Comprehension Analysis of Traffic Signs by Drivers on Urban Roads in Ilorin, Kwara State

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Traffic signs are the oldest and most commonly used Traffic Control Device (TCD). These signs convey messages in words or symbols and erected to regulate, warn, or guide the road users (motorists, and pedestrians). This study investigated the level of compliance of traffic control devices among drivers with different sociodemographic characteristics in Ilorin. A descriptive research design of survey type was used in the conduct of the study. The population for this study covers commercial and private drivers in Ilorin. The research instrument used for the study is a well-structured questionnaire. The data gathered were analysed using frequency counts and percentage for the demographic data, and factors that affect the non-understanding of drivers to traffic control devices. Statistical analysis was done with SPSS. For chi- square, only the years of driving experience was found statistically significant with a p-value of 0.006 and for Analysis of Variance (ANOVA) both educational experience and years of driving experience were found to be statistically significant with p-value of 0.001 and 0.000. It was deduced that major factors affecting the non-understanding of traffic control devices by drivers in Ilorin were lack of previous knowledge of the signs, lack of adequate enforcement and non-availability of control devices on most roads in Ilorin.

Keywords: Traffic signs; traffic control device; sociodemographic.

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1. INTRODUCTION

"Traffic signs are commonly used traffic safety tools, mainly developed to provide crucial information in a short time to support safe driving but the success depends on their comprehensibility by the drivers" [1]. "Traffic signs, 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" [2]. "Traffic signs use colour, shape, and words to convey information. However, the traffic signs cannot effectively serve their intended purpose if drivers do not understand the information concerning safe driving behavior that is encoded in the sign" [3].

One of the most reliable traffic control devices used to guide the safe and orderly movement of traffic and pedestrians are the traffic signs [4] and these should be a common sight when drivers pass around the busy networks and open highways. "Traffic signs give information for routes, directions, and warnings for drivers, they are commonly installed at major intersections in cities and towns" [5]. "The traffic signs should be clear and should convey the intended message so that the road users can understand the message and see it visibly. The non-compliance of these rules and regulations will result in penalties and violations to the driver. Not paying attention and failing to understand instructions can prove to be harmful and even dangerous" [6,7].

Clear and efficient signing is an essential part of the road system, and a road with poor signing or with badly maintained signs is not functioning well. Road users depend on signing for information and guidance, and road authorities rely on signing for traffic control and regulation, and for road safety.

1.1 Problem Statement

In the city of Ilorin, there are road signs, markings, and signals, amongst others, which are meant to guide road users and ensure their safety while traffic control signals are displayed by traffic officers to ensure free-flow of vehicular and human traffic. The essence is to reduce the rate of road traffic crashes. In spite of these, accidents continue to occur, and somehow tend to be on the increase. Therefore, there is need to investigate whether many road users intentionally violate the traffic rules?

Consequently, this research was undertaken to assess the driver's personal characteristics in understanding of traffic signs in Ilorin, the capital city of Kwara State.

1.2 Aim and Objectives of the Study

This study intends to investigate the level of understanding and compliance of traffic control devices among drivers with different socio-demographic characteristics in Ilorin.

The specific objectives are to:

i.   identify driver's characteristics that is significant to the non-understanding of traffic signs;
ii. determine factors that affect the non-comprehension of drivers to traffic control devices.

1.3 Research Questions

This study was guided by the following research questions:

i.   How effective are road traffic signs in Ilorin?
ii. Does educational background have any effect on road users' understanding of traffic signs?
iii. Why do drivers fail to comprehend and comply with traffic signs in Ilorin?

1.4 Significance of the Study

The study could be significant for the following reasons:

i.   The study could be having some great importance to the government and officials at the future to improve drivers' license training and testing.
ii. Even though the study is concentrated on traffic in Ilorin, the outcome to be obtained from this research could be helpful to officials committed to special effort to better drivers' understanding of a traffic control signs.
iii. The end result from the study may be helpful to gain valuable data and information about the traffic control signs understanding among drivers within personal characteristics and to suggest design solutions to enhance the traffic safety solution in these areas.

2. METHODOLOGY

The method adopted in this research work involved the use of questionnaire distributed to both private and commercial drivers within Ilorin metropolis. Three hundred and eighty-four (384) questionnaires were administered randomly amongst private and commercial drivers. The number of questionnaires used was determined using Krejcie and Morgan Table, the table helped to determine the sample size, the population of 1000000 gave the Sample size of 384.

2.1 Sample Approaching and Survey Administration

In-person interview technique was the chosen option to reach the potential respondents. A structured paper-based questionnaire was designed as the survey instrument.

2.2 Survey Questionnaire Design

The questionnaire consists of three main parts; the first part was made up of short answer questions designed to give detailed information about the drivers' demographic characteristics such as the age, sex and educational background, driving experience and vehicle type. The second section was designed to assess the comprehension of traffic control devices by the drivers. This section has twenty-nine (29) multiple choice questions of different traffic signs made up of eight warning signs, ten regulatory signs, six information sign and five road markings. While the third section was used to examine possible factors that could affect the non-understanding of the traffic control device.

2.3 Descriptive Analysis

Descriptive Statistics was used to present the quantitative descriptions in a manageable form. In this research study, using descriptive statistics helped us to simplify the large amounts of data in a sensible way which reduces lots of data into a simpler summary. The distributions were displayed, in graphs and tables using percentages. The completed questionnaires were analysed using a descriptive statistics of frequency counts and percentage, for the demographic and variables of the study using statistical package called (SPSS) version 26.0.

2.4 Statistical Analysis

For more robust analysis of the survey data, using SPSS'26, this study utilized two statistical methods to examine the relationship between the demographic information of the drivers and their understanding of the traffic control signs and on the reasons for non-compliance to the traffic control signs. The methods are:

(1) Chi-square analysis to measure if understanding of traffic signs is dependent on age, gender, education, driver category, and years of driving experience.
(2) Independent sample t test and Analysis of Variance (ANOVA) were also used to check if there are differences in mean response of the drivers' gender, and category regarding reasons for noncompliance, and drivers' education, age, and years of driving experience towards reasons for noncompliance of the traffic light. Based on this, the following statistical hypothesis were derived.

Hypothesis 1: There is a relationship between demographic information of drivers and their understanding of traffic light.

Hypothesis 2: There are differences in mean response of drivers on their reasons for noncompliance of traffic light.

3. RESULTS AND DISCUSSION

3.1 Major Factors Contributing Driver Non-compliance to Traffic Control Device

This section focuses on the identification and analysis of major factor contributing to driver's non-compliance to traffic control device.

3.2 Drivers Factor by Gender

The understanding of traffic signs based on gender and their corresponding numbers. For male drivers, a number of 65 understood road marking, 62 males with understanding of warning signs, informative signs being understood by 59 male driver and 57 males with clear understanding of regulatory signs. For the case of the female, road marking, warning signs, informative signs, and regulatory signs were understood by 32, 27, 48, 35 females, respectively. The male gender understands the traffic signs compared to the female which is in agreement to previous findings of Umar and Bashir [8].
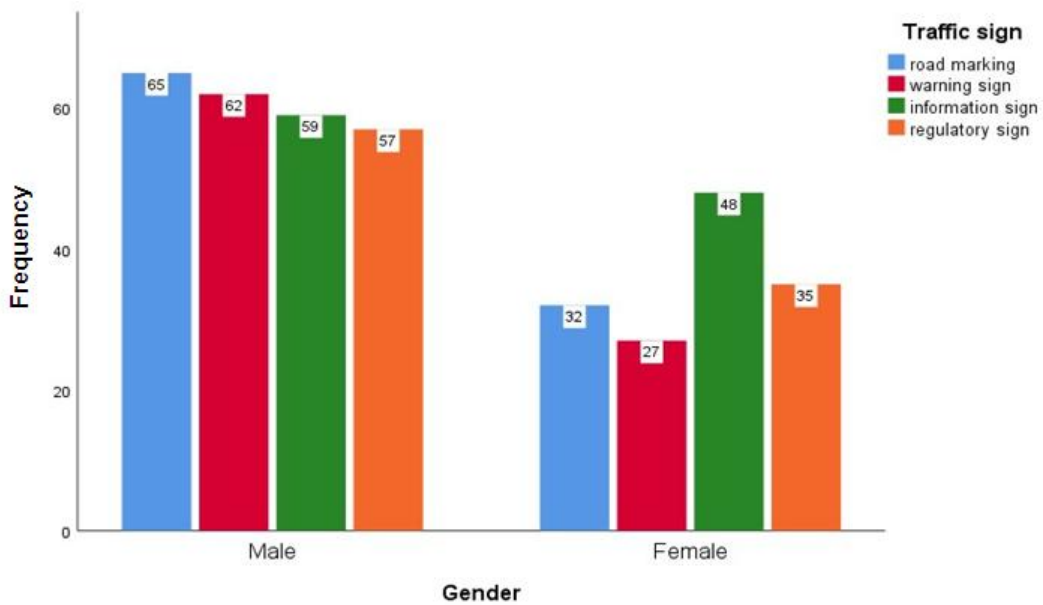
Fig. 1. Illustration of traffic signs understanding by gender

3.3 Drivers Factors by Age

The age distribution of the drivers and its effects on the driver's non-understanding of traffic control devices. When drivers' understanding was compared by their age category, those drivers with an age 31-40 year had higher understanding of the traffic control signs. And drivers of 51 years and above have the least understanding of the traffic signs except for regulatory signs which drivers of 18-24 years of age has the least understanding of regulatory signs. This result is in agreement with findings of Makinde and Opeyemi [9] and, Umar and Bashir [8] and common age range in Nigeria as reported by National Bureau of Statistics [10].
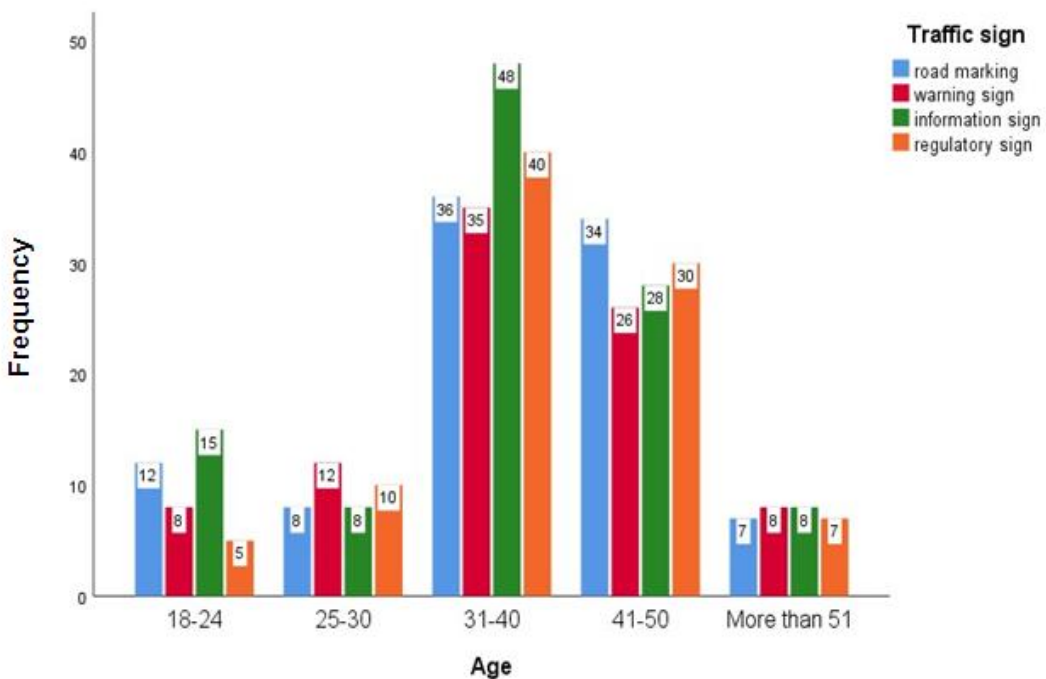

Fig. 2. Illustration of traffic signs understanding by Age

3.4 Drivers Factor by Educational Background

Among the four categories of educational background the number of drivers with primary school education is 20, 24, 21, 19 for road markings, warning signs, information signs and regulatory signs respectively, Those with secondary school are 41, 38, 43, 35 for road markings, warning signs, information signs and regulatory signs respectively and Those with tertiary has their highest level of education are 36, 27, 43, 38 for road markings, warning signs, information signs and regulatory signs respectively. This implies that the majority of the respondents who participated in the study are educated having gone through secondary school education. This correlate with the study by Makinde and Oluwasegunfunmi [11].

3.5 Drivers Factor by Driver's Category

This variable has two categories (private and commercial), Between the two categories, showed that commercial drivers have the highest number of drivers who understands all the types of traffic control devices with 60, 59, 60 and 64 for road markings, warning signs, information signs and regulatory signs respectively. Private drivers have the number of drivers who understands as 37,30,47 and 28 for road markings, warning signs, information signs and regulatory signs respectively.
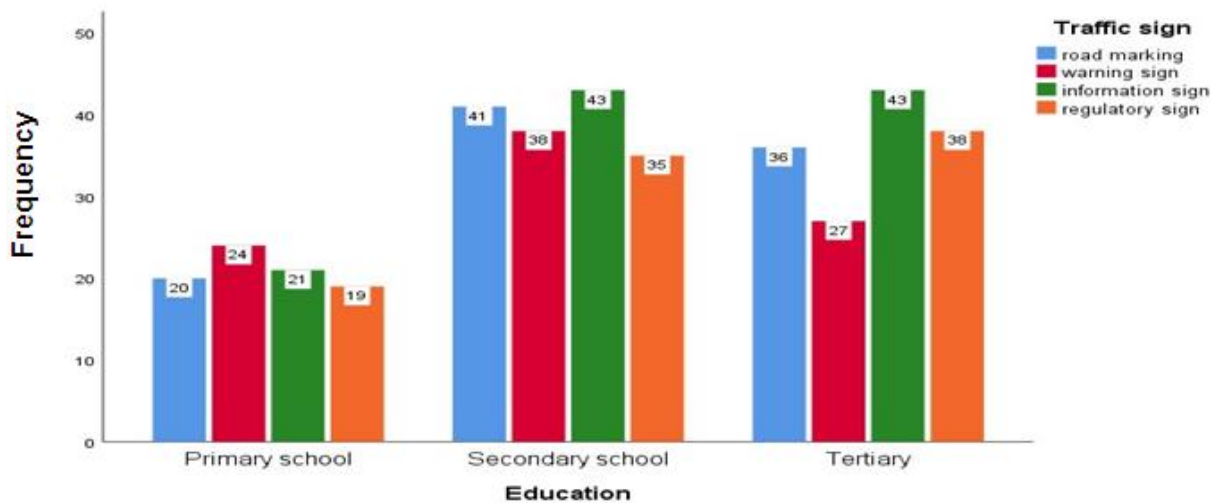

Fig. 3. Illustration of traffic signs understanding by Education
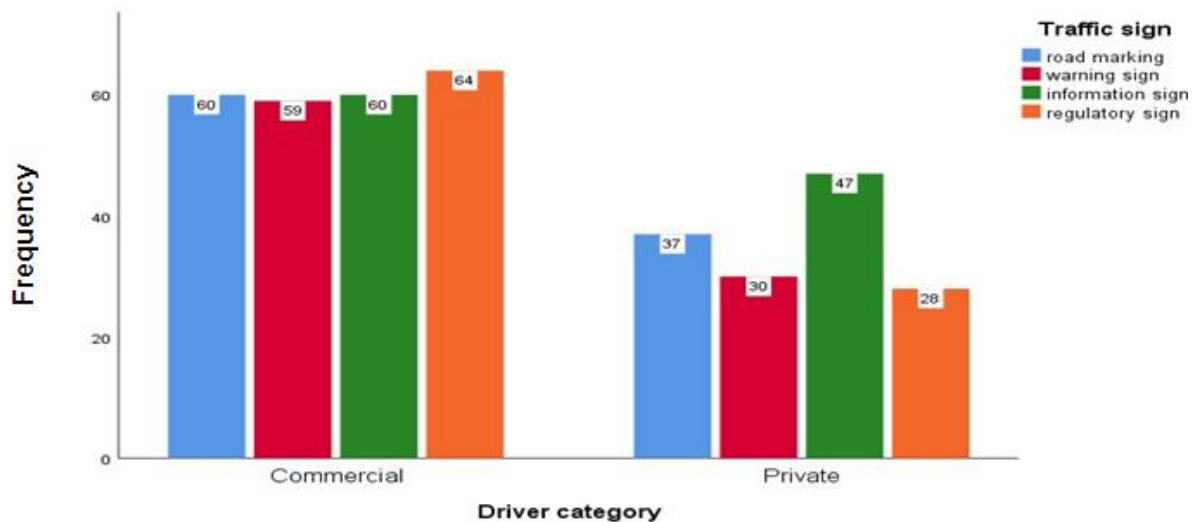

Fig. 4. Illustration of traffic signs understanding by Driver Category

3.6 Drivers Factor by Years of Driving Experience

The figure depicts that driver's with more than 10 years of experience have the highest number of understanding of road marking, information and regulatory signs with numbers of 45, 53, 45 but those with 5-10 years have the highest number of drivers understanding of warning signs which is 46. Those with the less than 5 years of driving experience have the least numbers of drivers who understands all the traffic control device, which correspond to the findings by Gana and Emmanuel [12] and Makinde and Oluwasegunfunmi [3].

3.7 Result from the Advance Statistical Analysis

3.7.1 Chi-square analysis of demographic background and driver understanding of traffic sign

The purpose of this test is to determine if a difference between observed data and expected data is due to chance, or if it is due to a relationship between the variables in this study. Therefore, a chi-square test is an excellent choice to help us better understand and interpret the relationship between our two categorical variables [13-15].

The Asymptotic Significance, or p-value, of the chi-square were run in SPSS. This value determines the statistical significance of the relationship as tested. In all tests of significance, if $p < 0.05$, there is a statistically significant relationship between the two variables.

The Table 1 provides the cross tabulation, otherwise known as chi-square analysis of the relationship between the demographic distribution of the drivers and their understanding of the traffic signs. As revealed in the table, there were no significant relationship between the gender and their understanding of the traffic signs $\chi^2(3) = 5.248$, $p - value > 0.05$, this means that irrespective of the gender, the understanding of the four categories of traffic control signs, as shown in the figure illustration for gender are not statistically different from each other. Also, regarding the age $\chi^2(12) = 8.857$, $p - value > 0.05$, education $\chi^2(6) = 3.535$, $p - value > 0.05$, and category of the driver $\chi^2(3) = 4.374$, $p - value > 0.05$, no evidence of statistically significant relationship with understanding of four categories of traffic control signs was reported. Their respective charts as regards the actual difference on the understanding of the traffic signs is are shown in the figure for age, figure for education, and figure for category of driver. However, when it comes to driving experience, the chi-square value showed that there is evidence to support the statistical and significant relationship between the driving experience and understanding of traffic signs $\chi^2(6) = 18.143$, $p - value < 0.05$. This, in real sense, denoted that driver with lot of driving experience have the ability to understand and master the traffic signs than those with less driving experience [16-18].
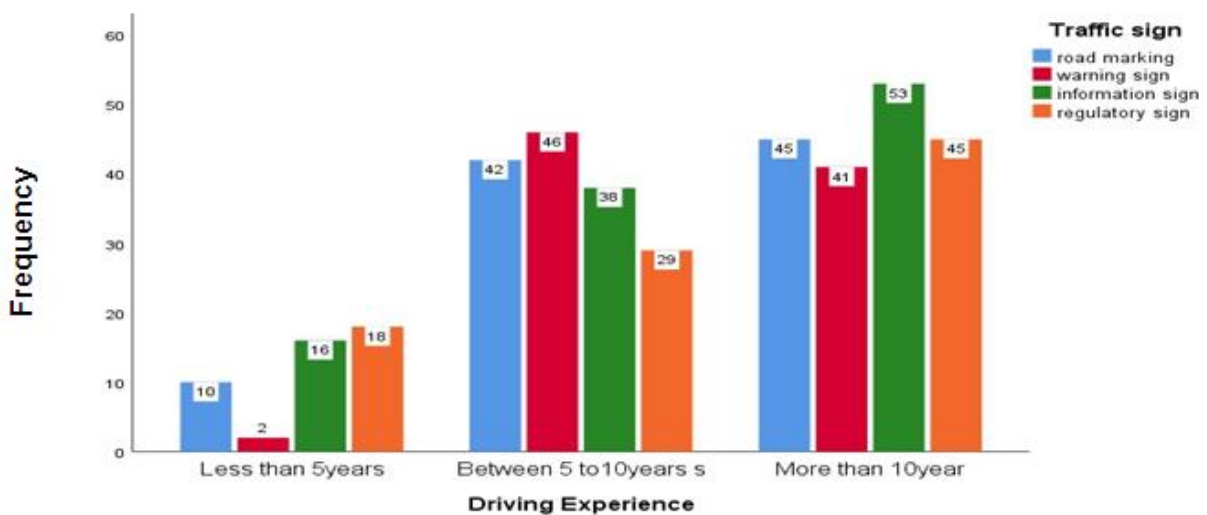

Fig. 5. Illustration of traffic signs understanding by driving experience

Table 1. Significance of demographic background and driver understanding of traffic sign

Variables	Chi-square	Traffic sign		Significant
		Df	p-value	
Gender	5.248	3	0.155	No
Age	8.857	12	0.715	No
Education	3.535	6	0.739	No
Category of Driver	4.374	3	0.224	No
Driving experience	18.143	6	0.006	Yes

3.7.2 ANOVA of demographic background and driver understanding of traffic Signs

Having explained the result of the descriptive statistics and visualization of the reasons why the drive show non-compliance attitude to the traffic sign, it is essential to proof the result using statistical evidence. As a result, independent sample t-test (for gender and category of drivers), and analysis of variance (ANOVA) were employed to test whether there is statistical evidence.

Significant differences among group means are calculated using the F statistic, which is the ratio of the mean sum of squares (the variance explained by the independent variable) to the mean square error (the variance left over). When the *p*-value falls below the chosen alpha value (0.05), then we say the result of the test is statistically significant.

The independent sample t-test result, Table 2, showed that gender and category of driver has no difference in their response towards reason for non-compliance of traffic signs $p > .05$, this denoted that the drivers are not sentiment on the traffic sign based on the gender and whether they are commercial or private driver. For the ANOVA test, the result revealed that non-compliance of traffic sign is not dependent on age since no statistical significance difference is established $F_{(4, 380)} = 0.867$, $p > .05$. However,

for the education with $F_{(2,382)} = 17.23$, $p < .05$ and driving experience with $F_{(2, 382)} = 10.479$, $p < .05$, there is statistical evidence to support the claim of differences in noncompliance to traffic sign's responses based on education and driving experience. What was gotten from this result is that education and driving experience can certainly be the yardstick to obey the traffic light. From the study education and years of driving experience is statistically significant which corresponds to the findings of Makinde and Oluwasegunfunmi [3].

3.8 Reasons for Non-compliance

Lack of previous knowledge of the signs, lack of adequate enforcement, lack of traffic control device on road, inadequate time for proper response and non-clarity of traffic control devices were determined to check the factors that affect the non-understanding of drivers to traffic control devices.

Fig. 6 revealed that 19.5%, 50.6% of the respondents strongly agreed and agreed to lack of previous knowledge of the signs. 20.5% somewhat agree while 5.7%, 3.6% disagree and strongly disagree to lack of previous knowledge of the signs. This indicated that majority of the respondents affirmed that lack of previous knowledge of the traffic signs affect the nonunderstanding of signs by drivers.

**Table 2. Significance of drivers' responses towards reason for noncompliance of traffic signs**

Variables	Stat value	Df	p-value	Significant
Gender	0.961	76	0.34	No
Age	0.867	4, 380	0.484	No
Education	17.23	2, 382	0.001	Yes
Category of Driver	1.792	383	0.074	No
Driving experience	10.479	2, 382	0.000	Yes
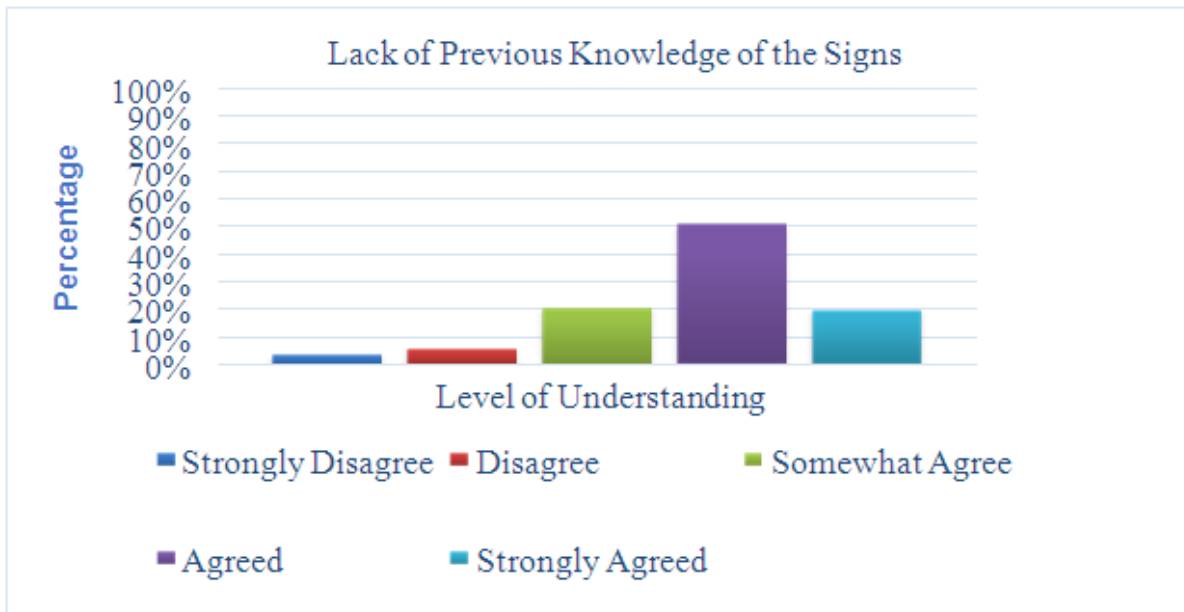
**Fig. 1. Lack of previous knowledge of the signs**

Fig. 7 revealed that 11.2%, 57.1% of the respondents strongly agreed and agreed to lack of adequate enforcement signs. 24.4% somewhat agree while 3.6%, 3.6% disagree and strongly disagree to lack of adequate enforcement on signs. most of the respondents affirmed that adequate enforcement by government is required for drivers to comprehend traffic signs.

Fig. 8 revealed that 10.1%, 52.7% of the respondents strongly agreed and agreed to lack of traffic control. 29.9% somewhat agree while 3.6%, 3.6% disagree and strongly disagree to lack of traffic control. Majority of the drivers believed that inadequate traffic control signs in Ilorin affect the non-understanding of signs by road users.
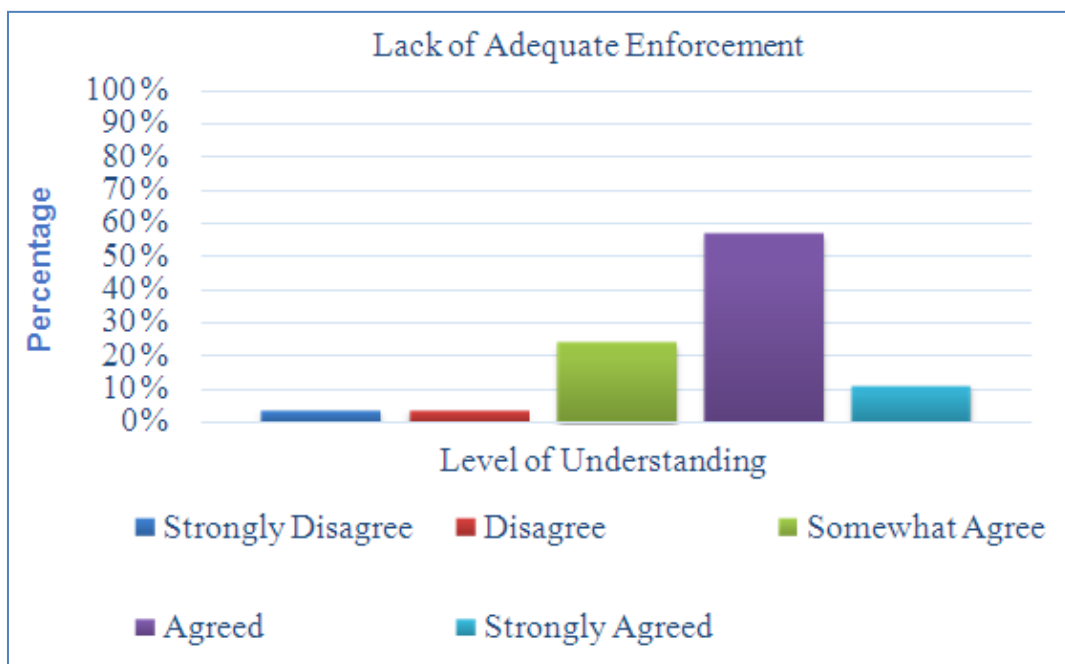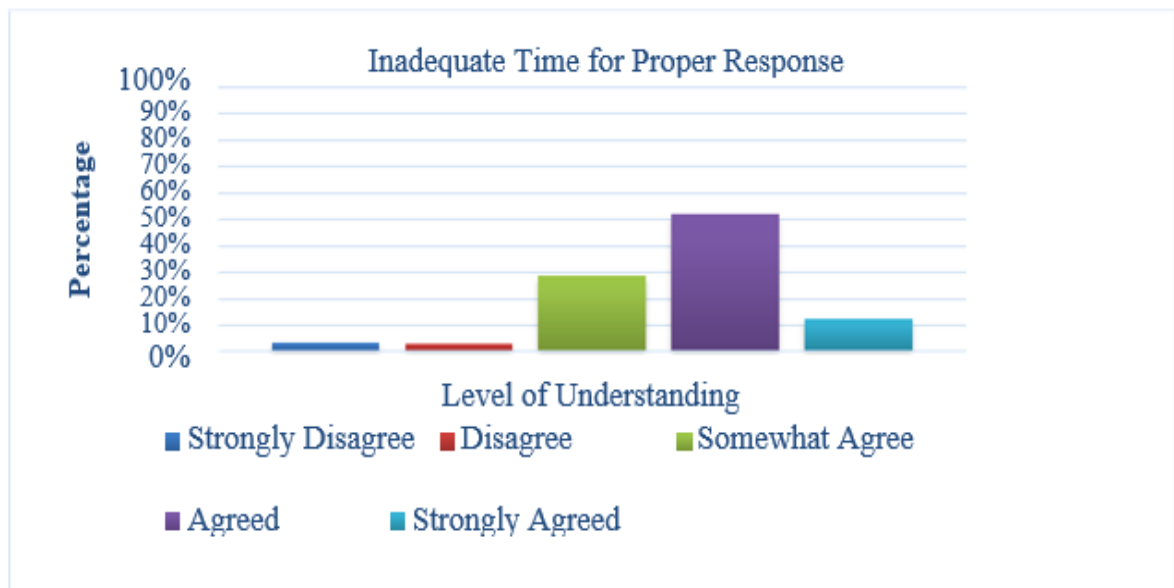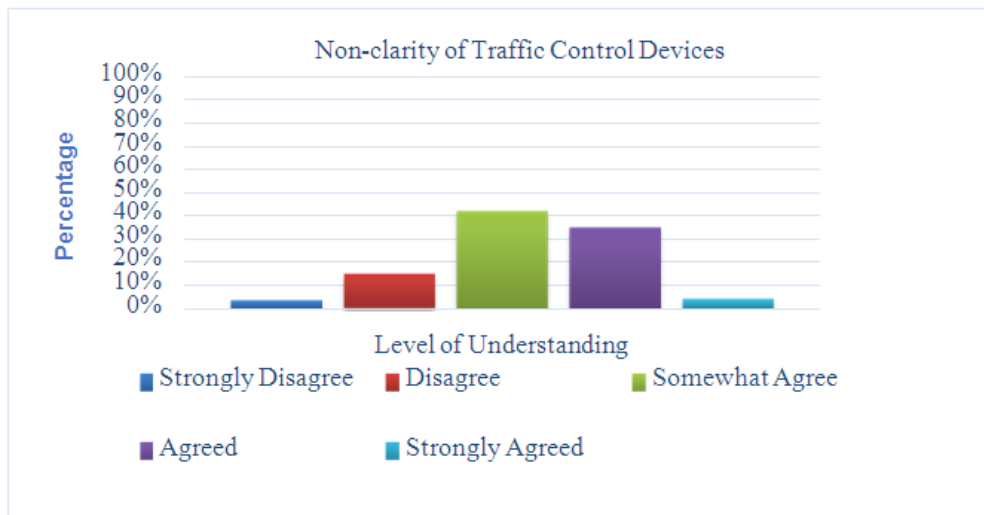

Fig. 2. Lack of adequate enforcement
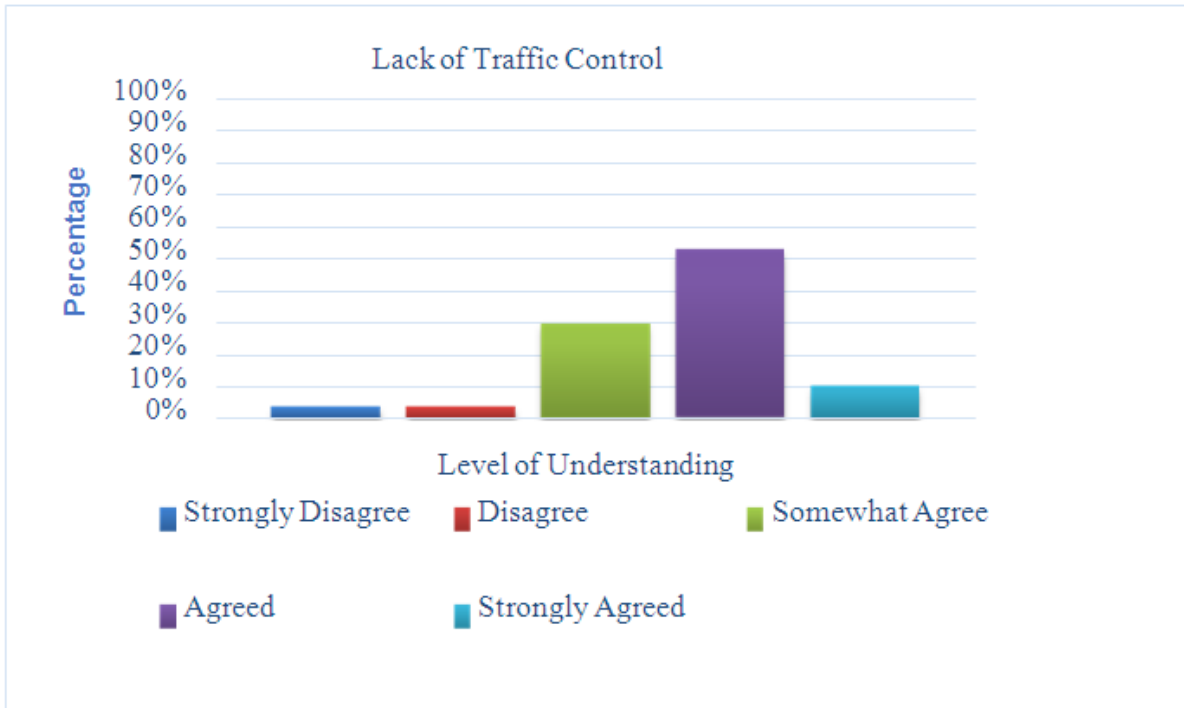
Fig. 8. Lack of Traffic Control

Fig. 9 revealed that 12.5%, 52.2% of the respondents strongly agreed and agreed to inadequate time for proper response.28.6% somewhat agree while 3.1%, 3.6% disagree and strongly disagree to inadequate time for proper response.

Fig. 3. Inadequate time for proper response

Fig. 4. Non-clarity of traffic control devices

Fig. 10 revealed that 4.2%, 31.1% of the respondents strongly agreed and agreed to non-clarity of traffic control devices.42.3% somewhat agree while 14.8%, 3.6% disagree and strongly disagree to non-clarity of traffic control devices. Most of the drivers partially agreed that non-clarity of traffic control devices is a major that affect the non-understanding of signs by drivers.

4. CONCLUSION AND RECOMMENDA-TIONS

4.1 Conclusion

The study has been able to investigate the comprehension and non-compliance of drivers to traffic control devices in Ilorin. The respondent to questionnaire interviewed revealed factors that have attributed to non-compliance of drivers to traffic control devices.

Based on the findings of the study, the following conclusions were made:

i. Driver's characteristics (Gender, Age, Educational Level, Category of Driver and Driving Experience) were found as factors affecting a driver's non-compliance with the traffic control device, although on education and years of driving experience are statistically significant. However, drivers between the ages of 18-24 years played prominent role in the non-compliance of drivers to traffic control devices compliance towards the traffic control device in Ilorin.

ii. The major factors that affect the non-understanding of drivers to traffic control devices in Ilorin were lack of previous knowledge of the signs, lack of adequate enforcement and lack of traffic control devices on road. As over 50% of the respondents strongly agreed to this.

iii. From the study education and years of driving experience is statistically significant which corresponds to the findings of Makinde and Oluwasegunfunmi [3].

4.2 Recommendation

Based on the conclusion of the study, the following recommendations were made:

i. Control devices manual should be made compulsory to drivers (commercial and private drivers) in Ilorin metropolis for proper understanding of traffic control devices and improvements such as higher enforcement levels, stiffer violation penalties should be considered.

ii. Drivers (both commercial and private drivers) should be educated/trained on the traffic rules and signs and it uses/meaning through private or government in collaboration with FRSC driving schools for drivers before driving on the road in Ilorin metropolis and before driving license is issued to drivers. This is achievable by the proper use of educational materials such as posters, handbooks, campaigns, use of public media like radio and television, seminars and talk shows.

iii. Similar study should be carried out in other parts of the state.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kirmizioglu E, Tuydes-Yaman H. Comprehensibility of traffic Signs among urban Drivers in turkey. Accid Anal Prev. 2012;45:131-41.
2. Canfield RR. Traffic Signs and markings. In: Pline J, editor, Traffic engineering handbook. 5th ed. Washington, DC: Institute of Transportation Engineers; 1999. p. 411-52.
3. Makinde OO, Oluwasegunfunmi V. Comprehension of Traffic Control Devices amongst Urban Drivers-A Study of Ado-Ekiti, Ekiti State, Nigeria. Eur J Eng Technol. 2014;2(1):9-19.
4. Aguilar M. Road Signs: your key to Responsible Driving – Feature Stories; 2015. Available from: https://www.autoindustriya.com/features/road-signs-your-key-toresponsibledriving.html.
5. Sigua R. Fundamentals of traffic engineering. Quezon City, Diliman: University of the Philippines Press; 2008. Bukhari SAR. Research gate; February 8, 2021.
6. Chan J, Gonzalez P, Perez E. Designing traffic Signs: A Case study on driver reading patterns and behaviour (tech.); 2016. Available:http://penoy.admu.edu.ph/~alls/wpcontent/uploads/2016/03/PCSC2016_Paper_2.pdf.
7. Fernandez JJ, Paringit MC, Salvador JR, Lucero PI, Galupino JG. Understanding of traffic Signs by Drivers in the City of Manila, Philippines. Transp Res Procedia. 2020;48:3037-48.
8. Umar IK, Bashir S. Comprehension of road traffic Signs by various road users in Kano city. Cumhuriyet Sci J. 2019;40(1):197-203.
9. Makinde OO, Opeyemi DA. Understanding of traffic Signs by Drivers – A case of Akure City, Ondo State, Nigeria. ARPN J Sci Technol. 2012;2(7):608-12.
10. National Bureau of Statistics. National population estimates. Abuja, Nigeria: National Bureau of Statistics; 2016.
11. Makinde OO, Opeyemi DA. Understanding of traffic Signs by Drivers – A case of Akure City, Ondo State, Nigeria. ARPN J Sci Technol. 2012;2(7):608-12.
12. Gana AJ, Emmanuel JA. Road Transportation and Traffic Law Enforcement in Nigeria: A case study of the Federal Road Safety Corps (FRSC), West African journal of Industrial & academic research. 2014;11(1): 134-51.
13. Choocharukula K, Sriroongvikrai K. Road safety awareness and comprehension of road Signs from international tourist's perspectives: A case study of Thailand. Transp Res Procedia. 2017;25: 4522-32.
14. Dissanayake S, Lu JJ. Traffic control device comprehension. IATSS Res. 2001;25(2):80-7.
15. Krejcie RV, Morgan DW 1970. Determining sample size for research Activities. Education and psychological Measurement.
16. Ogunmola AA. Signs and Symbols as a Communication strategy: A semiotic study of highway codes in Nigeria. New Media Mass Commun. 2013;19.
17. Parham AH, Womack KN, Hawkins, Jr. HG. Driver understanding of pavement marking colours and patterns. J Transp Res Board, (TRR 1844). 2003:35-44.
18. Ward SJ, Wogalter MS, Mercer AW. Comprehension and training of international road Signs. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting. 2004;48(17): 2104-8.

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