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Driver Behaviour in Developing Countries: Evidence from Modelling Anger and Aggressive Performance of Nigerian Drivers on Inter-city Trips

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Abstract
The study investigated driver behaviour in a developing country based on Nigerian data. It is assumed that angry and aggressive behaviours are revealed when drivers respond to various traffic situations. The drivers studied included shared-taxi, bus, truck, and impulsive drivers. Impulsive drivers were identified as a particular category of drivers to unravel the influence of the impulsivity of drivers. Drivers' angry and aggressive behaviours were captured from the replies reported when drivers faced a list of hypothetical traffic states prevalent on inter-city roads in Nigeria. The questionnaire used to elicit driver responses was adapted from Manchester's Driver Behaviour *Questionnaire (DBQ). Initially, drivers were asked how frequently they would perform each behaviour on a 6-point scale. Exploratory factor analysis was used to establish the data's principal components and remove highly correlated variables from the data set. Using the SPSS command syntax, the response menu of the new data set was re-coded to generate a yes and no answer, yielding binary data and simulating a binomial distribution. The maximum likelihood logistic regression was then employed to estimate the odds ratios associated with the estimated models. The results show that the anger performance model is a good fit, while the aggression performance model is satisfactory. A probability model of driver behaviour was next derived using the sigmoid function. Overall, the study suggests that the probability of driver aggression was high, while the likelihood of driver anger was even higher. Impulsive drivers revealed higher aggression performance than others. The approach is novel in quantifying the behaviour of drivers of different categories. The findings are also helpful in policy-making to influence driver behaviours on inter-city roads in developing countries.*
Keywords: *Driver behaviour, Developing countries, Nigeria, Factor analysis, Anger, Aggression, Odds Ratios, Probability models*

1. Introduction

Road crash rates in developing countries are about 3-4 times higher than in Western Europe and North America. The severity of road crashes, measured in terms of the number of persons killed in every 100 crashes, has remained high over the years, representing a gloomy picture of transport usage. Over 80 per cent of all crashes can be attributed to human causes. The most important causes of road crashes usually identified in Nigeria relate to driver's errors, arousal state, and experience level. It seems evident that driver behaviour is the fundamental cause of road crashes in Nigeria. While no actual crashes may occur in all conflict situations, cases of near crashes are frequent (Ogwude, 1986; Uzondu *et al*., 2019). This leaves the impression that road usage is very demanding and

stressful. There is much aggression on Nigerian roads, and many drivers are prone to anxieties of different kinds, including anger. Anger and aggression are variables one could relate to stressful driving that leads to road crashes prevalent on inter-city trips in Nigeria. Both behaviours represent a high state of arousal, showing aspects of negative emotions. In stressful environments, the emotional states of anger and aggression relate well to the personality traits of impulsiveness. The factor of impulsiveness, therefore, reveals a personality dimension, the influence of which could give rise to angry and aggressive behaviours during inter-city travels.

1.2 Objectives

This study aimed to investigate the impact of anger and aggression on driver behaviour, inferred from the stated response of drivers when they encounter various traffic conditions while making trips on Nigerian roads. For this purpose, three objectives were addressed, namely: (1) Estimate the level of anger implied when the driver's angry behaviour was performed (2) Estimate the implied level of aggression when the driver's aggressive behaviour was performed (3) Derive a probability model embodied in the estimated anger and aggression levels. 2.1 Literature Review: The study of driver behaviour has been approached from three angles, namely (a) the use of transactional models depicting the level of stress experienced by drivers (Mathews 2002, 2005), (b) the investigation of drivers' perceptions and self-reporting of their response to a range of driving environments (Sullman & Stephens, 2013) and (c) the behaviour of drivers on specific situations, either directly observed or simulated (Stephens & Groeger, 2008; Uzondu *et al*., 2020). The study based on driver perceptions and self-reporting of their responses to various traffic situations is perhaps the most common approach. In this approach, drivers are presented with various traffic scenarios that are known to elicit responses, and they are asked to report their response to the situation, either from a previous experience or hypothetically. In studying driver behaviour and the impact of personality factors relating to driver emotional states, it is expected to adopt a Driver Behaviour Questionnaire (DBQ), such as the frequently employed Manchester version designed initially by Lawton *et al*. (1990). The Manchester DBQ consists of 50 items on specific driving behaviours that can be subdivided into driving mistakes, lapses, and violations. The DBQ has been used in different countries on various categories of drivers. Usually, identified lapses are divided into inattention and inexperience errors, and violations into aggressive or ordinary violations. Comparisons between the results of studies using the DBQ have been somewhat difficult because of differences in cultural settings and the methods employed (Parker *et al*., 2002; Sullman *et al*., 2005; Sullman & Stephens, 2013). The number of DBQ items used varied considerably between studies, as did the sampling strategies, target populations, and statistical analysis. Other variants of driver behaviour questionnaires

apart from the Manchester brand have also been used in the self-reporting studies of driver behaviour. These include the Driver Anger Scale (DAS) Questionnaire (Deffenbacher *et al*., 1994; Deffenbacher *et al*., 2016; Sullman & Stephens, 2013; Ambak *et al*. 2017); the Driver Habits Questionnaire (Owsley *et al*., 1999) and the Dundee Stress State Questionnaire (Mathews *et al*. (2005). The DBQs have been used to study the influence of drivers' anger behaviours. A close link between road crashes and the aggressive behaviours of drivers has also been found. In some cases, drivers with high anger scales showed more anger for a longer duration, more aggressive behaviour, and more road crashes than drivers with lower levels of anger (Deffenbacher *et al*., 2002, 2003). Research approaches based on self-reporting have also found that aggressive driving produced road rage and was also likely to provoke intentions to retaliate from other drivers (Dukes *et al*., 2001; Alonso *et al*., 2019). The factors described in the DBQ impact other facets of driver behaviours. These include anxiety, angry hostility, depression, self-consciousness and impulsiveness. The personal factor of impulsiveness has been shown to impact driving behaviours and safety on the road (Lawton, Parker *et al*., 1997; Renner & Anderle, 2000). Eysenke and Eysenke (1978) addressed the influence of impulsiveness, venturesomeness, and empathy on drivers, using 63 questions requiring either yes or no answers. Owsley *et al*. (2003) suggested that drivers who reported high scores on DBQ violations were more likely to score highly on the effect of impulsiveness. This suggests the importance of personality dimensions in the study of driver behaviour, perhaps justifying the use of impulsivity of drivers in the arguments as well. In the literature, aggressive behaviours are often linked with impulsive personalities, as are the factors of anxiety, stress and anger. The present study complements existing literature by adapting the DBQ to study an aspect of driver behaviour in a developing country for the first time. Its central argument is that impulsiveness, anger and aggression combine to moderate the behaviour of drivers in the Nigerian context, where driving on the road is seen as stressful and demanding because of unfavourable traffic and road environments.

3.0 Methodology 3. 1 Driver Behaviour Survey A survey of drivers was carried out to obtain data for the study. The survey focused on professional drivers in the following categories:

i. Taxi Drivers (drivers of shared passenger cars used as public transport)
ii. Bus Drivers (drivers of conventional buses and minibuses used for public transport)
iii. Truck Drivers (drivers of trucks, tankers and trailers)
iv. Impulsive Drivers (drivers identified with impulsive behaviours from the surveys)

3.1.1 Direct Interviews with Questionnaires

The drivers were interviewed directly by trained survey assistants using questionnaires. The traffic situations addressed in the interviews were adapted from the Manchester Driver Behaviour Questionnaire (DBQ). Although DBQ was initially concerned with the study of lapses and violations of drivers, as earlier noted, it would seem evident that the lapses and violations of a driver in traffic situations could irritate other drivers, leading to the performance of anger or aggressive behaviours. The questionnaires were in four parts. The first part sought information on the drivers' background, while the second and third parts addressed drivers' anger and aggression performance. The questionnaires identified traffic states that evoked various responses from drivers who encountered them. For example, drivers were asked whether they would get angry if "someone makes an obscene gesture towards you", "when you are stuck in a traffic jam", and "when someone speeds up when you try to overtake them". The performance of aggression is provoked when the traffic state is caused by drivers imposing on others. For example, drivers abuse others who make them angry, "shoot headlights on other drivers", and " often chase offending drivers." The fourth part concerned identifying impulsive drivers. A drivers who admitted doing things on the spur of the moment, performing frequent lane changes, and showing impatience in traffic streams, was assumed to be impulsive for the purpose of this study.

3.1.2 Survey Stations and sample size

The survey of drivers took place at motor parks while the drivers of passenger vehicles were waiting for their full load of passengers before the commencement of inter-city trips. The truck drivers, on the other hand, were interviewed while on planned idle time at lorry parks in the course of their journeys. The survey stations selected were located in six capital cities across the six geopolitical zones of Nigeria, namely, Bauchi, Beni-city, Enugu, Kaduna, Lagos and Sokoto. Altogether, 500 questionnaires were administered, but 454 of them were correctly filled and collected. Eventually, 452 questionnaires were used due to two missing cases during data entry. 3.2 Exploratory factor Analysis Exploratory factor analysis was used to investigate the data structure and reduce the number of factors that were used in the estimation of the log -odds which are the basic arguments of this study. This served the purpose of streamlining the study by removing the highly correlated variables from the data set. The Principal Components Analysis (PCA) revealed ten key components of the traffic states encountered by drivers.

3.2.1 Principal Traffic States

Those principal components and 27 traffic states constituted the factors which provoked performance of angry and aggressive behaviours from drivers who encountered them. The principal components were interpreted as: 1- Confrontational driving 2- Aggressive

violation of traffic rules 3- Obstruction and inconvenience from other drivers 4- Resentment of discourtesy from other drivers 5- Being discourteous to other drivers 6- Impulsivity of driver 7- Effects of traffic intrusion 8- Impulsive dissonant driving 9-Effect of visual intrusion and 10-Traffic congestion effect. The factors embedded in the components accounted for about 60.2 percent of the total variance in the traffic states, with only 2.57 percent loss of information. The 27 traffic states constitute the argument of the study, and are reported in Table 2. They have been grouped under their associated components, with their corresponding factor loadings reported.

Table 1: The principal Components and Associated Traffic States

Component		Associated traffic state
1	**Confronting driving**	
	Nearly hit a car in front of you	0.750
	Often overtake on inside lane or by right	0.678
	Often drive with headlight on	0.524
	Often face oncoming vehicle on express way	0.539
2	**Aggressive violation of traffic rules**	
	Often force self on other vehicles	0.689
	Often disregard speed limits	0.683
	Foten speed in residential areas	0.670
	Often try to beat traffic light	0.650
3	**Obstruction and inconvenience from other drivers**	
	Angry if night vehicle shoots light at mirror	0.731
	Angry if someone speeds and overtake	0.639
	Angry if opposing vehicle does not deem light	0.706
	Angry if someone wants you to overtake when it is not safe	0.516
4	**Discourtesy from other drivers**	
	Angry when horned to	0.731
	Angry when shouted upon	0.650
	Angry when obscene gestures are made to you	0.602
	Angry when stopped by police/FRSC	0.677
5	**Discourtesy to other drivers**	
	Often show annoyance with horn	0.559
6	**Impulsivity of driver**	
	Get impatient in a queue	0.768
	Do things on the spur of the moment	0.735
	Get impatient	0.735
7	**Traffic intrusion effects**	
	Angry when sand is poured on your vehicle	
8	**Impulsive dissonant driving**	
	Change lane in queue	0.663
	Overtake drier who frustrates you	0.560
9	**Visual intrusion effect**	
	Angry when driving behind smoky vehicle	0.858
10	**Traffic congestion effect**	
	Angry when stuck in traffic	0.783

Source: Field work 2023

3.3 Transformation of Data for Estimation of Odds Ratios

The odds that a driver would perform angry or aggressive behaviours were calculated following the earlier work reported in Owsleg *et al*. (2003). Using odds ratios to analyse drivers' behaviour was preferred to other approaches for two reasons. In the first place, it was considered that the results would be more appealing for transport planning and policy. Secondly, it was easy to transform the log- odds into a probability measure, the impact of which is easier to interpret than, for example, the alternative outputs resulting from analysis of variance (ANOVA) employed in some approaches (Alonso *et al*. 2019). To compute the odds ratios required the use of binary data in the estimation of a logistic regression model. The binary data was obtained by recoding the scaled data set using the SPSS program syntax for the transformation of data. It means that the driver's response to the 27 traffic states was translated onto binary scores, so a score of 1 was assigned when the driver reported angry or aggressive behaviour upon encountering a traffic situation. Otherwise, a score of 0 was assigned. In that way, the data used approximated a binomial distribution resulting from Bernoulli trials, thus enabling the computation of odds ratios (0R) used in the analysis. The mean and standard deviation of the variables used, that is, the traffic situations encountered, are reported in Appendix 1.

3.3.1 Estimation method

The ORs reported in the study were estimated by the maximum likelihood logistic regression method, using the SPSS Software. This section outlines the essential features of the multiple logistic regression model based on Neter *et al*. (19960), pp. 591-94)). The multinomial regression model can be written as $\beta_0 + \beta_1 x_1 \ldots . + \beta_{p-1} x_{p-1}$. This formula is simplified using the matrix notation and the following three vectors:

$$\beta_{px1} = \begin{bmatrix} \beta_0 \\ \beta_1 \\ . \\ . \\ . \\ \beta_{p+1} \end{bmatrix} X_{px1} = \begin{bmatrix} X_1 \\ X_2 \\ . \\ . \\ . \\ X_{p+1} \end{bmatrix} X_1 = \begin{bmatrix} X_{i1} \\ X_{i2} \\ . \\ . \\ . \\ X_{ip-1} \end{bmatrix} \qquad \text{Eqn. 1}$$

Employing the notations, Eqn. 2(a) and Eqn 2 (b) can be written as follows:

$\beta X = \beta_0 + \beta_1 X_i \ldots . + \beta_{p-1} X_{p-1}$ Eqn. 2(a)

$\beta` X = \beta_0 + \beta_1 X_{i1} \ldots . + \beta_{p-1} X_{p-1}$ Eqn. 2(b)

The multinomial logistic response function can be given as follows

$$E(y) = \frac{exp\beta`X}{1+exp\beta`X} \quad \text{Eqn. 3(a)}$$

That is:

$$E(y) = [1 + exp^{-\beta`x}]^{-1} \quad \text{Eqn. 3(b)}$$

In general, the logit transformation can be represented by the formula

$$\pi^1 = \log_x \left(\frac{\pi}{1-\pi}\right) \quad \text{Eqn. 4}$$

This yields the logit response

$$-\pi` = \beta X \quad \text{Eqn. 5}$$

The multinomial logistic regression can therefore be stated as in Eqn. 6, for Yi defined as independent Bernoulli random variables with expected values $E(y_i) = \pi_i$, where

$$E(y_i) = \pi_i = \frac{\exp\,(\beta`X_i)}{1+exp(\beta`X_i)} \quad \text{Eqn. 6}$$

To estimate the model, the maximum likelihood method is used to compute the multinomial response functions (Eqn. 3), the log-likelihood function of which is represented as in Eqn.7:

$$\log_e L(\beta = \sum_{i=1}^{n} yi\,(\beta`X) - \sum_{i=1}^{n} \log_x\,[1 + exp(\beta`X_i)] \quad \text{Eqn. 7}$$

As already stated, the SPSS program was used for the estimation of the logistic regression model of this study which attempt was to capture the response of four categories of drivers to stated traffic situations described in Section 3.2. To summarise the argument, anger and aggression were posited as the outcomes of the drivers' responses to the stated traffic situations.

4.0 Results and Discussions

4.1 Background of Drivers Studied

The background of the drives studied is summarized in Table 1. The age distribution of the drivers shows that a few of them (2.2%) reported that they were less than 18 years old. The majority of the drivers were aged between 18-40 years, but the proportion of young adults (18-25 years) was low (11.0%), partly accounting for the similarity in the percentage of drivers who reported a driving experience of between 2-5 years (16.7%).

About 47.4% of the drivers had driving experience of over 10 years, while the percentage of ageing drivers was not that high (9.7%).

Table 1: Background of the Drivers

Age distribution

Years	Number	Percentage
Less 18	10	2.2
18-25	51	11.0
26-40	217	47.8
41-50	132	29.1
Above 50	44	9.7

Driving experience

Years	Number	Percentage
Less 2	19	4.2
2-5	76	16.7
6-10	141	31.1
Above 10	215	47.4

Education

Years	Number	Percentage
No Education at all	22	4.8
Less than SSCE	230	50.7
SSCE/GCE	163	35.9
OND/NCE	29	6.4
HND/BSc/BA	8	1.8

Source: Field work 2023

The educational background reported suggests that only about 4.8% of the drivers had no formal education, while up to 49.3% of them had qualifications equivalent to the Secondary School Certificate level and above, with a high percentage (8.2%) reporting to have attended tertiary educational institutions. Taken altogether, the above information would suggest an impression of a relatively experienced and somewhat well-educated professional driver population on Nigerian roads. This is significant in that the percentage of novice driving which tends to be more prone to road crashes was relatively low, whereas a fairly good level of education would make drivers aware of the need for safe road usage. The other information on the drivers relate to gender. One female driver was recorded in the surveys (0.22%). This was quite unexpected in that professional driving on inter-city road environment used to be exclusively by male drivers.

4.2 Estimated model of anger performance

The results of the estimates of the anger behaviour of the drivers are reported in Tables 3. They show the odds that a driver would perform anger behaviours. The estimated coefficients of three categories of the drivers, namely: taxi drivers, bus drivers, and truck drivers are highly significant. This is indicated by the associated standard errors of their

estimates reported as follows; taxi drivers (0.323), bus drivers (0. 207), and truck drivers (0.309). The obtained standard errors of the estimates are impressive for the categories mentioned and satisfactory for the impulsive driver (0.426). To have an alternative view of the status of the standard errors reported, it is useful to translate the standard errors into their corresponding t-statistic by dividing the estimated coefficients by the associated standard errors. In this model, the t-values associated with the estimated coefficients of the individual drivers are as follows: taxi drivers (6.30), bus drivers (8.29), truck drivers (7.36) and impulsive drivers (1.14). The high t values confirm more clearly that the individual estimated coefficients are significant, encouraging acceptance of the model as a whole.

The associated Wald statistic values of the estimate, interpreted as the Chi-squared, are remarkably large, with the respective scores in parenthesis for taxi drivers (39.67), bus drivers (68.88) and truck drivers (54.12). Even the Wald statistic score of impulsive drivers is fairly good (1.30), with a significance level of 0.25, implying that there is about 25% chance that impulsive drivers might not perform anger behaviour when the stated traffic situations are encountered. Clearly, the obtained Wald statistic scores encourage the rejection of the hypothesis that the traffic states encountered by the drivers have no influence on their performance of anger behaviour while travelling. On the whole, we are 95% confident that the drivers sampled are drawn from a known driver population, judging from the relatively narrow margins of the obtained confidence intervals. The fit of the model is good (Table 3.1), with a high overall statistical significance, (0.00), a good log-likelihood score (2.148) and an impressive Chi- square value (30.99).

4.2.1 Interpretation of the obtained odds ratios (OR)

The log odds, interpreted as the odds ratios, are reported in Table 3. They are the exponent of the coefficients of the logistic regression model, which have a good fit, as already discussed. The obtained OR values for each category of drivers are as follows: taxi drivers (7.663), bus drivers (5.560), truck drivers (9.708) and impulsive drivers (1.625). In terms of interpretation, the OR reported means that the odds are 7.7 times in favor of a taxi driver performing angry behaviour when the traffic situations studied are encountered, whereas the odds in favor of a bus driver and a truck driver behaving similarly are 5.6 times and 9.7 times respectively. The odds of performing anger behaviour are 1.6 times in favor of impulsive drivers.

In relating the results to driver behaviour, one can say that the incidence of performance of angry behaviours on inter-city road travel seemed quite strong across all category of drivers judging from the sheer size of the achieved ORs. Nevertheless, it would appear

that truck drivers admitted the highest anger performance behaviour compared to others (OR of 9.7). Taxi drivers ranked next in anger performance. This is surprising in that bus drivers are generally regarded as the most abrasive and anger prone in the Nigerian road environment.

Table 3: Multinomial Logistic Regression Results: Estimates of Log- Odds of Driver Anger Performance

Category of drivers	Coefficient (B)	Standard error	Wald	Significance	Log odds Exp(B)	95% confidence interval for Exp(B)	
						LB	UB
Taxi drivers	2.036	0.323	39.665	0.000	7.663	4.066	14.443
Bus drivers	1.716	0.207	68.875	0.000	5.560	3.708	8.337
Truck drivers	2.273	0.309	54.138	0.000	9.708	5.299	17.787
Impulsive drivers	0.486	0.426	1.302	0.254	1.626	0.705	3.748

Source: Field work 2023

Table 3.1 Fit of the Logistic Regression Model on Anger Performance

Model	-2Log kelihood	Chi-Square (x2)	df	Significance
Final	2.148	30.99	8	0.000

Source: Field work 2023

4.3 Estimated model of aggression performance

The logistic regression model of aggression performance is reported in Table 4. The model shows the odds that a driver will perform an aggression behaviour when a traffic state is encountered. The estimated coefficients of three categories of the drivers, namely: taxi driver, bus driver, and truck driver are fairly significant, whereas that of the impulsive driver is significant, with a significance chi- square level of 0.007, which suggests that there is less than 7% chance that an impulsive driver will not perform an aggressive behaviour when the traffic state is encountered. This is demonstrated by the associated standard errors of their estimates reported as follows; taxi drivers (0.406), bus drivers (0.334), truck drivers (0.743), and impulsive drivers (1.017). The obtained standard errors should be assessed in relation to their associated estimated coefficients (B). To get a clearer view of this assessment, the corresponding t- statistic of the estimate was calculated. The t- values associated with the estimated coefficients of the individual drivers are as follows: taxi drivers (1.05), bus drivers (0.97), truck drivers (1.13) and impulsive drivers (2.68). The modest t values suggest that the individual estimated coefficients are fairly significant for taxi and bus drivers, weakly significant for bus drivers, but highly significant in the case of impulsive drivers. This would suggest a tentative acceptance of the model as a whole.

The associated Wald statistic values of the estimate, interpreted as the Chi-squared, are not large enough with the respective scores in parenthesis for taxi drivers (1.099), bus drivers (0.948) and truck drivers (1.275). For 3 categories of driver, the Wald statistics are less than the critical value of 1.96 at the 95% level of confidence. However, the Wald statistic score of impulsive drivers is good (7.185), As already hinted, the obtained Wald statistic scores do encourage weakly the rejection of the hypothesis that the traffic states encountered by the drivers have no influence on their performance of aggression behaviour while travelling. On the whole, the 95% confidence intervals are relatively wide for truck divers (0.539, 9.922) and impulsive drivers (2.082, 12.285), which suggests imprecise estimates of their associated coefficients. This could be remedied by increasing the sample size in a future study.

Taken altogether, the fit of the model is fairly good (Table 4.1), with the overall statistical significance of 0.208 on taxi, bus and truck drivers, while the impulsive drivers achieved a very high significance (000), implying a less than 5% chance that impulsive drivers would not perform aggression behaviour when the traffic states were encountered. The overall chi- square score is good for impulsive drivers (23.095) and satisfactory for the other drivers (8.437). The log-likelihood ratios of the reduced model of aggression performance behaviour are good and are reported as follows: impulsive drivers (47.243) and the other drivers (32.585). The reduced model resulted from fitting the logistic regression model with partial deviance to test whether any driver category could be dropped (see Neter *et al*. (1996) pp. 585-90)). As it turned out, two categories of driver have been retained.

4.3.1 Interpretation of the obtained Odds ratios (OR)

The log odds of the aggression performance logistic regression model are reported in Table 4, as the exponent of the coefficients of the model. The model has a satisfactory overall fit.. The obtained OR values for each category of drivers are as follows: taxi drivers (1.531), bus drivers (1.384), truck drivers (2.313) and impulsive drivers (15.288). In terms of interpretation, the OR reported means that the odds are 1.6 times in favor of a taxi driver performing aggression behaviour when the traffic situations studied are encountered, whereas the odds in favor of a bus driver and a truck driver behaving similarly are 1. 4 and 2.3 times respectively. The odds of performing aggression behaviour are 15.3 times in favor of impulsive drivers.

It means that in the case of taxi drivers, the propensity for aggression is about 53 % higher for aggressive drivers than for non- aggressive drivers when aggression provoking traffic situations are encountered, whereas for bus drivers, the odds of performing aggressive

behaviour is just about 39 % higher for aggression prone drivers compared to drivers who reported that the stated traffic situations would not provoke their performance of aggression behaviours.

Based on the results, one could say that aggression performance estimated for both taxi and bus drivers are relatively low. On the other hand, truck drivers recorded higher levels of aggressive behaviour that would seem to be about 2.3 times the scale of those drivers with non- aggressive tendencies. Whilst relatively moderate ORs were estimated for aggression performance across categories of drivers, it would appear that impulsive drivers exhibited a much higher level of aggressive behaviour on Nigerian roads. Indeed, the odds that an impulsive driver would display a significant aggressive behaviour when confronted with the stated traffic situations is about 15.3 times higher than the odds that he would not.

Table 4: Multinomial Logistic Regression Results: Estimates of Log- Odds of Driver Anger Performance

Category of drivers	Coefficient (B)	Standard error	Wald	Significance	Log odds Exp(B)	95% confidence interval for Exp(B)	
						LB	UB
Taxi drivers	0.426	0.406	1.099	0.294	1.531	0.691	3.395
Bus drivers	0.325	0.334	0.948	0.330	1.384	0.720	2.661
Truck drivers	0.839	0.743	1.275	0.259	2.313	0.539	9.922
Impulsive drivers	2.725	1.017	7.185	0.007	15.288	2.082	12.285

Source: Field work 2023

Table 3.1 Fit of the Logistic Regression Model on Anger Performance

Effect	Model fitting criteria	Likelihood ration tests Chi-Square	df	Significance
Driver	32.585	8.437	6	0.208
Impulsive driver	47.243	23.096	2	0.000

Source: Field work 2023

4.4 Probability model of Driver Behaviour

We calculated the probabilities associated with categories of drivers being angry or aggressive when they experienced the stated traffic conditions. The purpose was to obtain a probability model of driver behaviour that is clear. The model is derived from the estimates of anger and aggression performance reported in Tables 3 and 4. The probability of anger performance (p(x)) equals the probability of getting angry given a traffic state (s) is calculated by the sigmoid function which transforms the log-odds to probability, with the formula:

$$S(x) = \frac{1}{1+e-x} \quad \text{Eqn. 8}$$

In the formula, x is equal to the coefficient (B) of the logistic regression model (Table 3 and Table 4). To give an example, from Table 3, the probability that a taxi driver would perform anger behaviour is given by:

$$\frac{1}{1+e-0.426} \quad \text{Eqn. 9}$$

The other probabilities were similarly calculated from both tables. The results of calculating the probabilities are reported in Table 5. Judging from the table, it seems clear that there is a high probability that the stated traffic situations would evoke the performance of anger and aggression behaviours across the categories of drivers studied. As expected, the probability that a driver would perform anger behaviour when the stated traffic situations are encountered is higher than the probability that the driver would perform aggressive behaviour when confronted with the factors posited as aggression provoking. However, the probability of aggressive behaviour is much higher for impulsive drivers. The probability estimates can be used to predict the behaviour of drivers on inter-city trips when prevailing traffic features are similar to those identified in this study. In that respect one can say, for example, that about 91% of truck drivers would perform anger behaviour when similar traffic conditions govern on a stretch of road. The rest of the reported probabilities can be similarly so interpreted in a predictive framework.

Table 4: Estimated Probability of Driver Behaviour

Category of drivers	Probability	
	Anger	Aggression
Taxi driver	o.88	0.61
Bus drivers	0.85	0.58
Truck drivers	0.91	0.70
Impulsive driver	0.62	0.94

Source: Field work 2023

5.0 Summary and Conclusions

The study investigated the behaviour of drivers in the context of inter-city travels on Nigerian roads, using data derived from self-reporting of perceived encounters with stated traffic situations. It is based on the assumption that driver behaviour is influenced by the personality factors of impulsiveness, as well as the emotional states of anger and aggression. Although professional drivers have been studied, the results could probably be used to anticipate the behaviour of other drivers in the context of inter-city trips in developing countries.

The impulsivity of drivers has turned out to be a strong factor which could be inferred to affect driving behaviour through impatience and frequent violations in lane changes, leading to reckless overtaking, a common attitude that is a major contributor to road crashes in Nigeria. The other findings of the study are equally significant. It seems apparent that the performance of anger behaviours would have a huge impact on road usage. This is confirmed by the strong showing of the estimated model of anger performance reported in the study, in terms of goodness of fit and in the status of the corresponding probabilities derived from the model. The estimated model of aggression performance behaviour is comparatively weaker, but satisfactory. To be sure, performance of aggressive behaviours would have a significant impact as well. The modeling of anger and aggression as distinct aspects of driver behaviour has perhaps been justified, although anger could in many circumstances be a trigger for performing aggressive behaviours.

Two novel features of the study should be remarked. The study is the first Nigerian attempt to have employed the standard Driver Behaviour Questionnaires showing the traffic states that are capable of eliciting anger or aggressive behaviours from drivers who encounter them. Secondly, it is new in providing quantitative estimates of qualitative responses in a Nigerian context based on data obtained from field studies. In that respect, the probability model of driver behaviour reported in this study constitutes a contribution different from the analyses of variance in anger scales commonly reported in the literature.

The findings have considerable status in that they could be used as a basis for designing policy measures for moderating anger-aggression inducing traffic states. The findings could also be used in the design of programs for managing anger and aggression that are of practical value to road safety agencies in developing countries.

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