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Original Research Paper

Investigating unsafe behaviours in traffic conflict situations: An observational study in Nigeria

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HIGHLIGHTS

- An observational study to investigate unsafe behaviours leading to traffic conflicts.
- Unsafe behaviours by different road users at different locations and time of day were compared.
- Incorrect use of indicators and tailgating were found to be most prevalent.
- Statistically associated with passenger scouting and other unsafe behaviours.

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ABSTRACT

Although road users are aware of the possible risks of engaging in unsafe behaviours while driving, they continue to do so. These behaviours often contribute to traffic incidents and crashes involving them and other road users. This study set out to analyse the effect of road user type, location and time of day on unsafe driving behaviours observed in traffic conflict situations. Data were collected by road side observation at three different locations in the eastern part of Nigeria using the traffic conflict technique (TCT). This approach was adopted to overcome the inherent problems associated with reliable, inadequate and accessible crash data in Nigeria. In total 946 traffic conflicts were observed and statistical testing showed that drivers were involved in one or more unsafe behaviours prior to these conflicts. Of all unsafe behaviours observed, the incorrect use of indicators (13.3%) and tailgating (11.3%) were found to be the most prevalent, while road user type, location and time of day were found to be statistically associated with passenger scouting and other unsafe behaviours. Tricycle drivers were significantly more likely to engage in unsafe behaviours than vehicle drivers. Drivers are also more likely to engage in unsafe behaviours on straight roads. Additionally, a greater number of these unsafe behaviours were observed during the peak periods. It is recommended that better road infrastructure, more effective regulations and enforcement, and proper road safety education could help improve traffic safety in Nigeria.

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1. Introduction

Road traffic crashes constitute a major public health problem, and a greater percentage of these occur in low and middle income countries. The nature of road safety issues in developing countries is significantly different from that in developed countries. For example, traffic safety records are much worse in Africa than in Northern and Western Europe. In its Global Status Report on Road Safety 2015 (WHO, 2015), the World Health Organisation (WHO) reported that the highest road traffic fatality rates are in the low and middle-income countries, particularly the African region. Despite the fact that the African region is the least motorised (2%) of the world, 16% of all recorded deaths as a result of road crashes is found there. Transport systems have increased and developed rapidly in these regions and whilst measures have been developed and implemented in an attempt to achieve crash reduction, there has been limited success and the crash rate keeps increasing.

The number and frequency of road crashes in Nigeria have become a growing concern and as such requires urgent attention. Nigerians depend majorly on the road transport system as a means of mobility in preference to cycling and walking, and the rail system is not developed. Nigeria as a country has not achieved much success in tackling this problem despite the programmes the Federal Road Safety Corps (FRSC) has implemented in the past. According to FRSC (2015), between 2010 and 2014, more than 27 000 people died and about 100 000 were injured in 48 841 road crashes. FRSC (2017) further shows that 5053 people were killed in 9694 road crashes in 2016, representing a decrease of 387 in comparison with the death toll of 5440 recorded in 2015 where about 9734 crashes happened. Fig. 1 shows the variations in the number of crashes and associated casualties from 2007 to 2016.

Transport users' behaviour has been identified as the main cause of road traffic crashes in Nigeria. According to Ogwude (2010), whilst no actual crash may occur in all conflict situations, cases of near crashes are very frequent and leave the impression that the road environment is quite demanding and might be very dangerous. A study by Ukoji (2014) has shown that unsafe driving behaviours accounted for up to 90% of crashes in Nigeria: this includes inappropriate speeding and speed-related factors, poor knowledge of traffic regulations, including road signs and markings, drink driving, dangerous driving, driver fatigue and inappropriate overtaking. Atubi (2010) examined the patterns of road traffic crashes in Lagos State with the use of secondary data from the FRSC and the Nigerian Police and found that more than 90% of road traffic crashes could be attributed to speeding and recklessness on the part of drivers. Additionally, the environment in which a driver operates can influence behaviour for example, weather conditions, time of day and road design (Abele and Moller, 2011; Dixit et al., 2012; Hao et al., 2016; Kilpelainen and Summala, 2012). Research (Hills and Baguley, 1992) has shown that most roads and road systems in developing countries are being built and upgraded with little consideration given to road safety. Almqvist and Hydén (1994) further suggested that some road design measures dramatically reduce the number of mistakes that lead to risks and crashes, by reducing opportunities for road users to make errors; and if errors do occur, making the environment more forgiving.

In response to the United Nations (UN) decade of action for road safety, FRSC launched SAFE ROAD in Nigeria with the aim of reducing road crash deaths and injuries by 50% by 2020. It is based more on changing driving behaviour than advocating for good road infrastructure. The FRSC has stepped up the campaign for a safer road environment in Nigeria to ensure that these objectives are met.

Research findings from experiments in other countries that attest to the effectiveness of measures put in place to ensure safety may not have a similar effect in Nigeria considering that some behaviours could be localised due to the nature of the driving environment and vehicles using the transport system. It is very important that research and evaluation studies should incorporate country-specific conditions and suggest appropriate interventions accordingly.

Data on traffic crash causation are also important for the targeting and monitoring of road safety interventions, such data could also help in defining the extent of the road safety

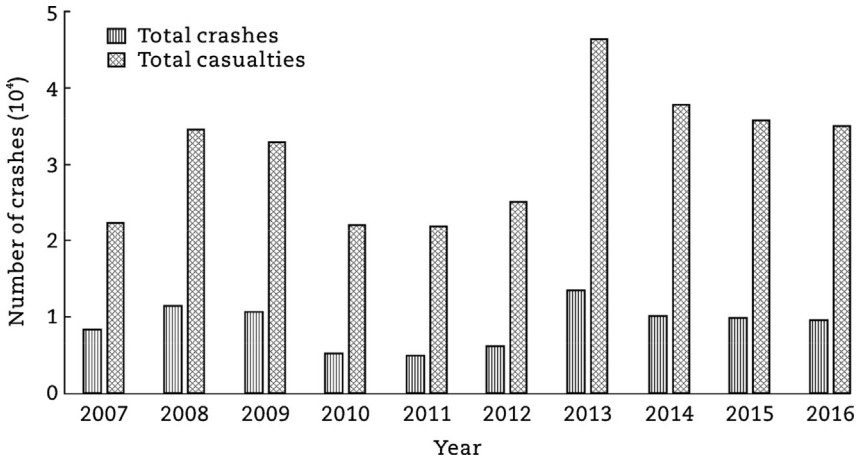

Fig. 1 – Number of road traffic crashes and associated casualties in Nigeria, 2007–2016 (FRSC, 2015).

problem by comparing it with other causes of death in order to make informed decisions (WHO, 2015). Crash data are not readily available in Nigeria and where they are usually incomplete and lack the necessary information needed to tackle road safety problems. For example crash data in Nigeria is aggregated and does not give specific information on how or why most crashes occurred.

Crash data has been used over the years in safety analysis and has proved to be very beneficial in improving road safety. Wegman (2013) has shown that the number of road crashes, casualties and associated consequences, all emanating from crash data are the most commonly used measure of assessment for road safety. On the other hand, understanding underlying factors leading to crashes are very important when planning effective crash reduction and prevention measures, and this requires obtaining accurate information about the problems involved. Researchers are continually searching for ways to gain a better understanding of factors that affect crash occurrence (Lord and Mannering, 2010; Savolainen et al., 2011). According to Muhlrad (1993), comprehensive safety diagnosis is required not only to highlight the main crash problems but also complementary information for use in design of relevant safety measures. This information obviously cannot be relied on solely or be easily captured from crash data. Crash numbers are too small, the method of collection and reporting is biased and not informative and in addition, it takes a very long time to collect the quantity of data needed for proper analysis. In the words of Almqvist and Hydén (1994), one might say that crash analysis is a "desk tool", often conducted indoors without any link to "what is going on in the street". This study, therefore, uses direct behavioural observation to collect non-crash data needed to examine and understand the underlying variables which contribute to the unsafe behaviour of drivers in conflict situations in Nigeria. The aim is to provide greater knowledge of behaviour and interaction of various road users, to overcome the inherent problems and inconsistencies associated with crash data in Nigeria and to provide adequate recommendations without waiting for actual crashes to occur.

In this study, we attempt to define unsafe driving behaviour as deliberate and systematic practices that increase the risk of a conflict or crash and also investigate the types of road users, road locations and time of day that are directly associated with these behaviours. It is also expected that this study will promote awareness on specific unsafe behaviours prevalent in Nigeria and create an understanding of the importance of safe driving in Nigeria, showing that all these could be achieved with non-crash data.

2. Method

2.1. Study area

This study was carried out in Owerri, Imo State in the eastern part of Nigeria. Imo State has recorded variations in the number of road traffic crashes over the years and although crash rate has consistently decreased in the last three years, the injury rate still remains very high (ISBOIR, 2018). Fig. 2 shows the number of road traffic crashes and injury rate in Imo State (2007–2016) and according to Ukibe et al. (2011) road traffic crashes remains a significant cause of morbidity and mortality in Owerri. The city is made up of three local government areas namely Owerri Municipal (where this study took place), Owerri North and Owerri West. The major activity centres are government public buildings such as the federal and state secretariats, medical centres, hotels and centres for higher education. Population studies carried out in 2006 in Nigeria show that Owerri city has an estimated population of 3 927 563 (NBS, 2016).

In recent years, there has been an overwhelming increase in vehicle ownership in Imo State. The number of tricycles (popularly called Keke N.A.P.E.P (Fig. 3)). as a means of public transportation has also increased due to a ban placed on motorcyclists in the city few years ago (Fig. 4). It is expected that in a city where there are many vehicle types, different road user groups without much knowledge of road safety and roads lacking properly designed road furniture (or none at all), there will exist peculiar behaviours that might seem different from what are observed in the developed world.

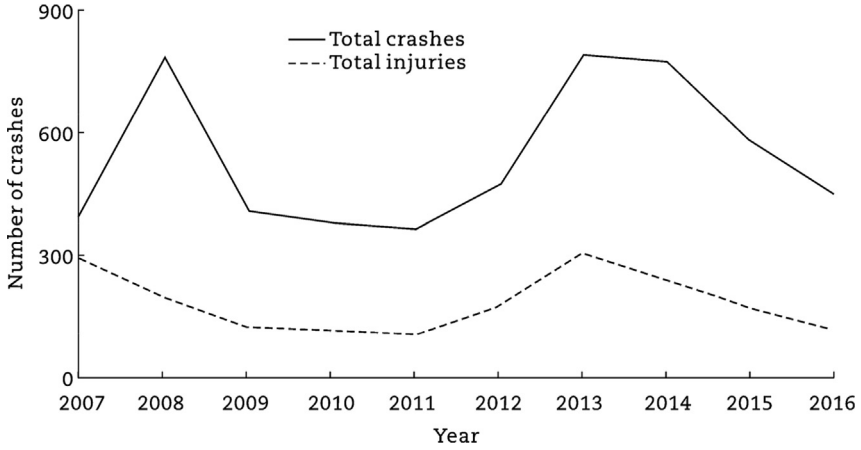

Fig. 2 – Trend of road traffic crashes and injury numbers in Imo State, 2007–2016 (FRSC, 2017).

Fig. 3 – Study locations. (a) Govt. Coll. (b) IMSU. (c) Dick Tiger.

2.2. *Locations of traffic observation*

The locations chosen represented typical road environments in Nigeria, and allowed observation without distractions and obstructions. Three locations were selected: Government College Road (Govt. Coll.), Imo State University junction (IMSU) and Dick Tiger junction. These roads all have a speed limit of 50 km/h for passenger cars and 45 km/h for trucks and tankers (not posted). Fig. 3 shows the study locations and the characteristic of each location is shown in Table 1.

The data were derived from observation of traffic conflicts involving vehicle and tricycle drivers at different locations and time periods (peak 7:30–9:00, off-peak 11:00–12:30) every day of the week for seven days. This study was carried out in daylight and good weather conditions. Data collection was limited to daylight because most activities in Nigeria take place in the day. The sun goes down between 18:00–19:00, visibility decreases, the street lights are not always functional, and there are issues of personal safety. Data collection was performed during June/July 2016.

2.3. *Procedure*

This study used the traffic conflict technique (TCT) as an alternative to analysing crash statistics. The TCT was adopted because of the limitations associated with crash data in Nigeria, as outlined in Section 1. The TCT is a method of observation, where near-crashes (conflicts) are recorded and used for predictions of crash risk and for studies of events leading to crash situations. A conflict situation is defined as being when

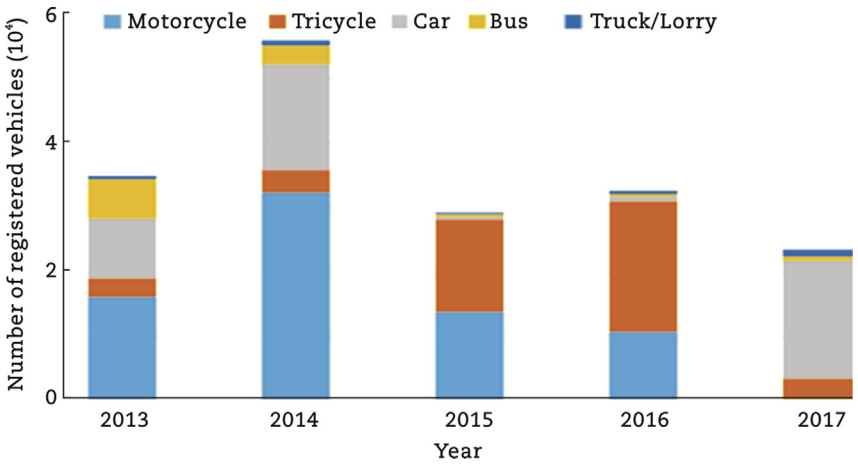

Fig. 4 – Number of registered vehicles in Imo State, 2013–2017 (Board of Internal Revenue Owerri, 2018).

Table 1 – Characteristics of study locations.

Location	Govt. Coll.	IMSU	Dick Tiger
General description	Dual carriageway; mix traffic; good condition road	Dual carriageway; mix traffic; poor road condition laid in residential and commercial zone	Single carriageway; mix traffic; poor road condition laid in residential and commercial zone
Speed limit (km/h)	50	50	50
Posted	None	None	None
Lane marking	Yes	No	No
Parking on street	Restricted	Restricted	Restricted
Loading	Unrestricted	Restricted	Unrestricted
Pedestrian crossing	None	Yes, one side	None
Pedestrian path	Yes, all sides	None	None
Traffic light	None	Yes	None
Road layout	Straight	Roundabout, semi signalised	Four arm, unsignalised
Traffic control	No	Yes	No
Warden	Part of morning peak	Part of morning peak till dusk	Part of morning peak
Presence of road divider	Yes	Yes	None

two or more road users approach each other in time and space to such an extent that a collision is imminent if their movements remain unchanged (Amundsen and Hydén, 1977).

Data were collected via roadside observation using a video recorder, clipboard, conflict recording form and pen by trained observers. According to Svensson and Carsten (2007), video recording is helpful in conflict studies as it aids in confirming conflicts and checking observer reliability. The definitions of conflicts were established according to Amundsen and Hydén (1977) as they can be identified by the fact that the closeness to a collision is anticipated and very imminent. Conflicts recorded included interactions between different road users (vehicle and tricycle drivers). Only manoeuvres where the vehicle driver proceeds straight ahead or makes a turn and interacts with either another vehicle or tricycle were included. The situations of interest were those where the road users were on a collision course, implying the existence of an evasive action or manoeuvre (braking, swerving and accelerating).

Observation procedures included the detection, recording and estimation of speed and distances, sketching the situation and describing the causes of the conflict (Almqvist and Ekman, 2001). Observers also had audio recorders to talk about the traffic situation and causes of conflicts (Almqvist and Ekman, 2001). Observers recorded basic data about each conflict, such as date, time of the day, light conditions, weather, involved road users, etc. They also recorded all circumstances that may contribute to the understanding of the possible reasons for occurrence of the conflicts. For ease of measurement, distances at the locations were mapped out using electric poles, billboards and other road furniture. Observers arrived 30 min before data collection started, to set up all necessary equipment, become familiar with traffic movement and practice speed and distance estimation. The observation started at the same time in all the locations and was the same length of time. The locations were filmed with video recorders set at some distance from the focus of observation. Their position was carefully chosen during the site survey to get the best view of the locations, and the video recorders and observers were also positioned covertly to reduce any influences or interference with normal road user behaviour. In addition, observers were also discouraged from wearing reflective vests. For each location, conflict observers worked in teams of two, each recording session lasted for 90 min and a total of 21 h of observation was carried out.

2.4. *Measures*

2.4.1. *Inter-observer reliability*

Twelve persons were trained as conflict observers for five days. During the training period, a large number of conflict situations were scored and discussed comparing manually recorded and video recorded conflicts to assess the inter-observer reliability. At the end of the training, a practice observation was conducted, and the inter-reliability of the observers was calculated. Eight observers whose recordings were almost the same were chosen. The reliability rate, i.e., the percentage of conflicts that were scored correctly, compared with all conflicts that should be scored, plus all the non-conflicts that were scored (Almqvist and Hydén, 1994), was calculated at 84%. These observers took part in the pilot study from which six were finally selected to take part in the main data collection while two were left in reserve in case a replacement was needed. The results from the pilot and main conflict studies were also used to estimate the reliability of the observers. Even though there was a great similarity in the results of the teams at different locations, in some cases, there were differences in scoring but this could be as a result of traffic which was very busy at certain times and because the observers were newly trained. Observers were trained to measure speed by comparing their estimates with measurements by a radar gun as a control instrument.

2.4.2. *Definitions of unsafe behaviours*

Unsafe behaviours derived from the observation of traffic conflicts were as follows.

(1) Inappropriate speed

According to Quimby (1986), inappropriate speed is defined as exceeding the speed limit, or failing to slow down under

different conditions, e.g., at intersections/junctions, approaching traffic lights, close to other vehicles or tricycles, parked cars or waiting cars, at road works, etc.

(2) Eating/drinking

Consuming any kind of food/drink or seen holding anything related to these.

(3) Cell phone use

Seen holding or using a cell phone, including earphones.

(4) Inappropriate overtaking

E.g., from the wrong side, too dangerous, etc.

(5) Tailgating

Following a vehicle too closely by leaving less than 2 s gap between them and the vehicles in front.

(6) Right of way violations

E.g., give way, failure to yield, red light.

(7) Picking/dropping passengers

Sudden and unexpected stops to pick up and drop off passengers without moving off the carriageway completely.

(8) Passenger scouting

This involves scouting for passengers while driving without stopping and parking appropriately.

(9) Incorrect indicator use

Neither using the indicators at all nor using them incorrectly.

(10) Driving on one way

Driving on the wrong side of the road or on the same side with opposing traffic.

(11) Others

All other behaviours which were not very common, e.g., smoking, personal grooming, calling attention of other road users (drivers or passengers), etc., and could not be identified or categorised as above were classified as "others".

2.5. *Data analysis*

SPSS statistical software (Version 24) was used to analyze the data. Chi-square test (χ^2) was used to examine whether there are any associations between eleven categories of unsafe driving behavior observed in conflict situations and i) different road users, ii) locations and iii) time of day. In addition, Cramér's V was used to test the strength of association. With a large number of cells for some of the cross tabulations, it can be difficult to determine which groups have significant differences within the analyses. Therefore post hoc tests using residual analysis were conducted on statistically significant variables to test the direction of association in each cell and to determine which cell differences contribute to the Chi-square results. The size of the standardized residuals was compared to the critical values that correspond to an alpha of 0.05 (±1.96). For example, where significant differences were found in the Chi-square results, the standardised residuals were further examined to identify which cells were responsible for the difference (those larger than 1.96 indicate that the observed frequency was significantly different from that which would have been expected if there were no association between the variables in question). According to Delucchi (1993), the larger the residual, the greater the contribution of the cell to the magnitude of the resulting Chi-square obtained value. And as stated by Agresti (2007), "a cell-by-cell comparison of observed and estimated expected frequencies helps to better understand the nature of the evidence" and cells with large residuals "show a greater discrepancy…than would be expected if the variables were truly independent".

3. Results

A total of 946 conflict observations involving vehicle and tricycle drivers were analysed. Tables 2 and 3 show result of statistical analysis for various unsafe behaviours by different road users, at different locations and time periods.

3.1. *Road user type*

About 70% of observed road users were vehicle drivers, while 30% were tricycle drivers. For all unsafe behaviours observed, vehicle drivers were involved in 68% while tricycle drivers were involved in 32%. The Chi-square test (Table 2) revealed a significant association between road users and incorrect indicator use ($\chi^2 = 13.967$, $p < 0.001$), passenger scouting ($\chi^2 = 12.928$, $p < 0.001$), picking/dropping passengers ($\chi^2 = 4.229$, $p < 0.05$). No differences were found with speed, eating/drinking, cell phone use, inappropriate overtaking, tailgating, right of way violations, one way violations and others. When comparing the Cramér's V, there is a weak association between road user and cell phone use, tailgating, and others. A moderate association between road user and speed, one way violations, a relatively strong association with eating/drinking, inappropriate overtaking, right of way violations, picking/dropping passengers and a strong association with indicator use and passenger scouting.

An examination of the standardized residuals (Std. Res.) (Table 3) shows that tricycle drivers engage in more unsafe behaviours than would be expected if road user type was unrelated to engage in unsafe behaviours. The most frequently observed unsafe behaviour for both vehicle and tricycle drivers was incorrect indicator use (30.8% and 16.5%, respectively), followed by tailgating (28.8%) for

Table 2 – Chi-square results of unsafe behaviours by road user type, location and time of day.

Unsafe behaviour	Road user type	Location	Time of day
Inappropriate speed			
χ^2	0.635	36.843**	9.445**
p-value	0.426	0.000	0.002
Cramér's V	0.026	0.197	0.100
Eating/drinking			
χ^2	2.504	8.551*	14.040**
p-value	0.114	0.014	0.000
Cramér's V	0.051	0.095	0.122
Cell phone use			
χ^2	0.206	0.693	0.214
p-value	0.650	0.707	0.643
Cramér's V	0.015	0.027	0.015
Inappropriate overtaking			
χ^2	2.329	8.788*	3.106
p-value	0.127	0.012	0.078
Cramér's V	0.050	0.096	0.057
Tailgating			
χ^2	0.046	56.129**	0.662
p-value	0.831	0.000	0.416
Cramér's V	0.007	0.244	0.026
Right of way violations			
χ^2	2.827	17.992**	5.772*
p-value	0.093	0.000	0.016
Cramér's V	0.055	0.138	0.078
Incorrect indicator use			
χ^2	13.967**	1.767	0.346
p-value	0.000	0.413	0.556
Cramér's V	0.122	0.043	0.019
Passenger scouting			
χ^2	12.928**	13.343**	6.301*
p-value	0.000	0.001	0.012
Cramér's V	0.117	0.121	0.082
Driving on one way			
χ^2	0.681	4.530	1.052
p-value	0.409	0.104	0.305
Cramér's V	0.027	0.069	0.033
Picking/dropping of passengers			
χ^2	4.229*	11.018**	0.616
p-value	0.040	0.004	0.433
Cramér's V	0.067	0.108	0.026
Others			
χ^2	0.002	7.185*	0.252
p-value	0.961	0.028	0.615
Cramér's V	0.002	0.087	0.016

Note: *significant at a 0.05 confidence level, **significant at a 0.01 confidence level.

vehicle drivers and picking/dropping of passengers (12.5%) for the tricycle drivers. Concentrating on statistically significant behaviours (Table 3, in bold), standardized residuals which were calculated to determine which cell differences contribute to the Chi-square result test, show that among road users who did not use their indicator (correctly), there were more tricycle drivers (2.3) than would be expected and less vehicle drivers (−1.5). Similarly, passenger scouting where tricycle drivers were observed scouting for passengers relatively more (2.6) compared to the vehicle drivers (−1.7). Tricycle drivers were also over-represented (1.4) in picking/dropping of passengers compared to vehicle drivers (−0.9).

3.2. *Location*

Depending on the physical characteristics of the locations, a number of unsafe behaviours were found to be spread across different locations (Table 2). At Govt. Coll., 20.8% of unsafe behaviours were observed, 44.2% at IMSU and 34.9% at Dick Tiger. Chi-square test results show significant association for inappropriate speed ($\chi^2 = 36.843$, $p < 0.001$), eating/drinking ($\chi^2 = 8.551$, $p < 0.05$), inappropriate overtaking ($\chi^2 = 8.788$, $p < 0.05$), tailgating ($\chi^2 = 56.129$, $p < 0.001$), right of way violations ($\chi^2 = 17.992$, $p < 0.001$), passenger scouting ($\chi^2 = 13.343$, $p = 0.001$), picking/dropping passenger ($\chi^2 = 11.018$, $p = 0.004$), others ($\chi^2 = 7.185$, $p < 0.05$). When comparing the Cramér's V, there is a moderate association with cell phone use, a relatively strong association with incorrect indicator use and a strong association with speed, eating/drinking, inappropriate overtaking, tailgating, right of way violations, passenger scouting, one way violations, picking/dropping of passengers and others.

Although a greater percentage of unsafe behaviours were observed at IMSU, a closer look at the result of the post hoc tests, using standardized residuals indicate otherwise (Table 3). Observations at Govt. Coll. shows that speed (4.5), eating/drinking (2.4), inappropriate overtaking (2.1), right of way violations (1.7), passenger scouting (2.6), one way violations (1.7), picking/dropping of passengers (2.2) and others (1.1) were over represented in the actual sample compared to the expected frequency. This means that there were more unsafe behaviours in this location than would be expected. At IMSU, tailgating (3.1) was relatively more common than would be expected and right of way violations (1.7) were over represented at Dick Tiger.

3.3. *Time of day*

Of all unsafe behavioural observations, 55.6% was made during the peak and 44.4% during the off peak hours. There were statistically significant associations between time of day and inappropriate speed ($\chi^2 = 9.445$, $p = 0.002$), eating/drinking ($\chi^2 = 14.040$, $p < 0.001$), right of way violations ($\chi^2 = 5.772$, $p < 0.05$) and passenger scouting ($\chi^2 = 6.301$, $p < 0.05$), with a strong effect size (Cramér's V = 0.100, 0.122, 0.078, 0.082, respectively). Post hoc tests, using standardized residuals (Table 3), indicates that the pattern and type of behaviour observed were different between the peak and off peak periods. Observation of inappropriate speed and right of way violations appeared to be more in the peak period, although the standardised residual was under 1.96 (1.6 and 1.3). On the other hand, during the off peak period, it was observed that eating/drinking (2.5) and passenger scouting (1.6) were relatively more common than expected.

4. Discussion

This study explored the impact of road user type, location and time of day on unsafe behaviours observed in conflict situations in Imo State, Nigeria. It was found that one or more unsafe behaviours were present in observed conflicts. According to Lee et al. (2009), these types of behaviours have the

Table 3 – Standardized residual results of unsafe behaviours by road user type, location and time of day.

Condition		Inappropriate speed	Eating/ drinking	Cell phone use	Inappropriate overtaking	Tailgating	Right of way violations	Incorrect indicator use	Passenger scouting	Driving on one way	Picking/dropping of passengers	Others	All unsafe behaviours (%)
Road user type													
Vehicle	*n* (%)	233 (24.6)	119 (12.6)	168 (17.8)	245 (25.9)	271 (28.8)	183 (19.30)	**291 (30.8)**	**162 (17.1)**	98 (10.4)	**240 (25.4)**	272 (28.6)	2282 (68.1)
	Std. Res.	−0.3	−0.8	0.2	−0.6	0.1	−0.8	**−1.5**	**−1.7**	−0.4	**−0.9**	0.0	
Tricycle	*n* (%)	103 (10.9)	61 (6.4)	65 (6.9)	115 (12.2)	109 (11.5)	90 (9.5)	**156 (16.5)**	**98 (10.4)**	46 (4.9)	**118 (12.5)**	111 (11.7)	1072 (31.9)
	Std. Res.	0.5	1.2	−0.3	1	−0.1	1.2	**2.3**	**2.6**	0.6	**1.4**	0.0	
Location													
Govt. Coll.	*n* (%)	**89 (9.4)**	**43 (4.5)**	39 (4.1)	**76 (8.0)**	**78 (8.2)**	**57 (6.0)**	77 (8.1)	**60 (6.3)**	32 (3.4)	**76 (8.0)**	**72 (7.6)**	699 (20.8)
	Std. Res.	**4.5**	**2.4**	0.1	**2.1**	**1.9**	**1.7**	0.3	**2.6**	1.7	**2.2**	**1.1**	
IMSU	*n* (%)	**133 (14.1)**	**74 (7.8)**	99 (10.5)	**149 (15.8)**	**210 (22.2)**	**93 (9.8)**	207 (21.9)	**118 (12.5)**	56 (5.9)	**161 (17.0)**	**182 (19.2)**	1482 (44.2)
	Std. Res.	**−1.4**	**−0.7**	−0.5	**−0.9**	**3.1**	**−2.6**	0.5	**0.2**	−1.0	**0.1**	**0.8**	
Dick tiger	*n* (%)	**114 (12.1)**	**63 (6.7)**	95 (10.0)	**135 (14.3)**	**92 (9.7)**	**123 (13.0)**	163 (17.2)	**82 (8.7)**	56 (5.9)	**121 (12.8)**	**129 (13.6)**	1173 (34.9)
	Std. Res.	**−1.4**	**−0.8**	0.5	**−0.4**	**−4.5**	**1.7**	−0.8	**−1.9**	0.0	**−1.5**	**−1.6**	
Time of day													
Peak	*n* (%)	**210 (22.2)**	**78 (8.2)**	127 (13.4)	214 (22.6)	206 (21.8)	**169 (17.9)**	245 (25.9)	**128 (13.5)**	86 (9.1)	194 (20.5)	210 (22.2)	1867 (55.6)
	Std. Res.	**1.6**	**−2.2**	−0.3	0.9	−0.4	**1.3**	−0.3	**−1.4**	0.6	−0.4	−0.3	
Off-peak	*n* (%)	**126 (13.3)**	**102 (10.8)**	106 (11.2)	146 (15.4)	174 (18.4)	**104 (11)**	202 (21.4)	**132 (14)**	58 (6.1)	164 (17.3)	173 (18.3)	1487 (44.4)
	Std. Res.	**−1.8**	**2.5**	0.3	−1.0	0.5	**−1.5**	0.3	**1.6**	−0.7	0.5	0.3	
Total	*n* (%)	336 (10)	180 (5.4)	233 (6.9)	360 (10.7)	380 (11.3)	273 (8.1)	447 (13.3)	260 (7.7)	144 (4.3)	358 (10.7)	383 (11.4)	3354 (100)

Note: statistically significant behaviours is in bold. Example: Chi-square test shows that inappropriate speed as an unsafe behaviour has a statistical relationship with location. Although a greater number and percentage of this unsafe behaviour was observed at IMSU (133, 14.1%), the result of the standardized residual shows that inappropriate speed observed at Govt. Coll. (4.5) was more than expected compared to the other locations (−1.4).

potential to degrade driving performance resulting in serious consequences for road safety and in addition greatly increase the risk of crashes.

There were statistically significant associations between road user type and three variables (incorrect indicator use, passenger scouting and picking/dropping of passengers). Regarding road user type and incorrect indicator use, a greater number of vehicle drivers were identified as not using it or using it in the wrong way, but a post hoc test (Table 3) showed that tricycle drivers were over-represented in this behaviour. The same was also observed with the other variables (passenger scouting and picking/dropping of passengers). As stated earlier, tricycles became more prevalent following the ban on motorcycles. The desired reduction in crashes seems far from being achieved as reports from media, which have been supported by this study, and shown that tricycle drivers disregard the rules and regulations. In a bid to attract passengers, they stop the vehicle wherever they want, creating chaos on the roads. Reckless driving and abrupt stopping in the middle of the roads often lead to crashes. According to Shailaja et al. (2013), the driving practices of auto-rickshaw drivers (tricycle drivers), specifically speeding and making frequent and often unexpected stops to pick up and drop passengers, increase risks of road traffic injuries for themselves, their passengers, and other road-users. It is therefore very important to regulate this group while organising some form of training for them and other road users and in addition, providing them with dedicated stops where they will have to pick and drop off passengers.

There was also significant association between location and eight variables related to unsafe behaviours (speed, eating/drinking, incorrect overtaking, tailgating, right of way violations, passenger scouting, picking/dropping passenger, others). Whilst the lowest number of unsafe behaviours (699) were recorded at Govt. Coll., the result of the residual analysis (Table 3) showed that most of the behaviours, for example inappropriate speed (4.5), eating and drinking (2.4), inappropriate overtaking (2.1), passenger scouting (2.6) and picking/dropping off passengers (2.2) were more than expected and contributed significantly to the Chi-square value compared to the other locations. As described in Table 1, this location is on a straight road which, according to Haynes et al. (2007), could be riskier than curved roads as drivers tend to be less careful and drive at higher speeds.

Time of day was found to be significantly associated with unsafe behaviours such as speed, eating/drinking, right of way violations and passenger scouting. Overall it appeared that this significant association was due to more unsafe behaviours observed in the morning peak. Of these, speed and right of way violations were mostly observed in the peak period and are closely associated with increased traffic flow and density. The other two behaviours were more present in the off peak period than would be expected.

The most frequently observed unsafe behaviours in this study were speeding, incorrect overtaking, tailgating, wrong indicator use, right of way violations, passenger scouting, one way violations, picking/dropping of passengers. All these are not exactly what have been identified in previous studies conducted in developed countries where most reported unsafe behaviours are mobile phone use, smoking, eating/drinking, etc. (Stutts et al., 2005; Sullman, 2012). The results of this study show that some unsafe behaviours can be localised and only be identified in specific environments. For example, behaviours such as passenger scouting and picking/dropping of passengers cannot be seen in environments with an organised transport system where passengers go to designated public stations to board taxis or buses instead of drivers shouting, stopping and moving at the same time while scouting for passengers. In a study by Olapoju (2016), investigating non driving activities that commercial drivers were engaged in while driving in Nigeria, 93% of drivers were observed scouting for passengers. And as seen in this study, results of the Chi-square test show that passenger scouting was significantly associated with all the variables tested (road user type, location and time of day). This indicates that this is a very big problem which should be further investigated.

This study shows that there are unsafe behaviours which are localised and can only be found in a particular cultural environment but also have a very big effect on safe driving as other generalised behaviours. A number of studies (Cale, 2011; Nordfjaern et al., 2011; Ozkan et al., 2006; Warner et al., 2011) which have compared driving behaviour in different countries, indicate that aside from variations in traffic composition and road infrastructure, driver behaviour and traffic characteristics can be distinctive. This study is one of the very few that have identified unsafe drivers' behaviour using data from the observation of traffic conflicts. These unsafe behaviours were established and categorised after careful examination of the events leading to observed conflicts. These behaviours represent driving activities that may be considered unsafe and are often linked to crashes on the road. Even though conflicts are not actual crashes, crashes could be described as unresolved conflicts and this study has provided the rare opportunity of observing what happens before most crashes occur. This is important because it is a proactive approach to traffic safety analysis without necessarily waiting for crashes to happen. In addition, it is important to say that the behaviours observed are what is happening in real traffic situation in this particular environment and reflects the nature of behaviours that could precede crashes. This study focused on identifying variables which are related to unsafe behaviours in conflict situations with the aim of making recommendations to improve the safety of road users in Nigeria.

This paper is based on behaviours observed in conflict situations at three different locations. The fact that the frequency of unsafe behaviours was closely associated with location and specifically on a straight road gives an indication of how dangerous that location is for road users, even though the absolute number was lower than other locations. These results may only be limited to studies in the urban areas and unsafe behaviours may be different in rural areas. Further research with a larger sample and locations with similar characteristics could help make a better comparison and to find out if these are prevalent across different locations.

Because we were particularly interested in behaviours in conflict situations, there could also have been a number of unsafe behaviours which were not observed probably because they didn't result in a conflict. As a result, the number of unsafe behaviours observed here is likely an underestimation of

the true frequency. In addition, with this method of data collection, it was also not very possible to observe all in-vehicle behaviours leading to conflicts. Different results may be obtained if every road user crossing the different locations of interest were observed. Future research could mitigate this issue by making observations of all road users including the behaviours not involved in conflicts and comparing unsafe behaviours across each group.

This study, however, provides an opportunity for future research in this study area using the traffic conflict technique to identify unsafe behaviours which may lead to conflicts and subsequently contribute to crashes.

5. Conclusions

Results demonstrate the usefulness of conflict observation in road safety research where there is no (or limited) crash data. At the same time, variables such as road user type, location and time of day were observed to be associated with different types of unsafe behaviours.

In this study, the main focus was establishing the possibility of applying the conflict technique to research unsafe behaviour of various road users in conflict situations. Most unsafe behaviours recorded in developed countries in the literature has always been linked to the use of mobile phones, eating/drinking, etc., however in Nigeria drivers tend to be rather engaged in other unsafe behaviours which are not seen in the developed countries. Behaviours such as passenger scouting, picking/dropping of passengers were found to be prevalent across locations, during different times of the day and among various road users. Because of the nature of the environment including lack of road infrastructure, road users find it difficult to obey simple road rules. Even though drivers know that engaging in these activities could increase crash risk, they do so anyway. In general, incorrect use of indicators and tailgating were observed to be the highest among all behaviours observed.

Based on the results of this study, the following recommendations are suggested in order to improve road user behaviour in Nigeria.

- Provision of better road infrastructure including traffic control devices would provide safe and efficient movement of all road users.
- Stricter regulations and enforcement would help reduce traffic offences.
- Appropriate road safety education (campaigns) for the general population through both formal and informal education systems: this could be done by introducing the traffic education system into schools, offering more education about proper and improper driver behaviour and traffic rules through the media, such as radio, TV program, newspaper, Facebook, Instagram, etc. These measures are expected to increase the knowledge of traffic rules for all road users.
- Comprehensive driver pre-licencing training program and driver improvement program during licence renewal should be implemented. Pre-licencing training programs must be supervised by qualified personnel and adequate testing conducted before the issuing of drivers' licences. The driving test should not be considered as the final stage of learning as drivers should take further training especially during licence renewal.

Conflict of interest

The authors do not have any conflict of interest with other entities or researchers.

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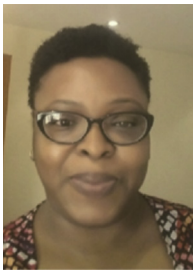

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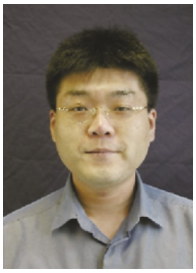

Dr. Frank Lai was a senior research fellow at the Institute for Transport Studies, University of Leeds. He sadly passed away before this paper was published and after 18 years researching and teaching in the field of road safety. His research sought to further understanding of road user behaviour, through projects funded by the UK government, the European Commission, and the UK research councils. This work encompassed interests in intelligent transport systems (ITS), traffic management, road accident causation, and future mobility. Frank's projects typically involved the deployment of both quantitative and qualitative research methods, to inform the design of transport infrastructure and/or technology interventions, as well as to evaluate the effectiveness of these interventions.