

Reaction behaviour of drivers to marked and unmarked road: Ghana perspective

Jacob Adedayo Adedeji^a, Xoliswa E. Feikie^b, Thywill Cephass Dzogbewu^c and Mohamed M.H. Mostafa^d

^a Department of Civil Engineering Midlands, Durban University of Technology, Durban, 4000, Republic of South Africa

^b Department of Civil Engineering and Geomatics, Durban University of Technology, Durban, 4000, Republic of South Africa

^c Central University of Technology, Free State, Bloemfontein, 9300, Republic of South African

^d Department of Civil Engineering, University of KwaZulu Natal, Durban, 4041, Republic of South Africa

ARTICLE INFO

DOI: 10.31075/PIS.67.01.01

Professional paper

Received: 16/02/2021

Accepted: 03/03/2021

Corresponding author:

jacoba@dut.ac.za

Keywords:

Traffic fatalities

Road user's

Behaviour

Traffic safety

Road markings

ABSTRACT

Africa is the leading continent globally in the rate of road traffic fatalities, yet it is the least motorized compared to the other five continents. This predicament is said to be one of the leading cause of death among youth and generally, rated as one of the ten causes of death in the world. Exclusively, Ghana's rate of traffic fatalities is growing despite the efforts invested in reducing it. Nevertheless, more focus needs to be invested in the traffic control systems such as traffic signals, signs or road markings. As this system tends to considerably reduce the number of conflicts and minimize road user's errors. Furthermore, this system creates drivers' expectations of the conditions which they will meet ahead and the driving tasks required. If misleading information is provided, or none is available, hazardous situations can result. Overall, this traffic system is inadequate or lacking in most developing countries as there are no proper maintenance strategies in place. Thus, this study investigates and evaluates the reaction of drivers to marked and unmarked roads. Using random quantitative sampling methods, Ghanaian drivers were interviewed on their experiences when driving on the marked and unmarked road. Overall, this study will highlight the necessity of road markings in reducing traffic fatality rate and the psychological effect of the unavailability of road marking on drivers' expectation and consequently, the effect on their behaviour in most developing countries.

1. Introduction

Vehicular accidents have a negative effect on human lives, properties and the environment, they are estimated to be the third leading cause of death worldwide by the year 2020 (Agyemang, 2013). On average 1.3 million people die globally every year, and 20 to 50 million people end up with disabilities because of traffic crashes. This phenomenon of increasing levels of vehicular accidents led to the establishment of the National Road Safety Commission (NRSC) in Ghana to promote road safety. NRSC Ghana reported that 1800 lives are lost in Ghana annually, with 14000 injuries on average, and 11000 road traffic crashes, costing the country \$288 million in 2009 (Pas, 2016; Agyemang et al., 2014). Nearly 42% of the pedestrian are affected, and 60% of people affected are within the productive age group. The causes of these traffic crashes include drunk driving; machine failure; over-speeding; rushing and negligence; not using seat belts while driving; using mobile phone while driving; careless driving; excessive

speed, tyre failure; distractions inside the vehicles and outside; smoking while driving; anxious driving; minimal enforcement of road laws and traffic regulation by the police; poor driving skills; disregard for traffic regulation; wrong over-taking; poor road network; bribery and corruption; road design and non-existent road markings and signs. While road transportation is dominant in Ghana, accounting for 98% of motorised transport. Research has shown that population growth and economic development are related to road traffic accidents, and the dramatic increase in traffic injuries in middle-income and low-income countries may be a result of rapid urbanisation and motorization, leading to high exposure to risk and reduced levels of safety on the road (Mihyeon Jeon et al., 2006).

In African countries, road transport is the most common mode of transport after walking, and there is a huge concern about poor transport services particularly in developing countries. World health organization estimated a decrease of 30% in traffic fatalities from

2000- 2020, but the latter is different for developing countries (Mihyeon Jeon et al., 2006). The danger in this prediction is that pedestrian fatalities constitute 42% of road traffic fatalities in Ghana, of which 68% of the total fatalities are relating to pedestrian crossing fatalities and behaviour (Damsere-Derry et al., 2010). The current system shows poor infrastructure with a lack of basic pedestrian facilities such as crossing facilities. Some of these pedestrian facilities are an integral part of road sign and markings as traffic safety is dependent on the ability of the driver to act in accordance with traffic rules and regulations. Even though the rapid growth in urbanization and financial resources makes it impossible to plan accordingly, it is evident that pedestrian facilities and infrastructures are not prioritised during the planning stage; this means pedestrians are at risk because they are also victims of traffic crashes and fatalities. In order for Ghana to meet the 2020 vision of WHO of reducing the number of road fatalities administrators, believe that a focus should be on traffic regulations and invested in road markings and road signs. Road signs and marking should be subject to maintenance and their performance should be based on durability and visibility. Though road maintenance costs are often high, they are critical for accessibility, reliability and safety. Thus, this study attempts to show that poor road signs and absent or faded road markings are a problem, and maintained road signs and marking should be prioritised to considerably reduce the number of conflicts and minimize road user's errors.

2. Driver's Expectancy and Reaction

The percentage of traffic fatalities in Ghana is increasing, despite the measures taken to reduce it. Among other components that contribute to traffic fatalities, road users' characteristic takes the precedence in being the most unpredictable. This is caused by the fact that the expectations and reactions of drivers may vary depending on factors such as years/experience of driving, familiarity with the place/road etc. Okwabi (2014) highlights that the expectations and reactions of drivers are also based on psychological influence. Road markings are generally used to provide information and guidance to drivers on what to expect along the road, and this affects how they drive and how they react to conditions along the road. The absence of these markings can generally lead to confusion, reduced level of confidence/unsureness, increased reaction time, and fear. This can also mean that drivers will depend on their discretion for guidance and information, which can be highly detrimental as high speeds and inconsistent movements can be expected (Adedeji et al., 2016; Adedeji et al., 2018). It is therefore imperative to ensure that the drivers' attention is not impaired and that distractions are minimised, to ensure safety along the roads (Louw et al., 2013).

3. Method and Data Collection

3.1. 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 drivers in Ho capital city of Volta Region, Ghana. Two hundred paper-based questionnaires were distributed amongst drivers in various inter-city motor parks, however, only 176 questionnaires were returned and the questionnaires were collected over 30 days.

The questionnaire used consists of three sections; the first section classifies the personal information (demographic characteristics) of the drivers: age, gender, the educational level which influence their level of behaviour and comprehension of the traffic signs and road markings, issuing country of driver's license and type, the driver's experience such as year of driving experience, driving fines received and involvement in a traffic accident. The second section looks at road conditions and the availability of road markings and traffic signs using a Likert-type scale. He/she may indicate the consequences of the class using a 5-point scale (where 1=never and 5=always). The final section on a Likert-scale seeks the opinions of the drivers on the influence of road markings unavailability.

3.2. Data Analysis

All data analysis was performed using the SPSS package. Standard descriptive statistics were reported; mean (M), standard deviation (SD) for numerical variables for Likert scale variables and frequency count (%) for categorical variables. In addition, a cross-tabulation with chi-square analysis was conducted to establish the relationship between the driver's characteristics, physiological characteristics and unavailability of road markings.

3.3. Evaluation and Interpretation of Results

3.3.1. Study Population

There were 176 respondents included in the study (Table 1), of the total respondents, 25.3 % were female. Most of the respondents are between the ages of 18-39 (75.6 %) and only 24.4 % are above 40 years old. Educational level among the respondents was a split were 44.3 % are undergraduate and postgraduate while the rest are in the grades with only 1.7 % as others. Furthermore, the majority of the respondents have a driving license issued by the Ghana traffic department and only 1.7% are from other countries such as Togo, Benin Republic, Cote d'Ivoire, and Burkina Faso, which boundaries with Ghana.

In addition, there was a wide range of respondents in terms of the driving license class type, where 46.6 % of the respondents have class C license type (drive buses and medium goods carrying vehicle not exceeding 10,000 tons or 1-45 passengers), 31.8 % class B (drive cars, cross country, minibuses, pickup vehicles up to 3,500kgs or 1-15 passengers) and the rest are class A (drive motorcycle with or without side car 1 up to 250cc).

Table 1. Demographic data (N= 176)

Item	Percent
Gender	
Male	74.7%
Female	25.3%
Age	
18-25	23.9%
26-30	22.2%
31-39	29.5%
40-49	15.9%
Above 50	8.5%
Educational Level	
Others	1.7%
Grade 1-3	4.0%
Grade 4-6	17.0%
Grade 7-12	33.0%
Undergraduate	22.7%
Postgraduate	21.6%
Driving License Issue Country	
Ghana	98.3%
Others	1.7%
License Type	
A	21.6%
B	31.8%
C	46.6%
Years of driving Experience	
0-3 years	29.5%
4-10 years	33.5%
11-25 years	23.9%
26-40 years	9.7%
Over 40 years	3.4%
Driving Fines in one year	
0	23.9%
1-3	30.1%
4-6	33.5%
Over 7	12.5%
Involvement in Car Accident in the Last 3 Years	
Yes	44.3%
No	55.7%

Source: Adedeji et al., 2019.

3.3.2. Road Marking on Ghana Road

This section investigates the present road conditions in Ho, Ghana. The first 2 questions evaluate the current road condition of the study area and results showed that the road is above average as 64 % of the respondents agreed that the road surface is fair to excellent for the driving condition during the day and night time.

To support that current condition of the road, the study showed that traffic signals and road markings (Table 2) are available, $M = 3.01$ ($SD = 1.05$) and $M = 3.13$ ($SD = 1.02$) respectively.

Table 2. Influence of Unavailability Road Marking on Drivers Behaviour

Road Conditions		Percentage
Availability of traffic signals	Never Available (1)	8.5%
	Fairly Available (2)	23.3%
	Neutral (3)	33.0%
	Available (4)	29.5%
Availability of road markings	Most Available (5)	5.7%
	Never Available (1)	8.5%
	Fairly Available (2)	17.6%
	Neutral (3)	30.1%
	Available (4)	40.3%
Understanding of the road markings	Most Available (5)	3.4%
	Never Conversant (1)	10.2%
	Fairly Conversant (2)	15.9%
	Neutral (3)	30.7%
	Conversant (4)	39.2%
Usefulness of road marking in making decisions	Very Conversant (5)	4.0%
	Never Useful (1)	9.7%
	Fairly Useful (2)	23.9%
	Neutral (3)	26.1%
	Useful (4)	34.1%
Comfortability level driving without road markings	Very Useful (5)	6.3%
	Never Comfortable (1)	6.3%
	Fairly Comfortable (2)	23.9%
	Neutral (3)	23.3%
	Comfortable (4)	39.2%
Necessity of road makings	Very Comfortable (5)	7.4%
	Never Necessary (1)	5.7%
	Fairly Necessary (2)	24.4%
	Neutral (3)	30.1%
	Necessary (4)	32.4%
Necessity of road makings on curves	Very Necessary (5)	7.4%
	Never Necessary (1)	4.0%
	Fairly Necessary (2)	20.5%
	Neutral (3)	31.3%
	Necessary (4)	38.1%
	Very Necessary (5)	6.3%

Source: Adedeji et al., 2019.

Furthermore, the majority of the drivers have a great understanding of the road markings ($M = 3.11$; $SD = 1.06$) and indicated that road markings are useful or helpful in decision making ($M = 3.03$; $SD = 1.11$), this can be supported by the level of literacy amongst the drivers interviewed. On the other hand, the majority of the respondents ($M = 3.18$; $SD = 1.07$) indicated that they are comfortable driving without the road markings. This could be as a result of the fact that the majority (70,5 %) of the drivers can be classified as average to expert drivers with over 4 years of driving experience or the fact that drivers do not obey rules and regulation related to road markings as 46 % of the respondents have received more than 4 traffic fines over the last one year and close to average of the respondents have been involved in a traffic accident over the last three years (Table 2). Overall, the majority of the drivers agrees that road markings are necessity ($M = 3.11$; $SD = 1.04$) and with more emphasis on the necessity at road curves ($M = 3.22$; $SD = 0.98$) as it helps in the process of decision making such as overtaking, maintaining once lane and obey the right of ways rules.

3.3.3. Impacts of Road Marking on Driver Capability (Driving Experience and Education)

Drivers capability is usually affected by various factors including personal characteristics, physiological characteristics, personal experiences, psychological resources, etc. (Oviedo-Trespacios et al., 2019). Using Cross-Tabulation with Chi-Square analysis, it is worthy to note that there is no significant association (independent) between driver's level of fear and age, gender, driving fines in one year and involvement in a car accident over the last 3 years, as a result of unavailable road marking.

Nevertheless, there was a significant association between the driver's level of fear and level of education (Table 3) as the calculated chi-square value (31.31) was greater than the chi-square value of 26.30. Additionally, the driver's level of fear is dependent on the years of driving experience (Table 4), considering 5% level of significance the chi-square value is 21.03. However, the calculated chi-square value was larger than the critical value (31.32). Furthermore, the result shows that there was no significant association between driver's level of focus (DBE11) and age, gender, educational level, years of driving experience, driving fines in one year and involvement in a car accident over the last 3 years, as a result of unavailable road marking. On the other, there are significant association between DBE12 (Do you notice the other drivers are confused when there is no road marking?) and age, driving fines in one year and years of driving experience with a chi-square value of 35.10 (Table 5). Overall, it can be re-echoed that age, education, personal experiences have an impact on the behaviour of road users on marked and unmarked roads.

Table 3. Do you feel that your fear level increase when road marking disappear (DBE10)? * Education

		Education					Total
		Grade 1-3	Grade 1-3	Grade 1-3	Postgraduate	Undergraduate	
1	Count	0	3	3	3	0	9
	% within EDUCATION	0.0%	9.1%	5.2%	7.9%	0.0%	5.1%
2	Count	4	4	8	6	14	36
	% within EDUCATION	57.1%	12.1%	13.8%	15.8%	35.0%	20.5%
3	Count	3	8	19	12	11	53
	% within EDUCATION	42.9%	24.2%	32.8%	31.6%	27.5%	30.1%
4	Count	0	14	27	10	12	63
	% within EDUCATION	0.0%	42.4%	46.6%	26.3%	30.0%	35.8%
5	Count	0	4	1	7	3	15
	% within EDUCATION	0.0%	12.1%	1.7%	18.4%	7.5%	8.5%
Total	Count	7	33	58	38	40	176

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.310 ^a	16	.012
Likelihood Ratio	34.976	16	.004
N of Valid Cases	176		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is .36.

Source: Adedeji et al., 2019.

Table 4. Do you feel that your fear level increase when road marking disappear (DBE10)? * Driving Experience

		Driving Experience				Total	
		0-3Y	10-25Y	26-40Y	4-10Y		
D B E 1 0	1	Count	1	1	0	7	9
		% within Driving Experience	2.1%	2.4%	0.0%	11.1%	5.1%
	2	Count	3	12	8	13	36
		% within Driving Experience	6.4%	28.6%	33.3%	20.6%	20.5%
	3	Count	16	16	9	12	53
		% within Driving Experience	34.0%	38.1%	37.5%	19.0%	30.1%
	4	Count	25	9	7	22	63
		% within Driving Experience	53.2%	21.4%	29.2%	34.9%	35.8%
	5	Count	2	4	0	9	15
		% within Driving Experience	4.3%	9.5%	0.0%	14.3%	8.5%
Total	Count	47	42	24	63	176	
	% within Driving Experience	100.0%	100.0%	100.0%	100.0%	100.0%	

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.530 ^a	16	.012
Likelihood Ratio	35.225	16	.004
N of Valid Cases	176		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is .36.

Source: Adedeji et al., 2019.

4. Practical Implications

Results of the survey suggest areas that may be improved to increase the efficiency and safety of the road network in Ho, Ghana and some practical implications are presented below;

Table 5. Do you notice the other drivers are confused when there is no road marking?n (DBE12) * Driving Experience

		Driving Experience				Total	
		0-3Y	10-25Y	26-40Y	4-10Y		
D B E 1 2	1	Count	1	3	0	7	11
		% within Driving Experience	2.1%	7.1%	0.0%	11.1%	6.3%
	2	Count	1	9	12	14	36
		% within Driving Experience	2.1%	21.4%	50.0%	22.2%	20.5%
	3	Count	14	17	6	18	55
		% within Driving Experience	29.8%	40.5%	25.0%	28.6%	31.3%
	4	Count	25	9	5	19	58
		% within Driving Experience	53.2%	21.4%	20.8%	30.2%	33.0%
	5	Count	6	4	1	5	16
		% within Driving Experience	12.8%	9.5%	4.2%	7.9%	9.1%
Total	Count	47	42	24	63	176	
	% within Driving Experience	100.0%	100.0%	100.0%	100.0%	100.0%	

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.758 ^a	16	.003
Likelihood Ratio	39.209	16	.001
N of Valid Cases	176		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is .44.

Source: Adedeji et al., 2019.

4.1. Improving Drivers Safety

In order to improve driver's safety on Ghana road network, it is of necessity to continuously improve the existing road conditions by providing adequate resources for the maintenances of the road to acceptable standards. As result shows that there is a relationship between road markings and drivers behaviour which consequently relates to safety. The absence of road marking tends to reduce drivers' safety. Thus, inadequate road maintenances have been one of the major challenges of most African countries, most especially preventative and emergency maintenance (Mostafa, 2018). With preventative maintenance, roads can be kept in good or acceptable condition and consequently prevent road fatalities. Road markings repair and rejuvenation fall under preventative maintenance and thus, African countries should implement policy on proper maintenance culture which will overall, improve all road users' safety. Furthermore, the visibility of the road markings during the daytime and the night-time is of great concern and necessity, as the most important aspect of road markings is that they must be retroreflective. Thus, it helps the driver to communicate or interact safely with other road users of the roadway.

4.2. Improving Drivers Driving Confidence Level

Drivers and other road users have widely varying characteristics, thus, a roadway design should confirm and agree with drivers expectancy based on previous experience. Improving drivers driving confidence can be achieved by presenting them with clear clues about what is expected of them. Road markings communicate regulatory and warning information to road users. In the aspect of regulatory, the stop paint marking 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 (also known as sleeper lines) serve as noise generators, also attempts to wake a sleeping driver or alter a driver to various upcoming hazards by both sound and the physical vibration of the vehicle. Furthermore, transverse road markings 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 the information needed while driving thus, increase their level of confidence on the roadway when available.

4.3. Cost Effective Road Network

Apart from the efficiency of road markings in enhancing road user's safety, road markings are also a great and cost effective measure in the design and construction of the road network. In Ghana, there is a need for considering road markings in the design and construction stage as it can help to reduce the numbers of lanes of road needed and help in effective sharing of the roadway, which will overall reduce the cost of road construction. Furthermore, road markings can be used to create special types of lanes such as bicycle and bus lanes, which thus, help in the effective utilization of roadway and consequently reducing the cost of using median barrier where they are not needed.

5. Conclusion

The necessity of road markings on our roadway cannot be overemphasised as they serve numerous purpose when available. This study examined the reaction and behaviour of drivers to marked and unmarked roads. Results indicate that the road surface, road markings and traffic signals are available and the drivers have a great understanding of the importance of road markings and traffic signals. Results also indicated the necessity of road markings in decision making while driving and more emphasis was made on the necessity of road marking availability on the curved section of the roadway. Additionally, the results validate the absence of road markings increases the drivers level of fear and there is a need to focus more when road markings are not present. Nevertheless, results show that age, education, personal experiences (especially years of driving) have an impact on the behaviour of road users on marked and unmarked roads. It is therefore imperative that road markings be maintained on a regular basis and be considered more in the planning, design and construction of road projects as it does not only enhance road users' safety but also, reduce the cost of construction of roads. Further research work will look at the maintenance strategies for road and road marking in Ghana and other Africa countries.

References

- Adedeji, J. A., Hassan, M. M. and Abejide, S. O. (2016). Effectiveness of communication tools in road transportation: Nigerian perspective. International Conference on Traffic and Transport Engineering-Belgrade November 24-25.
- Adedeji, J.A., Abejide, S.O., Monts'i, M., Hassan, M.M. and Mostafa, W.H., (2018). Reaction Behaviour of Drivers to Road Markings: Case Study of Main South Road Lesotho–N8 Road South Africa. In International Congress and Exhibition "Sustainable Civil Infrastructures: Innovative Infrastructure Geotechnology" (pp. 58-71). Springer, Cham.
- Adedeji, J.A., Feikie, X.F., Dzogbewuc, T.C. and Mostafa, M.H. (2019). [Road users survey]. Unpublished raw data.
- Agyemang, B. (2013). Regression Analysis of Road Traffic Accidents and Population Growth in Ghana. *International journal of business and social research*, 3(10), 41-47.
- Agyemang, B., Abledu, G.K. and Semevoh, R. (2014). Linking Road Traffic Accidents to Vehicle Population; Empirical Evidence from Ghana.
- Damsere-Derry, J., Ebel, B.E., Mock, C.N., Afukaar, F. and Donkor, P., 2010. Pedestrians' injury patterns in Ghana. *Accident Analysis & Prevention*, 42(4), 1080-1088.
- Gray, D.E. (2013). Doing research in the real world. Sage, London.
- Louw, T.L., Gobel, M. and Zschoernack, S. (2013). The effect of distraction modality on driver performance. *Ergonomics SA: Journal of the Ergonomics Society of South Africa*, 25(1), 13-25.
- Mihyeon Jeon, C., Amekudzi, A.A. and Vanegas, J. (2006). Transportation system sustainability issues in high-, middle-, and low-income economies: Case studies from Georgia (US), South Korea, Colombia, and Ghana. *Journal of urban planning and development*, 132(3), 172-186.
- Mostafa, H. M. (2018). Road Maintenance in Africa: Approaches and Perspectives. In *E3S Web of Conferences* (Vol. 38). EDP Sciences.
- Okwabi, S.O. (2014). Risk Perception, Risk-Taking Attitude and Risky Driving Behavior among Drivers in Ghana (Doctoral dissertation, University of Ghana).
- Oviedo-Trespalacios, O., Truelove, V., Watson, B., & Hinton, J. A. (2019). The impact of road advertising signs on driver behaviour and implications for road safety: A critical systematic review. *Transportation research part A: policy and practice*, 122, 85-98.
- Pas, C.N.D. (2016). Reported incidence of vehicular accidents at ledzokuku-krowor municipal assembly hospital in Teshie, Ghana.