

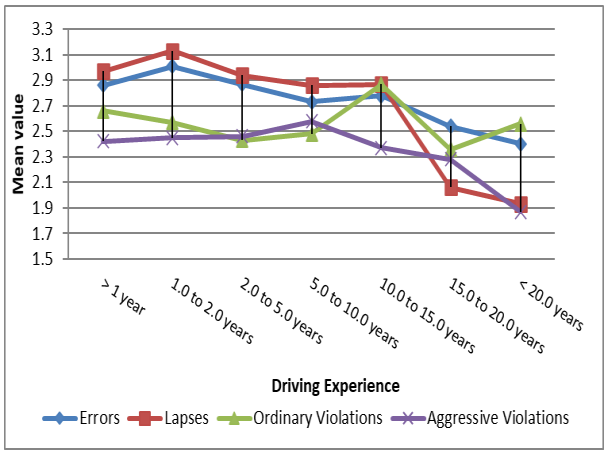

Figure 5. Mean scores of DBQ factors

6. Findings of Drivers' Behavior Modeling in terms of driving experience

Basis of this analysis is the survey conducted at four different locations along two-lane undivided National Highways, on the drivers having different driving experiences, about their behavior while driving. More experienced drivers tend to commit fewer violations than those within the experience bracket of 1 to 2 years and 10 to 15 years. The number of violations in the case of Drivers with more than 20 years of driving experience is the minimum. In other words, drivers with more than 20 years of driving experience tend to commit about 20% fewer violations than the less experienced ones. Drivers with experience ranging from 5 - 10 years are likely to commit more aggressive violations than those of other experience groups as shown in Figure 6. As such, they need free or forced (compulsory) education to improve their driving habits. Drivers with less than one year of experience on rural highways committed fewer mistakes than more experienced ones as they being new to driving concentrate more on driving and safety. Equations from eq. (1) to eq. (7) by considering experience group E1 has the basic effect, as shown below, are used to quantify the relation between the mistake commitments and the driving experience of the driver.

$$L1 = 3.33+0.09*E_2-0.18*E_3-6.41E-02*E_4+0.14*E_5-0.33*E_6-1.5*E_7 \quad (1)$$

$$L2 = 2.83+0.148*E_2+0.2066*E_3-0.089*E_4-0.46*E_5+0.43*E_6-0.99*E_7 \quad (2)$$

$$L3 = 2.76+0.21*E_2-0.10*E_3-0.172*E_4+1.58E-02*E_5+0.17*E_6-0.92*E_7 \quad (3)$$

$$AV1 = 2.77+0.159*E_2+2.61E-02*E_3+8.51E-02*E_4+0.115*E_5-0.24*E_6-0.77*E_7 \quad (4)$$

$$AV2 = 2.5-9.09E-03*E_2+9.99E-02*E_3-0.12*E_4-0.27*E_5-3.33E-02*E_6-1.0*E_7 \quad (5)$$

$$AV3 = 2.28+7.79E-02*E_2-5.71E-03*E_3+9.15E-03*E_4-0.32*E_5+4.76E-02*E_6-0.28*E_7 \quad (6)$$

$$AV4 = 2.11-0.08*E_2+0.04*E_3+6.04E-02*E_4+0.28*E_5-0.31*E_6-0.11*E_7 \quad (7)$$

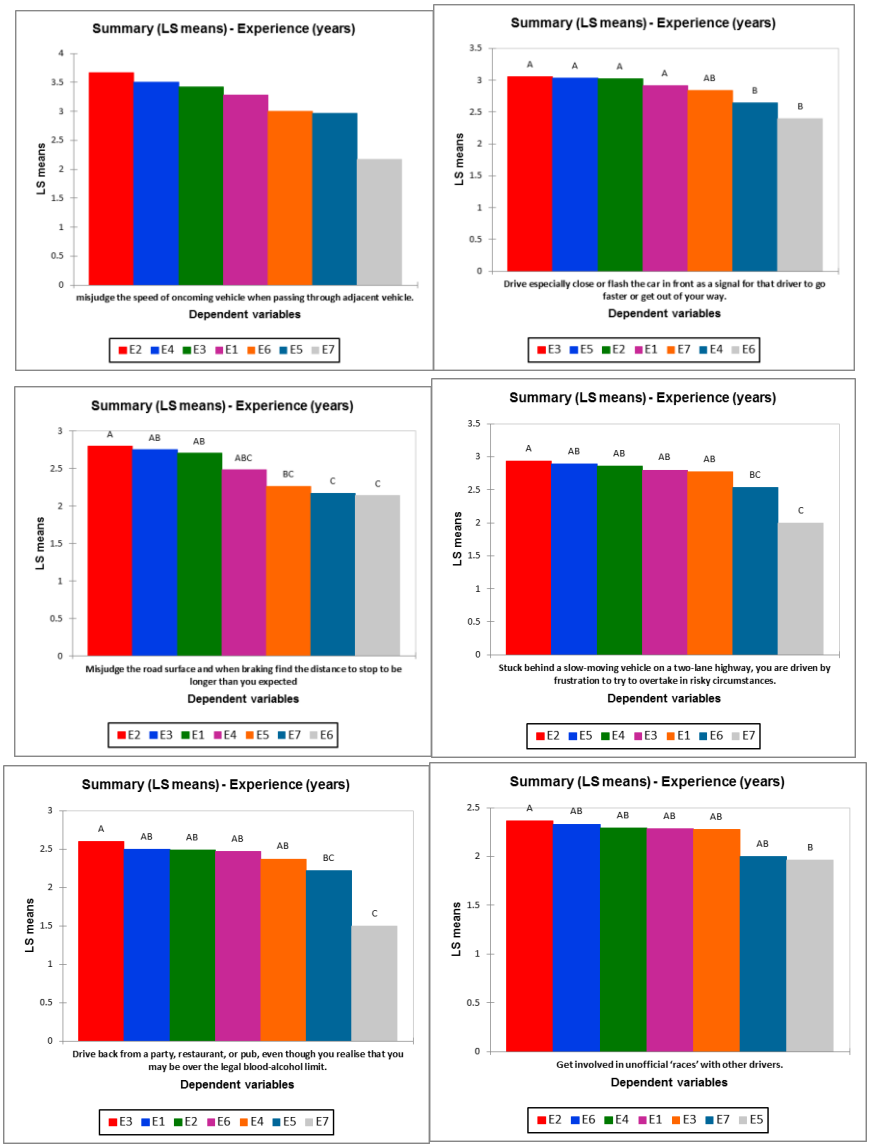

Figure 6. Violation commitment-various scenarios

In the Best model variable selection method, experience group E1 forms the basic variable for the validation of the model. Tukey's HSD (Honestly Significant Difference) test and Fisher's LSD (Least Significant Difference) test examine the hypothesis that all the means for the various categories are equal. These are the most used tests in ANOVA and performed on all variables of the questionnaire groups, as shown in Table 4. It shows that the variables are correlated with the experience range of the driver up to a maximum value of 0.73 and Tukey's critical value of 4.19 enunciates the significance of variables ($Pr < 0.0001$) with a confidence interval of 95%.

Table 4. Fisher's LSD test of DBQ

Type	Fisher's LSD test
Errors	0.175
Lapses	0.191
Ordinary Violations	0.177
Aggressive Violations	0.170

The Pearson correlation matrix in factor analysis indicated that the driver committing the error AV2 is also committing an error E3 at the same rate with a correlation value of 0.846. The driver committing OV4 also commits OV2 at the same rate with a Correlation value of 0.741. The factor pattern indicated that the four factors, which are highly related to the experience of the driver, are:

1. misjudging the speed of the oncoming vehicle when passing through the adjacent vehicle (E1);
2. Attempting to pass a vehicle that you had not noticed was signaling its intention to turn right (E2);
3. Trying to overtake without first checking your mirror and then get hooted at by the vehicle behind that has already initiated overtaking maneuvers (L1); and
4. Becoming impatient with a slow driver and trying to overtake (OV1).

7. Conclusions and Recommendations

The Present study made the following conclusions based on the survey conducted on long-distance traveling cargo truck driver's behavior on National highways with two-lane undivided, carriageway configuration in rural areas:

1. 62% of truck drivers passing the adjacent vehicle commit the error of misjudging the speed of the coming vehicle. It is the most common error that drivers commit along the highways. Therefore, it is a major reason for accidents on two-lane undivided highways.
2. 86% of all drivers try to overtake without first checking the mirror. While overtaking, vehicle behind which has already initiated overtaking hoot at them.
3. Factor analysis done, on the questionnaire variables, showed that the driver behavior questionnaire is a 4-factor structure with tolerable internal correlation coefficients.
4. Analysis of drivers' behavior in terms of their experience showed that drivers having more experience commit fewer violations than those with experience of 1-2 years who are in the habit of committing more errors.
5. Drivers' behavior showed that drivers with 10 to 15 years of experience committed more lapses than other groups.
6. Drivers with experience range 5 to 10 years committed more aggressive violations than other experience groups.
7. Less experienced drivers committed fewer mistakes than more experienced ones as they are new to driving and they concentrated on driving and safety.
8. The inferences of the current study proved that using the behavioral questionnaire in the field on a set of the real sample of drivers, with direct observation is effective in recognizing drivers' behavioral patterns and identifying improper behaviors during driving.
9. The results can help identify a particular driver experience group to provide specific educational measures and levels of education in identifying and finding solutions to road safety problems in India.

10. Imparting correct education to a particular driver experience group is to extend assistance in future planning about highways and thus cut down the rate of road accidents due to human error.

This type of study on commercial vehicle drivers with the use of above-mentioned techniques was for first time in India though with some limitations. For future similar studies, the relationship of other aspects of driver's factor such as strength, literacy level, vision, and speed choice need consideration.

Another field required for study is considering 'the behavioral evaluation of hazard material transport drivers. It is one of the challenges of great interest, which needs consideration especially in Asian countries.

8. References

- Af Wåhlberg, L. Dorn & T. Kline (2011) "The Manchester Driver Behaviour Questionnaire as a predictor of road traffic accidents", Theoretical Issues in Ergonomics Science, 12:1, 66-86, DOI: 10.1080/14639220903023376.

- Allison Daniello, Hampton C. Gabler and Yusuf A. Mehta (2009) "Effectiveness of Motorcycle Training and Licensing", Transportation Research Record: Journal of the Transportation Research Board, No. 2140, pp. 206–213, DOI: 10.3141/2140-23.

- Brown, I. D., (2011) "Driver's margins of safety considered as a focus for research on error", Article in Ergonomics, Volume 33, 2011, Issue 10-11, Pages 1307-1314.

- Changxi Ma , Wei Hao , Wang Xiang, and Wei Yan (2018) "The Impact of Aggressive Driving Behavior on Driver-Injury Severity at Highway-Rail Grade Crossings Accidents", Journal of Advanced Transportation, vol. 2018, Article ID 9841498, 10 pages, 2018. https://doi.org/10.1155/2018/9841498.

- Dianne Parker, James T. Reason, Antony S. R. Manstead and Stephen G. Stradling (2007) "Driving errors, driving violations and accident involvement", Journal of Ergonomics , Volume 38, 1995 - Issue 5, Pages 1036-1048.

- Dr. D. E. Broadbent, P. F. Cooper, P. FitzGerald and K. R. Parkes (1982) "The Cognitive Failures Questionnaire (CFQ) and its correlates", British journal of clinical psychology, February 1982, https://doi.org/10.1111/j.2044-8260.1982.tb01421.

- Erik Hollnagel, Magnhild Kaarstad and Hyun-Chul Lee, (1999) "Error mode prediction", Article in Ergonomics, December 1999, DOI: 10.1080/001401399184811

- Hakamies Liisa and Blomquist, (2006) "Are there safe and unsafe drivers?", Transportation Research Part F: Traffic Psychology and Behavior, Volume 9, Issue 5, September 2006, Pages 347-352.

- Lawton, R., Parker, D., Manstead, A. S. and Stradling, S. G., (1997) "The role of affect in predicting social behaviors: the case of road traffic violations", Journal of Applied Social Psychology, Vol. 27, No. 14, pp. 1258- 1276.

- MoRTH report, 2019. Road Accidents in India 2019, Government of India, Ministry of Road Transport and Highways, Transport Research wing, New Delhi.

- MoRTH report, 2010. Road Accidents in India – 2010, Government of India, Ministry of Road Transport and Highways, Transport Research wing, New Delhi.

- MoRTH report, 2015. Road Accidents in India – 2015, Government of India, Ministry of Road Transport and Highways, Transport Research wing, New Delhi.

- Reason, J., Manstead, A., Stradling, S., Baxter, J. and Campbell, K. (1990) "Errors and violations on the roads: a real distinction?", Ergonomics, Vol. 33, No.10- 11, pp.1315-1332.
DOI:10.1080/00140139008925335

- Timo Lajunen, Dianne Parker, Heikki Summala, (2004) "The Manchester Driver Behaviour Questionnaire: a cross-cultural study", Accident Analysis & Prevention, Volume 36, Issue 2, Pages 231-238.

- Tom Kontogiannis, Zoe Kossiavelou, Nicolas Marmaras, (2002) "Self-reports of aberrant behaviour on the roads: errors and violations in a sample of Greek drivers", Accident Analysis & Prevention, Volume 34, Issue 3, Pages 381-399.

- Victor Corcoba Magana, Xabiel Garcia Paneda, Roberto Garcia, Sara Paiva and Laura Pozueco (2021) "Beside and Behind the Wheel: Factors that Influence Driving Stress and Driving Behavior", Sustainability 2021, 13, 4775. https://doi.org/10.3390/ su13094775.