COMPREHENSION OF TRAFFIC CONTROL DEVICES AMONGST URBAN DRIVERS - A STUDY OF ADO-EKITI, EKITI STATE, NIGERIA

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ABSTRACT

Traffic control devices aim to regulate and control traffic by providing information about the road and its environment for road users in order to promote safety. This paper elucidates on the understanding of traffic control devices as a safety measure in controlling traffic problems relative to accident occurrences. This study investigated the understanding of traffic control devices by drivers in the city of Ado-Ekiti with respect to their personal characteristic such as age, gender, educational background and marital status. A total of 32 symbols which includes traffic signs of eight warning signs, 10 regulatory signs and 6 informatory signs, 5 road markings and 3 traffic signal lights were investigated. The analysis showed that there is a low understanding of traffic control devices by drivers. The overall average percentage of drivers who correctly understood the traffic control device investigated was 64.5%. From the study, education is an important factor in the understanding of traffic control devices while age and gender were of no effect. The statistical analysis at 5% significance further proved that education and understanding of traffic control devices are dependent on each other.

Keywords: Comprehension, traffic control device, traffic safety, drivers' characteristics.

INTRODUCTION

Traffic safety has become a global issue in recent years because of the loss of live and associated accident costs. The authorities responsible for traffic safety have taken extensive measures to achieve safety in many areas of the traffic system, Al-Gadhi et al (1994). Road traffic accidents have been recognized as a leading cause of death and fatal injuries worldwide. It is estimated that almost 1.3 million people are killed from road accidents every year, which is nearly 3,500 deaths everyday and 140 every single hour (WHO 2008) as cited by Rubayat and Sultana (2013).

The number of vehicles on Nigerian roads had increased in recent years due to technological and economical development and unfortunately, this has also increased the number of accidents and fatalities. According to the Federal Road Safety Corps, a total of 4765 road traffic crashes were recorded in 2011 which resulted in 4372 persons killed and left 17,464 people with varying degrees of injuries, (FRSC report, 2011). A general analysis of the cause of traffic accidents shows that majority are due to driver's mistakes and traffic violations. One major factor affecting safe driving is the comprehensibility of traffic control devices by drivers.

Traffic control devices as a safety measure have been of keen interest to researchers in the past few decades. The interest covered many areas such as safety, comprehension and design and many more. Based on the fact that many studies had been carried out in many developed countries such as Turkey, Qatar, USA, Uk, Bahrain etc, the review showed that little or no

study to assess the driver's comprehensibility of traffic control devices in Nigeria has been reported to date. There is a general public perception which is also supported by Okafor et al. (2013) that city drivers in Nigeria do not have a satisfactory level of comprehensibility of traffic control devices and often this is thought to be a major contribution to road accident. This study therefore undertakes to assess the driver's understanding of certain traffic control devices in Ado-Ekiti, the capital city of Ekiti State.

Ado-Ekiti, a town in the South-West region of Nigeria, is the capital of Ekiti State. The town spread over an area of about 146 square kilometers. The population of Ado town according to the Nigeria census (2006) is about 308,621 and is the first most thickly populated town in Ekiti State. Ado-Ekiti lies on coordinates of 7° 35' and 74° 47' North and 5° 11' and 5° 16' east of Greenwich meridian. It is situated in the humid tropical region of Nigeria. Ado-Ekiti enjoys abundant rainfall of over 1,500mm annually and the south-western wind blows most of the year from December to February. Cooler continental winds from the interior of Ado-Ekiti prevail the rainy season from March to October every year.

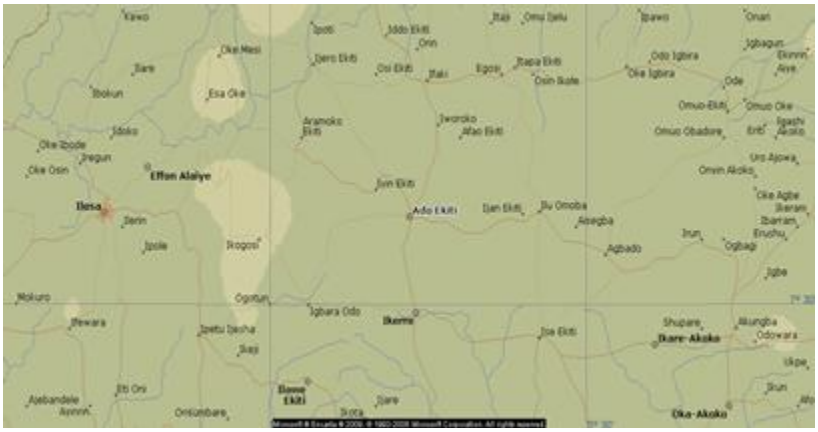

Fig 1: Map of Ado-Ekiti, Ekiti State

LITERATURE REVIEW

Traffic control devices aim to regulate and control traffic by providing information about the road and its environment to road users, Makinde and Opeyemi (2012). Traffic control devices such as traffic signs, pavement marking and traffic signals are a vital part of the highway system (Razzak and Hasan 2010). Traffic control devices provide a means of communicating important information about the roadway to the users especially the drivers with the use of colour, shape, symbols, light and/or words to convey the information. However, it is worthy to note that the traffic control devices cannot serve their intended purposes effectively if the information encoded in the devices is not properly understood by the driver and other road users. With traffic volume increasing over the last eight decades, many countries have adapted pictorial sign or otherwise simplified and standardize their traffic control devices to facilitate international travel where language difference could create barrier. To help in enhancing traffic safety, such pictorial traffic device use symbols and signs in place of words.

Effects of traffic control devices on drivers have been a topic of considerable interest to researchers during the past few years. Zhang and Chan (2013) opined that research concerning traffic sign comprehension dates back to 1966 and that early studies focused on evaluating user understanding levels of local traffic signs and most of the results indicated that

the general comprehension performance was far from satisfactory. Some researches further investigated individual differences in performance on comprehension test and proposed that user characteristics like age, gender, driving experience, education background etc. might significantly influence comprehension level, they covered a wide range of aspect related to comprehensibility Kirmizioglu and Tuydes-Yaman (2012), Al-Madani and Al-Janahi (2002a&b), understanding Razzak and Hasan, (2010), Makinde and Opeyemi (2012).

Al-Madani and Al-Janahi (2002a) opined that age, gender, education and income played major roles in determining drivers' comprehension of signs while marital status showed no significant effect. Makinde and Opeyemi (2012) in another study was of the opinion that age, education and driving experience played prominent roles in understanding of traffic signs while marital status and age had no effect on the understanding. Al-Madani and Al-Janahi (2002b) assessed drivers' comprehension of traffic signs with respect to their personal and social characteristics in UAE and the results indicated that drivers' personal characteristics are primarily associated with their understanding capabilities and not with accident involvement rates.

In the recent time, research study had gone further taking into consideration the effect of sign cognitive features such as sign visibility Kline, Ghali and Kline (1990), design features Ng and Chan (2007),detection and recall Al-Gadhi et al. (1994) with respect to familiarity, concreteness, simplicity, meaningfulness and semantic distance.

Ng and Chan (2007) stated that the success of effective communication of traffic signs messages to road users may not relate to the user characteristics but also the signs themselves. Ng and Chan (2007) examined the cognitive design features such as familiarity, concreteness, simplicity, meaningfulness and semantic closeness of 120 Mainland China traffic signs and the results suggested that cognitive design features are useful for designing more user-friendly traffic signs, which should transmit clear messages about road conditions ahead at the right time to road users. According to Zhang and Chan (2013), unsatisfactory comprehension of traffic signs is a common problem for drivers in many countries. The unsatisfactory comprehension is related to the characteristics of the traffic control devices themselves.

Another factor affecting the comprehension of traffic control devices is differences in cultural background relative to traffic control devices design. In a study by Ou and Liu (2012), the comprehension of Taiwanese traffic signs were examined between two user groups: Taiwanese and Vietnamese. The Taiwanese showed a better understanding of the traffic signs compared to the Vietnamese, and the reason according to the Ou and Liu (2012) was the different traffic sign design principles in different cultures.

Dissanayake and Lu (2001) investigated the comprehension of traffic control devices comprehension amongst domestic and international drivers in USA and through the data analyses; it was found that more international drivers lack understanding of traffic signs, markings and signal indications than the domestic drivers in USA. The overall conclusion was that personal characteristics, design features and cultural differences are clearly associated with comprehension capabilities.

METHODOLOGY

The method adopted in this research work involved the use of questionnaire completed by drivers within Ado-Ekiti town. One hundred and fifty questionnaires were randomly administered amongst the commercial and private drivers; only one hundred and forty two questionnaires were returned (94.67%).

The questionnaire used was divided into three sections with the first section made up of short answer questions designed to give detailed information about the drivers' demographic characteristics such as the age, sex, marital status and educational background etc. The second section gave information about the driver's characteristics like driving as a job, driving experience. The third section was designed to assess the comprehension of traffic control devices by the drivers. The third section was subdivided into three groups comprising of traffic signs, traffic signal and road marking questions. The first group had 24 multiple choice questions of different traffic signs made up of ten regulatory signs, eight warning signs and six informatory signs. The second group, the three different meaning of traffic light was tested and third group, five different road markings were also tested.

The use of chi-square as a statistical tool was employed to test for hypothesis relating driver's characteristics. The null and alternative hypotheses for the testing were:

H_o: - The characteristic and traffic control devices comprehension are independent of each other.

H_i: - Null hypothesis is not true.

The expected cell frequencies were compared with the observed cell frequencies using the test chi-square, as estimated.

$$X^2 = \Sigma \frac{(O_i - E_j)^2}{E_{ij}}$$

where:

X^2 = chi-square

o_{ij}= observed frequency of the cell in the *i*th row and *j*th column

e_{ij} = expected frequency of the cell in the *i*th row and *j*th column

The calculated chi-square result was compared with the critical chi-square value (using the table) with (r-1) x (c-1) degree of freedom to make a decision regarding the acceptance or rejection of the null hypothesis, Kothari (2004).

Decision Rule

If $X^2_{tab} > X^2_{cal}$, accept H_o otherwise reject

RESULTS

Personal Characteristic of Drivers

Table 1 summaries the personal characteristic of the 142 survey respondents, out of the 142 respondents 137 were male and only 5 of them were female. The age distribution shows that the drivers were mostly young, 69% were below the age 36 while 31% were above the age 35. The educational background of the driver shows that 47.9% of the drivers have WAEC certificate, 22.5% of them with NCE/OND certificate, 16.2% of the drivers possess HND certificate and 13.4% with B.S.C. certificate.

Table 1: Personal Characteristics of Drivers

Characteristics		Sample No	Percentage %
Gender	Male	137	96.5
	Female	5	3.5
Age (years)	20 – 25	34	23.9
	26 – 30	35	24.7
	31 – 35	29	20.4
	36 – 40	24	16.9
	41 and above	20	14.1
Marital Status	Single	44	31
	Married	95	66.9
	Divorced	3	2.1
Educational background	WAEC	68	47.9
	NCE/OND	32	22.5
	HND	23	16.2
	B.Sc	19	13.4

Drivers Comprehension of Traffic Signs

Understanding of Warning Signs

Table 2 shows the result of drivers' comprehension of warning signs. A total of 8 warning signs were evaluated in this study. The average percentage of correct answers of these signs was 56.1% which indicated that the comprehension was poor. The signs that were well understood by drivers were "Roundabout" 90%, 'T-Junction" 71.8% and "Four-way junction" 82.9%. These high percentages could be attributed to the self explanatory graphics in the signs. The least understood signs were "dangerous" double bend 34.5%, narrow bridge 33.8% and two way traffic 37.3%.

Table 2: Understanding of Warning signs

Signs	Meaning of Sign	Percentage %
	Roundabout	90
	T – Junction	71.8
	Dangerous Double Bend	34.5
	Two Way Traffic	37.3
	Narrow Bridge	33.8
	Four Way Junction	82.9
	Road Hump / Uneven Road	48.6
	Pedestrian Crossing	50

Comprehension of Regulatory Signs

A total of 10 regulatory signs were evaluated with the result presented in table 3. The average percentage of the correct answer is 60.3%, which indicated that the comprehension was very poor. "Speed limit" 83.1%, "No parking" 79.6%, "No right turn" 75.4%, "No left turn" 66.9% and "No pedestrian crossing" 71.1% were well understood signs while "no horn 35.8% was the least understood sign. These high percentages of correct answers can be attributed to the self explanatory graphics in this mandatory signs.

Table 3: Comprehension of Regulatory signs

Signs	Meaning of Sign	Percentage %
	No Right Turn	75.4
	No Parking	79.6
	No Left Turn	66.6
	No U – Turn	44.9
	No Overtaking	42.3
	No Horn	35.8
	No Pedestrian Crossing	71.1
	Speed Limit	83.1
	No Stopping	47.2
	No Waiting	38.7

Comprehension of Informatory Signs

A total of six informatory signs were assessed and the result is shown in table 4. The average understanding level of these signs was 64.6% indicating poor understanding. The signs well understood were "Airport" 91.5%, "Hospital" 73.2% and "Filling station" 67.6%.

Table 4: Comprehension of Informatory signs

Sign	Meaning of sign	Percentage %
	Parking	50.7
	Hospital	73.2
	Church	43.7
	Telephone	61
	Filling Station	67.6
	Airport	91.5

Drivers Comprehension of Road Marking

Table 5 shows the result of drivers' comprehension of road markings. A total of five road markings were evaluated and the average percentage of correct answer was 59% which indicated that the comprehension was very poor. The road markings well understood are centre line and warning line with 81.7% and 65.5% respectively. These high percentages could be attributed to the fact that these road markings are common and readily visible on roads. The least understood were "no crossing" 43%, "enter marked area" 48.6% and "zebra crossing" 56.3%.

Table 5: Comprehension of Road markings

Sign	Meaning of sign	Percentage %
	No Crossing	43
	Zebra Crossing	56.3
	Warning Line	65.5
	Center Line	81.7
	Do not enter Marked Area	48.6

Drivers Comprehension of Traffic Signal

The meaning of three traffic signal indications i.e. yellow, green and red were tested in this survey and the comprehension levels for the three signal indications is presented in table 6. The average percentage of correct answer of these three signal indication was 85% which shows that the comprehension ability was very good. All the three traffic signal indications -

red, yellow and green were well understood. The high percentage is attributed to the use of traffic signal within Ado-Ekiti township for traffic control.

Table 6: Comprehension of Traffic signal

Signal	Meaning	Percentage %
 Red Light	Danger / Stop	95.8
 Yellow Light	Ready to stop / move	85.9
 Green Light	Safe to move	73.2

Cross Analysis of Individual Characteristics and Traffic Control Devices Comprehension

Analyses of seven selected signs were conducted to check for relationship between traffic control device comprehension and individual characteristics of the respondent drivers.

Cross-classification analysis of educational background and traffic control devices comprehension

In the cross-classification analysis of educational background of the respondents and the comprehension of the selected traffic control devices, the result is given below in table 7. By considering a 5% level of significance, the critical chi-square value is 7.815. The calculated chi-square values of all the traffic control devices evaluated were larger than the critical value indicating that there are reasons to believe that the variables are dependent.

Table 7: Cross analysis of Educational background

Educational background	Traffic Control Devices													
	Pedestrian Crossing		Road Hump		No Left Turn		No Stopping		Parking		Zebra Crossing		Yellow Light	
	C	W	C	W	C	W	C	W	C	W	C	W	C	W
WAEC	14	54	18	50	32	36	19	49	15	53	30	38	33	35
OND/NCE	23	9	21	11	27	5	17	15	20	12	23	7	30	2
HND	18	5	16	7	19	4	16	7	18	5	20	3	22	1
BSC	16	3	14	5	17	2	15	4	19	0	15	4	18	1
Chi-square Test Statistic	45.72		25.81		23.47		22.78		49.60		20.36		37.75	
H_0 Rejected?	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

C* = frequency of correct answer
W* = frequency of wrong answer

From table at 5% significance, X^2_{tab} = 7.815 while the individual X^2_{cal} were all greater than the X^2_{tab}. Since X^2_{cal} is greater than X^2_{tab}, reject H_o, meaning that the characteristics i.e. educational background and traffic control devices understanding are dependent on each other.

Cross-classification analysis of gender and traffic control devices comprehension

In the cross-classification analysis of gender of the respondents and the comprehension of the selected traffic control devices, the result is given below in table 8. By considering a 5% level of significance, the critical chi-square value is 3.841. The calculated chi-square values of all the traffic control devices were smaller than the critical value indicating that the variables are independent of each other.

Table 8: Cross analysis with Gender of the respondents

Gender	Traffic Control Devices													
	Pedestrian Crossing		Road Hump		No Left Turn		No Stopping		Parking		Zebra Crossing		Yellow Light	
	C	W	C	W	C	W	C	W	C	W	C	W	C	W
Male	69	68	65	72	39	98	63	74	67	70	55	82	118	19
Female	2	3	3	2	1	4	2	3	1	4	3	2	5	0
Chi-square Test Statistics	0.207		0.299		0.165		0.075		1.627		0.864		0.845	
H_0 rejected?	No		No		No		No		No		No		No	

Decision Rule

If $X^2_{tab} > X^2_{cal}$, accept H_o otherwise reject, from table at 5% significance, X^2_{tab} =3.841. Since X^2_{tab} (3.841) > X^2_{cal}, accept H_o this mean that the gender characteristics and the traffic control devices understanding are independent.

Cross-classification analysis of age and traffic control devices comprehension

In the cross-classification analysis of age of the respondents and the comprehension of the selected traffic control devices, the result is presented in table 9. Considering a 5% level of significance, the critical chi-square value is 9.488. The calculated chi-square values of all the traffic control devices were smaller than the critical value indicating that the variables are independent of each other.

Table 9: Cross analysis with Age of respondent

Age	Traffic Control Devices													
	Pedestrian Crossing		Road Hump		No Left Turn		No Stopping		Parking		Zebra Crossing		Yellow Light	
	C	W	C	W	C	W	C	W	C	W	C	W	C	W
20-25	15	19	20	14	16	18	20	14	21	13	19	15	18	16
26-30	23	12	17	18	21	14	13	22	19	16	18	17	15	20
31-35	17	12	9	20	17	12	18	11	14	15	19	10	18	11
36-40	8	16	13	11	11	13	14	10	11	13	15	9	14	10
41above	12	8	11	9	12	8	15	5	8	12	7	13	9	11
Chi Test statistics	7.87		5.57		2.34		8.52		3.09		5.29		3.12	
Ho rejected?	No		No		No		No		No		No		No	

Decision Rule

If $X^2_{tab} > X^2_{cal}$, accept H_0 otherwise reject, from table at 5% significance, X^2_{tab} =9.488. Since X^2_{tab} (9.488) > X^2_{cal}, accept H_0 this mean that the age characteristics and the traffic control devices understanding are independent.

In general, individual characteristics with respect to age and gender do not have influence on the understanding of traffic control devices while the education background characteristics do have a great influence on the understanding of traffic control devices. Note that other characteristics such as marital status, driving experience were not tested in this study.

CONCLUSIONS

In summary, the comprehension of traffic control devices by drivers is very important factor in enhancing maximum safety on the roads. The results from this study show that drivers generally have poor understanding of traffic control devices. From the study, drivers' personal characteristics control drivers' comprehension abilities with educational background as a major factor affecting the understanding of traffic control devices as observed in the statistical test carried out. The findings agree with other research works that drivers generally have problems in comprehension of traffic control device.

In view of this finding, extra efforts should be given to driver especially those with low educational background to facilitate a better understanding of traffic control devices. Government organizations saddled with the responsibility of maintaining safety on roads should be better empowered with educational materials such as hand book, poster, campaign, use of public media like radio and television, seminar and talk shows.

Enforcement of reasonable traffic laws which at the same time are best designed to prevent accidents should be encouraged amongst drivers at all levels by the authority concerned.

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