EFFECTIVENESS OF COMMUNICATION TOOLS IN ROAD TRANSPORTATION: NIGERIAN PERSPECTIVE

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Abstract: Continuous increase in death toll as a result of road accident is at an alarming rate. Recent World Health Organization (WHO) global annual report estimated that about 1.25 million people die in road crashes and Africa region as the highest contributor. This traffic fatality rate has, however, been associated with poor roads condition, drink-driving, over speeding, violation of traffic rules, and careless attitude of the road users. Over the years, various measures such as rehabilitation of poor roads and traffic regulations …etc., has been put in place to avert this predicament but the reverse is the case as death toll through road accident increases by years. Additional measures also include the use of traffic communication tools. Although various communication tools exist on the road, this ought to guide the road users and in a way avert the dangers upcoming; however, this is not the case. In Nigeria, various studies have been conducted to this regards but little or no attention is given to the road marking as a communication tool, thus, these three question remains for Nigeria road network; (1) Do these tools (especially, road marking) exist on roads where accidents are frequent? (2) Are these tools effective? (3) What is the understanding of the road users of these tools? Therefore, this study pertains to the effectiveness of the communication tools in road transportation by considering the Nigeria road features and views of the road users. Results show that the drivers have a good knowledge of these traffic communication tools but on an average of 92%, the road marking sampled are not available on the roads and have in one way or the other contributed to the fatality rate experienced. There is a need for stakeholder's interventions which include regular funding and schedule for routine maintenance with more focus on road marking.

Keywords: traffic fatality, traffic communication tools, road marking, traffic safety, Nigeria roads.

1. Introduction

1.1. Traffic Fatality Rate

Globally, road traffic crashes are a leading cause of death and the main cause of death among those aged 15 – 29 years (Agbonkhese et al., 2013; WHO, 2015). Traffic crashes have been blamed on poor roads condition, poor maintenance culture, drink-driving, over speeding, violation of traffic rules, and careless attitude of the road users. Considering the magnitude of death caused by traffic crashes, which is estimated at 1.25 million people per year over the last seven years, it was considered as one of the sustainability development goals. The goal's target is to reduce road traffic death and injuries by 50% by the year 2020 (WHO, 2015).
In view of this, various measures such as rehabilitation of poor roads, implementation of new traffic regulations, and the invention of traffic communication tools (such as; traffic signs, road marking, and traffic signals) were put in place. These measures have improved road safety to some extent. Nonetheless, the measures on global level didn't reduce the predicament rather it only place it on a flat terrain (WHO, 2015), yet the in case of Nigeria, it is on the increase (Adedokun, 2015; Odeleye, 2000; Ezenwa, 1986). As a result, all of these measures have been receiving an improvement in a way to meet up with the aforementioned sustainability development goal. Hitherto, little or no results have been achieved despite the improvement. Focusing on the aspect of traffic communication tools; which should serve as information dispersal to the road user, this information ought to guide the road users and in a way avert the dangers upcoming.
Although some of these tools exist on roads yet, their impact are not felt. Thus, these three question remains for Nigeria road network; (1) Do this tool (especially, road marking) exist on roads where accidents are frequent? (2) Are these tools effective? (3) What is the understanding of the road users of these tools? Therefore, the objective of this study pertains to the effectiveness of the communication tools in road transportation by considering the Nigeria road features and views of the road users.

1.2. Death Toll in Nigerian Roads

Nigeria road network is the largest in West Africa and the second largest in the Sub-Saharan Africa (Okezie, 2013), with an estimate of approximately 200,000 km in length; where 17% is owned by the federal, 16% state and the remaining owned by the local government (Nnanna, 2003). Likewise, Nigeria has a total vehicle population of 10 million vehicles. However, only 19% of the total road network is in good condition while others are either in fair or bad conditions. The fair and bad conditions have contributed greatly to the death toll rate in Nigeria, such that Nigerian road is rated second most deadly road in the world (WHO, 2015). Additionally, according to a report from WHO, Nigeria was adjudged the most dangerous country in Africa with 33.7 deaths per 100,000 population every year (Adedokun, 2015).

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However, the problem of traffic fatality in Nigeria is not a new development as Ezenwa (1986) reported on the increasing trends in fatality rates for a period of ten years (1974 – 1983). In the report, within those periods, the number of accidents increased by 10.4% and injured cases increased by 43%. This trend, however, is not capsizing but rather on the increase (Odeleye, 2000), this is evident as recent report show that; 6,450 Nigerian lost their lives in traffic accident and also between 2009 - 2013, the size of small European city population (30,435 people) were killed in traffic fatality on Nigerian roads (Adedokun, 2015). Overall, based on best conservative estimated data, Nigeria is a country with a serious and growing road accident problem and about the worst in the world.

The major contributors to this traffic fatality rate on Nigerian road are, however, similar to those of the rest of the world. Yet, these contributors on a broader note can be categories under some basic factors such as; vehicle operator factors or driver factors, vehicle factors, road condition factors, and environmental factors (Bun, 2012; Agbonkhese et al., 2013). Although most safety studies concluded that driver factors (or human error) are the main cause of accidents (Agbonkhese et al., 2013) yet, it is not the only cause but rather other sources contribute to this factor.

Thus, various measures have been put in place such as; traffic regulation to solve the issues around vehicle operator factors, vehicle factors have also been tackled by some traffic regulations and improvement in the design of the vehicles such as anti-collision sensor, and little or nothing can be done with regards to the environmental factors as these concerns nature and in most cases beyond human control. However, the issue around road condition factors is way behind in resolving the fatality in Nigeria, as most Nigerian roads are still in fair or bad condition. Withal, even the ones in good condition still lack communication tools which as further contributed to the increase in fatality rate (Olaifa, 2013).

2. Traffic Communication Tools

According to Mathew and Krishna Rao (2007), road communication tools or traffic control device is a medium used for communicating between traffic engineer and road users, or mechanisms installed, placed or drawn on road or roadsides by the traffic engineers to communicate certain information to the road users. Furthermore, they are used to provide information to regulate, warn, and guide the road users in a traffic system (Ogunmola, 2013). Some of these tools include; traffic signs, road marking, traffic signals, and parking controls.

Furthermore, communication tools are usually the combination of linguistic and non-linguistic elements (Ogunmola, 2013) and are very important in reducing conflict and collision between the road users and road mishap; thus, their use is not an option to ignore. On the other hand, there is a need for the road users to properly understand these tools and strictly in vive the habit of obeying these tools (Agbonkhese et al., 2013). However, it must be noted that before the installation or positioning of communication tools takes place it should satisfy one or more of the following requirement such as; fulfilling a specific need, commanding attention from users, simple and should convey clear message, and providing adequate time for proper response (Mathew and Krishna Rao, 2007).

In accomplishing the task set before the traffic communication tools, there are various characteristics which need to be put in place for this mechanism to work. These characteristics include; Colour (commonly red, green, yellow, black, blue and brown), Shape (Circular, triangular, rectangular and diamond), legend (Symbols) and Pattern, thus, consistency is of concern as these help the road users to identify them easily (Kadiyali, 1987; Mathew and Krishna Rao, 2007). However, this is based on the fact that these mechanisms recognize the limitation of human (road users) involved, this talk more of the eyesight. Overall, it can be said that most traffic signs available abide by these requirements yet, their maximum impact on the road are not felt but is this the case of Nigerian Road?

2.1. Safety Feature

Traffic communication tools converse safety categorically in three main ways, which are; regulatory signs, warning signs, and informative signs. In-depth explanations on these categories are available in studies Horberry et al., (2004), and Olumide and Owoaje (2016). The various examples of communication tools aforementioned mostly fall under any or all of these three categories except with the exceptional case which is the work zone signs (Mathew and Krishna Rao, 2007). In Nigeria, the importances of these tools are understood such that; in Nigeria road safety strategy 2012, traffic communication tools are one of the strategic goals in improving road infrastructures (Federal Ministry of Works, 2013).

Globally, various researchers (Hulberty et al., 1979; Stokes et al., 1995; Makinde and Opeyemi, 2012; Ogunmola, 2013; Makinde and Oluwasegunfunmi, 2014) have conducted research on the effectiveness of these communication tools. According to Hulbert et al. (1979) and Stokes et al. (1995) in the USA and Kansas respectively, the road users basically misunderstood these tools. In Nigeria, studies showed that these tools are effective in their capacity but the Nigerian road users do not pay attention, rather these tools are seen as mere decorations on the roads (Ogunmola, 2013; Adeboye et al., 2014). Overall, it was, however, noticed that most of the studies concerning Nigeria are centered on the tools such as; traffic signs and signals, with little or no attention given to road marking as a traffic communication tools, thus road fatality continues to increase (Adedokun, 2015). Although the Highway Code of Nigeria entails the road marking as one of the major traffic communication tools, yet little study have put them into consideration.

2.2. Necessities of Road Marking

Speed mitigation devices include signage, road markings, and variable message systems, typically placed in advance of an upcoming hazard with the aim of initiating a change in driver behavior. In particular, signage and markings are widely used for the purposes of explaining road layouts and hazards because of their relatively minor costs in comparison to altering existing geometric layouts (Martindale and Urlich, 2010). Road marking, however, is any kind of device or material that is used on the road surface in order to convey official information. These markings make a vital contribution to safety by clearly defining the path to be followed and are used as communication tools on paved roadways to provide guidance and information to the road users (Federal Ministry of Works, 2013; Ozelim and Turochy, 2014; Rehman and Duggal, 2015).

Road markings can either be mechanical (cat's eye, botts' dots, rumble strips and reflective markers), non-mechanical (paintings) or temporary in nature. As in other communication tools, road markings should be uniform in order to minimize confusion and uncertainty about their meaning and efforts exist to standardize such markings across borders (Mathew and Krishna Rao, 2007; Rehman and Duggal, 2015). However, there are different types of road marking which include; longitudinal marking, transverse marking, arrow marking, oblique parallel lines, word marking, …etc (Federal Ministry of Works, 2013). Additionally, as aforementioned road markings can fall in all the categories of communication tools such as regulatory signs, warning signs, and informative signs.

In the aspect of regulatory signs, the stop paint marking (Figure 1a) at the end of an intersection communicate to the road users (motorists) to stop for a while and observe other vehicles before progressing. Additionally, road marking act as a warning sign in the case of rumble strips (Figure 1b) (also known as sleeper lines) serve as noise generators, also attempts to wake a sleeping driver or alter a driver to various upcoming hazards both by sound and the physical vibration of the vehicle. Transverse road markings as defined by Martindale and Urlich (2010) are used to assist in raising driver awareness of risk through perceptual optical effects, thus encouraging drivers to reduce their speed in anticipation of an upcoming hazard. Overall, road marking alters the road users with information such as the common zebra crossing line, which gives the pedestrians right of way as soon as it is stepped on. In addition, a study based on the USA over a period of twenty years has shown that road markings can reduce fatality by 13% (FHWA, 1994 cited in Grosskopf, 2001).

Fig. 1.
Road Marking (A) Stop paint marking and (B) Rumble strips (Pratt, 2015)

In South Africa, road markings are used on all surfaced roads (Grosskopf, 2001) however, this is not the case in Nigeria as the usage of road marking on roads is still lacking, although after the completion of newly constructed roads, they are mostly marked with road marking such as; solid white line, white broken line, single solid yellow line, lane direction change line, stop marking …etc. Nevertheless, the road markings on the existing ones are poorly maintained (Odeleye, 2000) and thus, the markings fade off and the roads are left without markings. Thus, as a result of their unavailability on most Nigerian roads, the road users do not put them into consideration when available rather, these markings are seen as mere road ornaments by Nigerian road users (Ogunmola, 2013; Adeboye et al., 2014). While on the contrary, because of their available on South African roads the drivers have become so accustomed to them that they tend to react to them without really thinking (Grosskopf, 2001).

Furthermore, in the case of Nigeria most researchers (Makinde and Opeyemi, 2012; Makinde and Oluwasegunfunmi, 2014) have blamed the lack of understanding the traffic signs and communication tools on the education level, yet Akpan et al. (2015) argues that educational background does not seem to correlate with the understanding of and compliance with road traffic signs. Overall, the studies further argue that these tools are too simple not to be understood by a layman or an illiterate; however, these tools seem not to be available on Nigerian roads (Figure 2), despite their enormous contribution to traffic safety.

Fig. 2.
State Road in Nigeria without road markings (Photo taken 29-01-2016)

Charlton and Baas (2006) published a study that evaluated speed change or speed maintenance methods to alter driver behavior, particularly to reduce their approach speeds to a hazard. In Nigeria, the recent security measures (Military checking point stops) taken to screen traffic users on roads in the saga of *Boko Haram* has rather rendered death to some lives than good due to poor visibility of the road blocks sign as well as the approach distance to road blocks in other to alert the driver speed to slow down. Furthermore, speed reduction signals and driver communicating devices are lacking on the Nigerian roads. For example an approach to a roundabout somewhere in the north eastern part of Nigeria has no approach caution signal to a roundabout (Figure 3).

Fig. 3.
Approach to a roundabout without any signal or marking device (Photo taken 29-01-2016)

3. Methodology and Data Collection

3.1. Description of the Study Area

The study was conducted in Nigeria with major emphasis on the North Eastern region since it is a major road mostly challenged by security hazards where both road users and pedestrians have high illiteracy mentality (UNESCO, 2012). Additionally, based on a recent report on traffic fatality in Bauchi state; 123 persons were killed and 1378 were injured in the year 2015, this is without the inclusion of the last three months which are more noted for traffic fatality (Udodiong, 2015). According to a study on causes of road accident in Bauchi state by Yero et al. (2015), the major causes of road accidents include; tire burst, fatigue, obstruction on roads, night journey, loss of control, speed violation, dangerous driving, bad roads, use of phone, and dangerous overtaking. However, it is worthy to note that speed violation and bad roads are the leading contributors to these accidents.
On the bad roads aspect, this has been attributed to limited road signs on the roads. For instance road, signs such as zebra crossings, playgrounds …etc., were unsatisfactorily marked and even lacking at some appropriate places like approach to schools, roundabouts, market areas etc. Most of the communities along the route were denied some useful road signs. The few road signs available are not visible to motorists and pedestrians. Motorists and pedestrians find it difficult to move safely within these areas. Furthermore, because of the busy nature of vehicles on the road, bikers, people especially children and aged found it difficult to cross the road. There is always heavy overcrowding of vehicles and pedestrians on the route.

3.2. Data Collection

The approach used to collect data involved the use of questionnaires defined by sample size specifying a given margin of error which will justify the population size of the total road users and provide a confidence interval of judgment (Gray, 2013). The method used in this research involved the use of questionnaires administered and completed by commercial drivers. Two hundred questionnaires were distributed amongst drivers in various inter-city motor parks in Bauchi, Jos and Gombe viz-a-viz Bauchi-Jos Park, Bauchi-Gombe Park, Bauchi-Yola Park and Bauchi-Kaduna Park and Yankari Park. The questionnaire used was made up of three sections; the first section classifies the personal experience of the drivers, the second section classifies the driver's opinion and views based on road markings and the third section on traffic signs and signals. The first section was designed to give detailed information about the driver's bio-data and personal experiences such as the age, gender, and educational background, how well they comprehend the traffic signs and signals as well as the road markings etc. The second section gave information about the availability and type of road markings present on the federal roadways …etc. while the third section assessed the understanding of traffic signs and signals by the drivers. The third section had fifteen multiple choice questions of different traffic signs made up of five warning signs and ten regulatory signs.

4. Results and Discussions

4.1. Demographic Characteristics of respondents

The study indicated that all the respondents (90%) were males and 10% females; this is because driving is a male dominated activity within the north-eastern route drivers. It was observed that females who drive normally do not drive long distances except for few and most females normally drive within the towns or cities. Most of the drivers (80%) interviewed were in the age range of 18 - 35 years (Table 1). The driver's interviewed were all above the 18 years mandatory driving age in most African countries. As, results from another study indicated that very young drivers (under 19 years) and elderly drivers (over 54 years) face difficulties in understanding and recognizing traffic devices such as road signs (Al-Madani, 2000). The drivers interviewed were educated to some extent, as results show that majority of them (75%) were Junior and Senior high school graduates (Table 2). This implies that the respondents could easily read and write which is a basic requirement for obtaining a driving license in Nigeria. Thus, in this study, it is assumed that all respondents would understand road signs since they have driving licenses and accordingly have passed both the oral and written examinations for obtaining a driving license.

Table 1
Age Range of Respondents

Age of respondents	**Percentage (%)**
18 – 34	80.0
35 – 59	15.0
60 – and above	5.0
Total	100.0

Table 2
Educational level of respondents

Educational Level	**Percentage (%)**
Primary	60.0
Secondary	25.0
Graduate	5.0
Not Educated	10.0
Total	100.0

4.2. General Remarks on Road Signs and Markings

Knowledge of road signs and markings is not only a factor for road accident prevention. However, the application of the knowledge is a key to the essence of these communication tools. This is because road signs and markings convey messages in terms of words or symbols. Signs are, therefore, essential where special regulations apply at specific places or at specific times, where hazards are not self-evident (Al-Madani, 2000). In this study, result indicated that 95% drivers have some level of knowledge concerning road signs and markings while 5% don't. The interviewed drivers had different driving experiences with the majority of them (45%) having over 6 years driving experience, especially the commercial bus drivers and this shows that they were not novice drivers. It also implies that they have higher class driving licenses and thus, they should comprehend road signs and markings better.

According to Brachacki et al. (1995), year of driving experience helps in proper identification of road signs. Furthermore, Al-Madani, (2000) observed that there exist significant differences between novice and experienced drivers in observing and understanding road signs. This was also confirmed with the exception of drivers with over 10 years of experience (25%) comprehend significantly better than less experienced drivers (Al-Madani & Al-Janahi, 2002). The drivers interviewed belong to various drivers' unions in exception of 10% private car drivers and 10% truck drivers. The unions include the National Union of road Transport Workers (NURTW) (30%), and Bauchi Co-operative Commercial Driver union (70%).
The result also indicated that the common road sign was the speed bumps; 100% of the drivers observed that the roads were in very poor condition due to reduced shoulder and excessive increase in speed bumps on the federal highway resulting in increasing mortality growth. Thus, according to the drivers majority of the road markings (average 91.7%) were not available on the roads as well as the road signs except for few as seen in Table 3.

Table 3
Road Marking Survey

Road Marking	Available	Percentage	Not Available	Percentage
Solid White line	60	30	140	70
Single Yellow Line	10	5	190	95
Double Solid Yellow Line	0	0	200	100
White Broken Line	60	30	140	70
Yellow Broken Line and Solid Line	0	0	200	100
White Line-Stop Line	0	0	200	100
Pedestrian Crosswalk	0	0	200	100
Yellow Painted Island	0	0	200	100
Lane Direction Change Line	20	10	180	90
Average	16.7	8.3	183.3	91.7

4.3. Recognition and Application of Road signs and Markings

The ability of drivers to recognized road signs and apply them are the main contributing factors in reducing potential dangers associated with road usage. According to the majority of drivers (90%), mentioned that most of the accidents occurred in communities along the route. However, they could not link it to the negligence of road signs but the occurrence of accidents in communities especially knocking off pedestrians resulted from the reduced shoulder and sudden breaking speed on approach to speed bumps negotiation; knocking down pedestrians and even running into residential buildings close to the roads. This is because driving within a speed limit in town (< 50 km/hr.) when followed should allow drivers to control their vehicles. Encountering road signs about 100 m ahead before seeing the signpost signal drivers to prepare adequately and comply with the sign.

4.4. Challenges of Traffic Communication Tools Along the Routes

Road users face some level of challenges in conforming to the road signs and markings. The result from the study indicates that some of the road signs were covered with leaves of trees along the edge of the road and some have faded off due to the wearing of the paint used. Therefore, drivers could not see what situation is being displayed on the road sign. More so, the conspicuity of some road signs was questionable, as they were blurry and not easily recognizable. In addition, reflectivity, size and placement of road signs were some challenges and the respondents assert that some of the sign posts were not reflective in the dark. The standard guideline for placement of sign post is about 100 m from the situation being shown. Some drivers were of the view that, some road signs were too close to the situation. These situations even pose a risk to them since they normally drive into the situation without any conscious preparedness.

4.5. Road Safety Interventions

Road safety challenges in developing countries such as Nigeria are enormous. However, practical and effective interventions can be implemented to reduce road safety menace. Interventions such as wearing a seatbelt correctly can reduce the risk of road fatalities. Actions such as training of drivers on road safety should be coordinated among the stakeholders for effective results. Additionally, adequate fund should be set aside for routine maintenance which should encompass the repainting of the road markings. Overall, there should be a strong political will from the government for enforcement of road safety measures and capacity of drivers should also be built for the sustenance of interventions.
In addition, it is paramount for all road owning agencies (which in the case of Nigeria includes the federal, state and local governments) to devise a cyclic process for maintenance/ repairing of the road markings, according to their time cycle. Overall, the following guides can help in improving the conditions of road marking on Nigeria roads; firstly, ascertain the total length of road markings to be maintained and this can be done by each of the road owning agencies in Nigeria. Through the projected length, the cost of maintenance can be estimated. Secondly, the quality of the paints to be used must be according to the international recommended standard and the newly improved materials which

improved nighttime visibility should be considered. Thirdly, the function of each road marking must be checked if effective or not and finally, the specification standard of the application must be adhered to as this talk more about quality control. Once these guidelines are put in place one should expect a functional and safety enhance road markings on Nigeria roads.

5. Conclusions

Road signs and markings are very important traffic regulator devices. Neglecting road signs and markings pose potential dangers to both drivers and pedestrian. Different road signs and markings are identified along the route examined the majority without posted notices. Hump ridge ramps are dominant among the road situations for controlling speed in town, as it is more effective than the speed limit warning sign post. However, drivers are aware of the road signs and their importance but most of the drivers do not make any conscious effort to abide by the road signs. Along the route examined, some of the road signs are not conspicuous, not reflective enough to catch the eyes of drivers and their placement were covered with objects and defaced. Thus, the roadsides should be frequently cleared about 3 meters from the road.

Furthermore, the stakeholders involved in road sign designs and traffic regulations such as the Federal Highway Authority should be adequately resourced for the maintenance of road signs along the route and increase the length of the shoulder. In addition, symbolic road signs are easily remembered thus proper placement of these signs within the cities and travel route should be done to reduce mortality rates.

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