A Survey of the Effect, Visibility and Application of Road and Traffic Symbols among Road Motorists in Zaria

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Abstract
Symbols in communication have always been of great importance to human activities. The need for people to recognise and identify these graphical symbols and what they represent can ease a lot of communication problems. The purpose of this study was to survey the effect of road signs on drivers in Zaria, Kaduna state, Nigeria. Symbols make up an essential element of a modern and well maintained road infrastructure to help regulate traffic, provide crucial visual guidance, alert drivers to potential hazards on the road and give them important preview time in day and night-time conditions. The effectiveness of road and traffic signs depends on their visibility, legibility and their ability to be recognised at day and night-times to avert or significantly reduce road accidents, Six thousand people in Nigeria, and 1.25 million people worldwide lose their lives annually due to traffic mishaps. The study explored both the qualitative and quantitative approach to delineate the visual content of road signs which guided the survey procedures before administering questionnaires to respondents (drivers) purposively. The results of the findings indicate that there is insufficient road and traffic signs around Zaria. In addition, maintenance and replacements of roads and road signs are seldom. Therefore the need for road users to familiarise themselves with the iconicity of graphical symbols was apparent. The study further suggested the effective use and application of road signs, enforcement of all regulations pertaining to road use to avert hazards as well as proper use of size, colour and style of letters/numerals and retro reflective materials used for the backgrounds and legends in the design of road signs and symbols.

Keywords: Graphical Symbols, Concept Related Symbols, Communication, Iconicity of Symbols, Retro Reflectivity, Traffic Sign, Symbol Identification Task.

INTRODUCTION
Many interactive communications make use of symbols to convey information for several reasons. The advantage of using symbols lies in the fact that they are assumed to be able convey large amounts of information quickly and concisely. They also have the potential to overcome language and cultural barriers. A symbol can be said to be a visual graphical representation of a concept, object, or word. Symbols may be used as iconic images to represent an area of content, written information or functional area within an application (Ceri and Tony,2015). The use of symbols as a means of communicating important information have become very essential as the world is progressively metamorphosing into a global parlour. Information represented in graphical symbols can be transmitted in a nonverbal manner and do not rely on a set of clear rules to convey meaning, as do written words (Gyang, 2015). The lack of clear conventions to access meaning makes symbols easy to interpret; since they are pictorial representations of real objects that are very familiar and are commonly used and shared amongst people in daily life. Most symbols are either a direct representation of the object, in outline drawing or silhouette form on a background; or an abstract representation of an object or information.

In a conference at Paris in 1909, the first iconic symbols for public use in modern times, were agreed upon on an international level, that they should have widespread meanings that can be universally understood, (Abdulla and Hubner, 2006). These symbols are to be accepted and used by all around the world. They are recognised internationally, by the unique shape, and colour employed. Symbols should be clear, simple, and easy to understand.

The need for people to comprehend and understand these graphical symbols and comprehend what they mean can be an effective and less cumbersome way of communicating important information. This is even more imperative among information communication design students who are learning the art of design and dissemination of information. The graphic designer in this case encodes the information through a channel that the receiver can easily decode it, in compliance with all the elements and principles of design. This study tested the skills of identifying/recognizing graphical symbols among drivers (not restricted to those with driving careers) within Zaria metropolis using the Symbol Identification Task (SIT). The method simply provides recognizable symbols that are in use

in public communication for the respondents to write what they think the symbols represent. Road signs are usually concept related therefore, this study restricted itself to concept related symbols, as against the image and arbitrary/abstract symbols.

Figure 1: Concept-related icons Image related symbol Arbitrary/abstract symbols
https://www.google.com.ng/search?q=road+signs+indicating+animal+crossing

Significance of Graphical Symbols in Information Communication

Symbols have played an important role for decades in communicating information in Nigeria. Specifically, national symbols and badges play an important role in religion and culture. Today, technology has greatly advanced and has profoundly affected so many things; most of the gadgets, appliances, such mobile phones, television are designed to communicate beyond the boundaries of language and culture. Symbols are now the international vehicle that transmits information visually to all, irrespective of ethnicity. In a study conducted by Ojiakor *et al.,* (2015), it was found that Nigerians do not generally obey traffic signs as spelt out categorically in their findings. This is the reason why the interpretation of signs is conventional. Akinyosoye (2015) asserted that such reasons could be connected to the lazy attitude to reading sign codes. Noting that by considering various literature on reading reveals that most Nigerians have a lazy attitude towards reading and literacy.

The significance of identifying and recognising graphical symbols and their meanings has been common across disciplines; reading of directional signs in public places like the airport, train stations, schools and libraries have been very significant in information communication. Similarly, humans have relied on symbols to make meaningful interpretation of important and urgent information, for example, designers in earth quake prone areas of Japan and Thailand developed and tested symbols that can communicate urgent information to residence in moments of risk (Ongkrutraksa, 2015).

Graphical Symbol Design

There are about five different degrees of details and realism in designing graphical symbols for communication. Using the appropriate level of detail and realism makes a symbol easy to recognise. However, the excessive use of detail can be clumsy, chaotic and distractive, making it hard to see the pattern of relationships (Rousek & Hallbeck, 2011). The five levels include:

i. *Photographic realism:* This involves the use of photograph of the object directly to symbolise what it means and most times present complex symbols with a lot of detail.
ii. *Simplified drawing Design Style:* The use of outline with distinct interior details is employed to present complex symbols with small significant parts, especially when the objects have similar profiles.
iii. *Caricature Design Style:* This is an exaggeration of crucial details to present symbols that have a small crucial feature or for simplifying complex details.
iv. *Outline:* This is a drawing using outline only to project details of small symbols that represent a familiar object with a distinct profile.
v. *Silhouette:* These Shapes are filled with solid colour contrasting with background for presenting symbols that are too thin to show in outline format and for symbols that have a very distinct profile and do not require details for recognition.

Perception of Symbols

In study of semiotics by Peirce cited by Ceri A., and Tony, R. (2015), sign is a process of a three-way interaction between the representamen (i.e. the symbol), the object (i.e. the referent that is represented) and the interpretant (i.e. the mental representation of the object), and sign is a sign only when it represents something for someone. Identifying symbols can also be described to be a progressions of object recognition introduced in perceptual psychology. In the identification of symbols process, bottom-up and top-down approach is employed concurrently. Visual symbols can assume unfamiliarity, starting from geometric shapes and ending with highly realistic depictions of real world objects.

Cross-Cultural Perception of Symbols

Cross-cultural studies and visual images carry a consistent message – images are powerful, they are not just art, they are used to represent certain cultures. People respond to images in an active way, based on the circumstance of social activities, beliefs and concerns. Many studies investigating cross–cultural designs reveal a consistent outcome: People from different cultures interpret and perceive visual images differently. Several studies reported that cross-cultural design of symbols, lack of cultural understanding and sensitivity in the interpretation of symbols, and there is cultural and social differences in how people recognize images (Gyang, 2015). Zirkel and Greene cited in Basson (2004), measured cultural attitudes towards visual images among three different cultures and the results indicate differences in the perception of images.

Traffic Signs and Symbols

Traffic signs are one of the oldest and most commonly used Traffic Control Device (TCD). These signs convey messages in words or symbols and vertically erected to regulate, warn, or guide road users. The American National Standard Institute (ANSI Z535.3) advice that traffic signs should meet 85% target, while the Organization of International Standardization (ISO 3864) pegged its own at 67%. Traffic signs in relation with congestion and road accident occurrences have been a topic of considerable interest to some researchers in Nigeria such as Makinde, O. O. and Opeyemi, D. A. (2012) and Matawal D. S. (2013). There is a general perception that some drivers plying Nigerian roads do not have a satisfactory level of understanding traffic signs; this could be the reason thought to be a major cause of road accidents in the country. Consequently, this research was undertaken to access the drivers' personal characteristics in understanding traffic signs in Zaria, Kaduna state of Nigeria.

Traffic signs are essential element of a modern and well maintained road infrastructure. The European Union Road Federation (2015) explained that road signs help regulate traffic, provide crucial visual guidance, can alert drivers to potential hazards on the road and give drivers important preview time during day and night-time conditions. The effectiveness of road and traffic signs depends on their visibility, legibility and recognisebility at day and night-times. In the day, this requires that the sign face and symbol colours are not faded in such a way that it becomes difficult to decode the message that the sign is trying to convey. The US Department of Transportation (2007) observed that traffic signs are the principle medium by which highway agencies communicate regulatory, warning, guidance, or other information to road users. Traffic signs are designed to satisfy these requirements by selection of sign size and colour, the size and style of letters and numerals and application of symbols, and the reflective materials used for the backgrounds and legends. Unfortunately, the installations of road signs are not very evident within the Zaria metropolis. Adams (2015) observed that other problems are caused by irresponsible human activities ranging from the dumping of refuse on the shoulders, drainage channels and manholes, illegal and dangerous parking on the road causing failure and collapse of these roads, in addition to the avoidable road crashes, injuries and fatalities they cause, vandalisation of road infrastructure such as street light cables and fittings, bridge railings, bollards and road signs, metallic crash barriers, driving on curbs and burning of tires among others.

This study aims to survey the opinions of motorists to ascertain if certain road and traffic signs can be properly identified and applied in the road usage with a view to educating them generally through examining the driving conditions and experience of drivers in compliance with road safety and traffic regulations; determine if drivers can meaningfully identify certain road and traffic signs; explore the use of design elements (colour, shape, text and symbols) to convey information on traffic signs to enhance visibility; and suggest advocacy driven campaigns for drivers and other road users on the application of road and traffic signs.

In Zaria, it is generally observed that drivers and other commuters do not apply the available road and traffic signs. The implication of this noncompliance to traffic signs is over speeding, traffic jams, and accidents which may eventually lead to severe injuries as well as loss of lives and properties. WHO (2014) in Ojiakor *et al.* (2015) together with Oyeyemi (2016) noted that over 6000 lives are lost yearly in auto crashes in Nigeria while Makinde *et al.* (2012) revealed that the figure worldwide stands at 1.25 million. Traffic signs, however are most effective when they command attention, convey a clear and simple meaning, command respect of the road users and give adequate time for proper response. However, the traffic signs cannot effectively serve their intended purposse if drivers do not understand the information concerning safe driving behavior that is encoded in the road sign.

This study therefore, surveyed the perception of drivers and other road users as to the identification of certain road signs and the application of these signs thereafter.

Structure of Roads in Nigeria

Integrated road development in Nigeria dates back to as early as 1925, when the Road Board was established by the colonial administration. The Board had the responsibility to evolve blueprints for trunk road network and connecting major administrative centers of that time. The roads were however lacking in standard designs and were in single lane, with sharp bends, poor drainage system and without any much attention given to traffic signs to alert drivers (CBN, 2003).

The growth of economic activities prompted the need, for improvement in roads. Consequent upon this, the quality of road construction was improved as the length and network continued to increase such that by 1952, 15,785km of bituminous surface and 75,200km of earth/gravel surface roads were already in place in Nigeria but today, Elebeke (2016) noted that the minister of Power Works and Housing lamented that the country constructed only about 28,980km out of the current total road network estimated about 194,000 kilometers. Igbokwe (2016) noted that this length makes Nigeria to have the largest road network in West Africa and the second largest south of the Sahara. The Nigerian road system is classified into four broad categories: The Federal Trunk 'A' roads exclusively owned, developed and maintained by Federal Government; The Federal Trunk 'F' Roads: These were formerly under state ownership, but were taken over by the Federal Government, with a view to upgrading them to Federal highway standards; The State Trunk 'B' roads under the ownership and management of the component states and the Local Government Trunk 'C' roads under Local Government ownership and management. Each tier of government has the responsibility for planning, construction and maintenance of the network of roads under its jurisdiction. The current road network of roads, estimated at 200,000 kilometers, is shared among the three tiers of government (Adelekan, 2016).

Status of Highway Maintenance in Nigeria

Maintenance of highway consists of correcting potholes as well as road markings and signage that have deteriorated, and taking steps to prevent the development of other deficiencies. Road maintenance is important in order to prolong the life of a structure. Proper maintenance also keeps the road signs open and ensures greater regularity, punctuality and safety of transport services.

Several efforts have been put in place by the government but the performance of the Nigerian roads sector has not been satisfactory despite its enormous potentials for growth and development. Matawal (2013) observed that traditionally, the poor transport facilities and infrastructure have severely delayed economic development which weakened transport infrastructure and contributed negatively to the attempts to alleviate poverty in the country. Consequently, this paper gives a clear picture of the meaning and types of road signs, modes of failures and possible steps to take to proffer remedies that may be adopted for solution to the identification and application of such signs when there is failure in doing so.

Visibility of Traffic Signs

The visibility of traffic control devices such as signs, signals, reflective bridge railings, kerbs and pavement markings are important to the effective usage of roads of both day and night. The U.S. Department of Transportation Federal Highway Administration (2007) noted that TCDs represent one aspect where night visibility enhancements are considered possible to depict the roadway, alert drivers of unexpected conditions, as well as facilitate their abilities to navigate the road network. A variety of sign materials have evolved to provide options in meeting legible and detectable objectives, but there have been no specific design or maintenance thresholds. The available materials vary in cost and performance, particularly relative to night visibility, complicating decisions for traffic sign design and budgets for sign programmes. One of the factors associated with night visibility, is the property of a material to redirect light back towards its source. In the case of a traffic sign, light is redirected back from the sign face toward the vehicle's headlights, making the sign visible to car drivers and commuters. With legible designs that convey traffic messages, road and traffic signs still face problems associated with recognition as well as deterioration will not happen. The U.S. Department of Transportation Federal Highway Administration (2007) observed that reflectivity of road signs gradually deteriorates over time by way of fading, thus, making signs progressively less visible especially at night. Deterioration can occur in a number of ways, the primary mechanisms are the fading of the colour portions and the loss of retro reflectivity. When the colours fade, the sign loses its contrast values between legend and background. For critical signs, such as STOP signs, fading of the

red background may make the sign less legible even during the daytime. Deterioration can occur for a variety of reasons, ranging from the weather conditions such as the abrasion of rain, sun, wind, dust, environment in which the sign exists and poor workmanship during fabrication or improper installation procedures.

Fig 2 (a) and (b): Traffic Signs Warning Not to Undertake Certain Actions,
Source: Original Design by Bonaventure Zirra (2016)

Fig 2: Traffic Signs Warning Not to Undertake Certain Actions,
Source: Original Design by Bonaventure Zirra (2016)

Fig 3: Traffic Signs Indicating Maximum Speed Limits,
Source: Original Design by Bonaventure Zirra (2016)

Figure 4: (a) Double Traffic (b) Adjoining Roads,
Source: Original Design by Bonaventure Zirra (2016)

Figure 4 (c) High/ Main Merging Roads (d) Narrow Roads,
Source: Original Design by Bonaventure Zirra (2016)

Figure 5: Stop Signs No Parking Sign Stop Sign No Entry Sign Dual Usage Sign,
Source: Original Design by Gyang Sunday (2016)

Figure 5 (c): No Parking Sign (d): No Entry Sign Dual Usage Sign,
Source: http://www.wishafriend.com 2016

Fig 6: Zebra Crossing Men at Work,
Source: Original Design by Jonah Baba (2017)

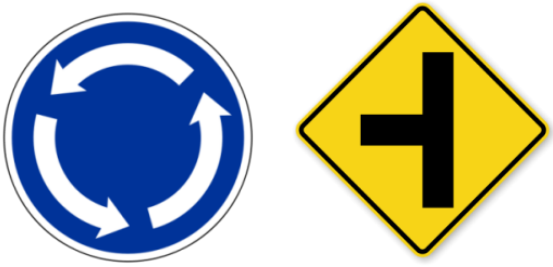

Fig 7(a): Round about (b) T –Junction,
Source: Original Design by Bonaventure Zirra (2016)

Fig 8: Sign Depicting Bending and Winding Roads,
Source: Original Design by Jonah Baba (2017)

Methodology

The study is qualitative and quantitative research with use of analysis to address the problems of the visual perception such as identification, recognition and application of road sign by some drivers. This approach of analyzing communication materials of signs is preferred because of the nature of the research.

In assessing the impact of the road signs have on road users, the study used the quantitative aspect through the use of questionnaire, observations, and interviews administered and completed by respondents who are drivers and interview was employed. The questionnaire with road signs were presented to participants and were expected to write down a phrase that first comes to mind when they come across each symbol. They are expected to write what each object represents in terms of graphical symbol for comprehension, communication and application. Through this technique unprejudiced responses that are less influenced by other considerations of tense examination conditions in which all effort is geared towards correctness and good grades as opined by Callaghan *et al*., (2014) was provided. The study which was conducted in October, 2016 was referred to as Symbol Identification Task (SIT).

One hundred and twenty (120) questionnaires were distributed amongst motorists in Zaria out of which only one hundred and six (106) were returned. The questionnaire used is made up of three sections. The first section is made up of short demographic information. The second section was designed to give information about the motorists' personal and socio-economic characteristics such as educational background, driving as a job, driving experience and to assess the understanding of traffic signs by the drivers, while the third section is to solicit multiple choice responses on means to improve upon different warning and regulatory-prohibitory traffic signs. Some selections of different existing global traffic signs made up of warning and regulatory-prohibitory signs were printed on separate sheets of cardboard and shown to the respondents to ascertain their level of identification, recognition and application of such signs during driving. These signs were shown to purposively selected motorists who were asked to identify signs, after which series of semi-structured enquiries were made pertaining to the steps of caution to be applied at the sight of road signs.

Results and Discussions

This study earlier highlighted some identification problems that were observed in some drivers recognition and application procedures. The information on the drivers opinions were obtained through interviews, observation, and questionnaire. The questionnaire wasn the 5-point Likert Scale and was analysed with descriptive statistics. Seventy five per cent (75%) of the respondents were male while about 15% were female and 50% of them were between the ages of 25-40 while the other 50% were above 40 years. Only 33% of the respondents had secondary education while the other 67% had their first and additional degrees.

The first section of the questionnaire sought to obtain the social and demographic account of the respondents and the results showed that all the respondents were literate but not all the signs shown them were identified correctly, only some of them were easily recognizable by the respondents. Eighty percent (80%) of the respondents agreed that the signs they recognized actually convey their intended messages. Fifty one percent (51%) respondents strongly agreed that when they see signs they apply it while twenty nine percent (29%) agree and twenty one percent (21%) are undecided about the application of certain signs while driving.

Table 1: Responses Shown in Percentage Distribution

		SA (%)	A (%)	U (%)	D (%)	SD (%)
1.	I can identify all the symbols shown to me	5	12	11	59	19
2	I can identify some of the symbols shown to me	37	52	10	4	3
3	I know the meaning of the symbols shown to me	31	56	7	9	3
4	The road signs shown to me actually conveys its intended message to me	26	57	5	14	4
5	While driving, I apply some of these symbols shown to me	51	29	21	3	2

Source: Researchers Field work (2016)

About 95% of the respondents agreed that there are no sufficient road signs while only 1% respondent said there are sufficient road signs in Kaduna State. All the respondents agreed that lack of adequate road signs can constitute road hazards. The findings indicate that the effectiveness of road signs should be assessed in terms of their ability to sensitize the driver to hazards, rather than in terms of identification and recognition accuracy, and point to inconsistencies between drivers′ verbal recall and vehicle control behaviour which were apparent from observations.

In the open ended section of the questionnaire, suggestions were made on how to improve road signs. The findings indicate that there is no wide spread of road and traffic signs around the cities and metropolis. There is need for increase of road signs and placements of signs at strategic places, regular maintenance and replacements of roads and road signs, use of public enlightenment campaigns and enforcement of all regulations pertaining to road usage.

Findings

The study revealed the following:

(i) There is no wide spread road and traffic signs around strategic places on streets and roads in Zaria metropolis.

(ii) Road signs are an essential element of a well maintained road infrastructure to help regulate traffic, provide important visual guidance, give drivers important preview time at day and night-time as well as alert them to potential hazards on the road.

(iii) All drivers need legible signs to make important decisions at locations such as junctions, roundabouts and exit routes on high-speed facilities. Factors that cause low perception of road and traffic signs is problems associated with visibility. Improving sign reflectivity will be especially beneficial to older drivers, all drivers, including younger drivers, will find that improved symbol reflectivity will be beneficial especially for their nighttime driving experience.

Conclusion

The results seem to suggest that even though the perception of graphical symbols among road users in Zaria is high, it was clear that identifying a symbol as referent is still an issue. About 51% of participants could not correctly associate all the silhouette of a symbol with its intended conceptual draft, only about 44% of the participants could correctly identify and associate all of the symbols correctly, and 5% were undecided.

The effectiveness of road and traffic signs largely depends on their visibility, legibility and ability of signs to be recognised by drivers at both day and night-times. Traffic signs are designed to satisfy these requirements by selection of the size of signs, colour, style of letters and numerals and application of symbols, as well as the retroreflective materials used for both backgrounds and legends. As the number of vehicles on roads have greatly been on the increase, illegal human activities such as dumping of refuse on road shoulders, drainage and channels, wrong and dangerous parking on the road causing failure and collapse of these roads, vandalisation of road infrastructure such as street light cables and fittings, bridge railings and road signs, metallic crash barriers, driving on kerbs and burning of tires have all added to the avoidable road crashes, injuries and fatalities. It is through the appropriate selection of the design specifications (colour, size and fonts) that Federal, State and Local agencies develop signs intended to meet drivers' needs both under day and night conditions.

This study surveyed the opinions of drivers and other road users to ascertain if certain road and traffic signs can be properly identified and if the signs are applied in the cause of plying the roads with a view to educating, enhance visibility, and suggest advocacy driven campaigns for drivers and other road users on the application of road and traffic signs and reduce accidents and other road hazards

which may lead to loss of lives and properties. The results shows that there is no wide spread of road and traffic signs around strategic places on streets om cities and metropolis of Zaria. The study suggests means of improving road signs in this regard.

There is the need, on behalf of road authorities such as the Federal Road Maintenance Agency (FERMA), to urgently prioritize road signs by taking stock of signs under their various government jurisdictions, and establish a work plan for the replacement of old signs as well as installing new legible signs in strategic locations along streets, major roads and highways that have no signs. It is necessary to adapt traffic signs to the needs of an ever increasing number of drivers and ensure that safety and warning signs are sufficiently visible for the reduced visual abilities of old drivers and those who have eye problems.

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