Obedience of road users before transit control devices - a case study

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Abstract

This article presents an obedience study of road users before traffic control devices carried out in a population with high accident rates throughout three clearly defined phases. These consisted in determining the behavior of the users through traffic gauges, verifying the state of the signaling and the application of surveys to know the users' behavior. During the development of the project, it was evidenced that the human factor is the main cause of risks of road accidents and traffic infractions, represented by pedestrians and motorcyclists. The study is original and of interest in Civil Engineering due to the fact that there are few works of this type about small populations in Colombia and it works as a model project that could be replicated if necessary. However, limitations were found for the realization of the project such as the scarce documented information existing in the country that could be an effective support for comparison with the results obtained here.

Keywords: road users, traffic accidents, traffic devices, infractions, road traffic.

INTRODUCTION

According to [1], approximately 1.25 million lives are lost each year as a result of traffic accidents. Between 20 million and 50 million people suffer non-fatal injuries, and many of these injuries cause a disability. More than 90% of deaths caused by traffic accidents occur in low and middle income countries. People between 15 and 44 years old represent 48% of deaths due to traffic accidents worldwide. The risk of death of a pedestrian adult struck by a car at a speed of 50 km/h is less than 20%, but it is almost 60% if the accident occurs at 80 km/h. Likewise, [2] if the traffic regulations related to driving under the influence of alcohol, the use of safety belts, speed limits, the use of helmets and restraint systems for children are not applied, the expected reduction of deaths and injuries due to traffic accidents related to specific behaviors cannot be achieved. Therefore, according to [3], if the traffic regulations are not enforced, or if it is perceived that they are not enforced, it is likely that they will not be respected and, consequently, they will be very unlikely to influence behaviors.

In the case of Colombia, [4] affirms that traffic accidents are, after homicides, the second cause of violent death in Colombia. According to [5], there is evidence that, between 2005 and 2015, more than 2 million of the so-called accidents, 64,952 deaths and 441,527 injuries in traffic accidents happened. Similarly, [6] recorded the highest number of

deaths in the last 10 years are motorcyclists with 43%, followed by pedestrians with 30.67%, who represent 73.67% of deaths in traffic accidents. In certain studies [7] [8] [9] [10] it is said that in the Colombian context it has been observed that the motorcyclist suffers more often when encountering a complex intersection due to lack of experience when driving, lack of demarcation of the roads, high speed, wide roads with high traffic flow that can encourage high-speed driving and allow interaction with other vehicles, several manoeuvres, use of high-capacity motorcycles, young men with aggressive driving styles and who sometimes do not use the helmet in an appropriate way or regulations. The above is confirmed by [11] in their study, where they state that the most vulnerable population is between 21 and 30 years old, and that one of the causes can be recklessness when driving, speeding and the overconfidence. In relation to pedestrians, [12] [13] indicate that road incidents are considered events that vary with age and with physical and environmental characteristics. Some studies [14] [15] have detected that the pedestrian is injured when waiting to cross the road, while crossing when they do not have the priority to do so and without respecting the traffic signals, by not using a bridge, by crossing distractedly, among others. Also, in other studies [15] [16] it has been observed that they can be injured when crossing the road through non-recommended places, when the pedestrian traffic light is in red, when they speak on the cell phone without noticing if a vehicle is coming, and when they do not look to both sides of the road. Considering traffic, according to [17], it is also important to carry out specific studies of micro-simulation of traffic at certain critical intersections due to their high accident rate, which will allow us to assess/or improve the vehicle flow in terms of engineering through simulation models that are constantly evolving.

Given the above, this article aims to conduct a study of road users' obedience against traffic control devices, characterize and identify the behavior of road users (pedestrians, cyclo-users and drivers) with respect to such devices and propose measures that lead to reduce accident rates in the roads under study in the municipality of Puerto Boyacá. Likewise, field visits and surveys to collect all the necessary information to identify the problem to be solved will be shown to both road users and traffic agents. Critical points will be established where higher accident rates are presented, it will be analyzed and the behavior of the road users before the traffic control devices and the status of the different traffic control devices will be identified. Optimum vertical signaling and horizontal signaling perfectly demarcated on the road for the visualization of the users will be verified and reported.

METHODOLOGY

This research project seeks to find the reasons why road users disobey information and prevention of different traffic control devices.

The way in which the research process was developed had the following work actions:

Behavior of users through transit gauges

For the development of this contemplated activity and to be able to achieve part of the general objective of the investigative work, assessments have been made with 3 people in each of the 5 signalized intersections where the number of offenders has been obtained in the vertical and horizontal signaling, depending on the type of road user. This field work was carried out in single days at different times during 15 minutes of interval. It lasted 5 weeks.The pilot municipality to do this study was Puerto Boyacá in the Department of Boyacá. The selected intersections were: road 5 with 26th street, road 5 with 14th street, road 4 with 12th street, road 3 with 11th street and road 3 with 14th street. Gauging was recorded in a standard format, as can be seen in Table 01.

Table 1. Example of format used in the gauging. Source: authors

BEHAVIOR OF THE ROAD USER IN 15 MINUTE INTERVALS INTERSECTION WITH TRAFFIC LIGHTS AVENUE ROAD 5 WITH 14th STREET						
KIND OF ROAD USER	**UNITY**	**R** 6:00 AM a 6:15 AM	**R** 12:00 PM a 12:15 PM	**R** 2:00 PM a 2:15 PM	**R** 6:00 PM a 6:15 PM	**R** 10:00 PM a 10:15 PM
		Amount of infringers				
Motorcycle driver	UND	22	37	32	39	39
Motorcycle taxi	UND	20	38	36	34	36
Pedestrian	UND	18	18	16	22	9
Light private vehicle	UND	1	0	0	8	12
Public service vehicle	UND	1	0	1	2	2
Bicycle	UND	9	11	8	26	5

State of signaling

Another fundamental activity in the development of the project was the visual verification of the state of both vertical and horizontal signaling in the roads where the study was carried out —roads 3 and 5, since they are the busiest routes, which travel from end to end of the city, and are the main road connectors. For the above, the format shown in Table 02 was applied. This activity lasted approximately two days and two people were employed for its execution.

Surveys to know the behavior of the user

Finally, in order to analyze disobedience, the causes for which users have this type of behavior on the roads must be identified. For this purpose, surveys were carried out on the inhabitants of Puerto Boyacá, totalling about 400 surveys, which served to analyze the problem more clearly. For the calculation of said sample, the following equation was used [18] with a confidence level of 95% and a margin of error of 5%:

$$n = \frac{N*Z^2*p*q}{d^2*(N-1)+Z^2*p*q} \quad (1)$$

Where "N" is equal to 55.286 people who inhabit the pilot municipality, data according to the National Administrative Department of Statistics of Colombia [19]. The values of "p" and "q" are equal to 0,5. Afterwards, the data was processed and the results were analyzed. The following section shows the most relevant results.

RESULTS AND DISCUSSION

Behavior of users through transit gauges

As can be seen in Figure 1, by means of the assessments made in the first campaign, during 5 days and 1 per week, the statistical data showed that the biggest offenders are users of the motorcycle-type vehicle, as they commit 50% of offences, followed then by pedestrians at 37%; users of this type of vehicle exceed the maximum speed allowed within the urban perimeter of study (30 km/h). In these gauges, it was decided

to show the volume of offenders of both private motorcycle drivers and motorcycle taxi drivers separately. These can be differentiated with particular details such as helmet for the passenger and protection in the arms. The light private vehicle and public service vehicle have a low level of infringement at 4%; however, they do not exonerate themselves from the excuses by infringing the warning signs for proper mobility in the streets and civic culture.
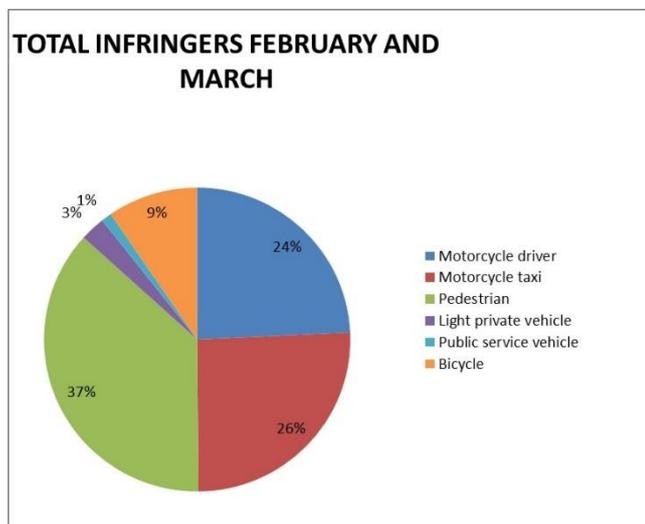

Figure 01. Distribution of infringers from the first data collection campaign. Source: authors.

In the second campaign of data collection, according to the statistics in Figure 2, 47% of disobedience to red lights corresponds to motorcycle drivers. Compared to the first campaign, it only varied by 2%. Likewise, there is the same appreciation with respect to other types of users, which leads to deduce a complete lack of culture, ethics and values. The pedestrian reflects a total of 39% of the infractions before signaling; bicycle users, 9% —which is 2% higher than that taken in the first campaign—; private and public vehicles, a total of 3%. All of the above indicates that the percentages do not vary beyond 2% or 3%, indicating a constant trend in the

values obtained for both campaigns and showing the need to take other data that can make this data better understood and explained.

These surveys demonstrate the behaviors that users have on the roads of Puerto Boyacá. But to be able to visualize the source of the problem, it is essential to know the reason for these actions when using the roads. For this, it was necessary to carry out surveys where one could understand the reason for the disobedience before the traffic control devices, since most accidents are due to human error.
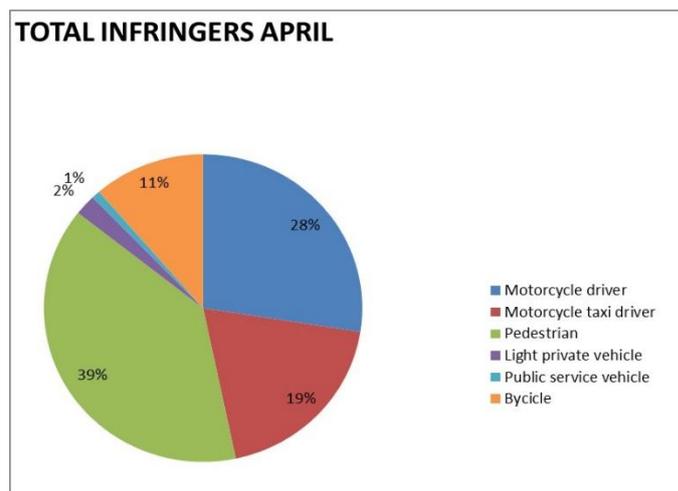

Figure 02. Distribution of infringers from the second data collection campaign. Source: authors

State of signaling

One of the activities carried out in the second stage of the project was the behavior of road users before the vertical and horizontal signs in different points of the city. As can be seen in Table 2, a tour of the road 5, the main avenue of Puerto Boyacá, was carried out to verify the vertical and horizontal signaling status. Road 5 was selected since this is the busiest road, which runs through end to end the city, and it is the main road connector.

Table 2. State of signaling carrera 5. Source: authors

STATE	VERTICAL SIGNALING					HORIZONTAL SIGNALING			
	STOP	YIELD	PROHIBITED U-TURNS	SPEED LIMIT >30 KM/H	DO NOT PARK	REDUCE SPEED (TEMPORARY SPEED BUMP)	REDUCE SPEED (RUMBLE STRIPS)	CROSS WALK	DO NOT PARK
GOOD	X	X	X	X					
BAD						N/A	X	X	X
Observations: the rumble stripstype reducers, due to the volume of traffic, have been detached, while the paint for the horizontal crosswalk, the stop lines, and the anti-lock lines are not displayed well at night and very little during the day. This is possibly due to the low application of the micro glass spheres and the poor quality of the paint. The horizontal signs of prohibited parking on the pavement were not found.									

The state of the signaling shows that there are elements that regulate traffic control. The vertical signaling is in good condition, unlike the horizontal signaling which are in a considerable bad state, the latter being very important in the interaction between the users of vehicles and pedestrians.

Encuestas para conocer el comportamiento del usuario

The road safety surveys completed by the inhabitants of the different roads of the study area showed the results that can be observed in Figures 03, 04, 05 and 06. The statistics are alarming when observing how excuses are more important than one's life and that of others. In Figure 03, it can be seen that approximately half of the users surveyed have no knowledge of traffic regulations, a fact that indicates a high degree of the need to work on pedagogical strategies that improves this indicator. The high percentage of users who ignore the red light of the traffic light is alarming, which is shown in Figure 04. This can put at risk their physical integrity and that of others. The reasons users give for the disobedience of traffic signals and speeding, as shown in Figures 05 and 06, is disproportionate to the consequences of these decisions.
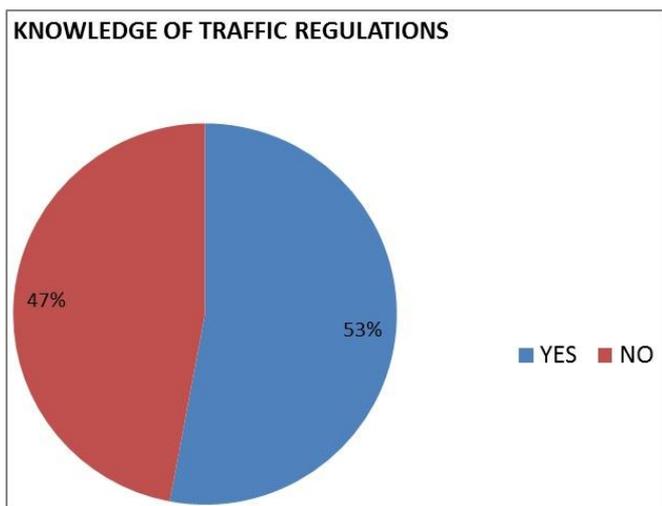
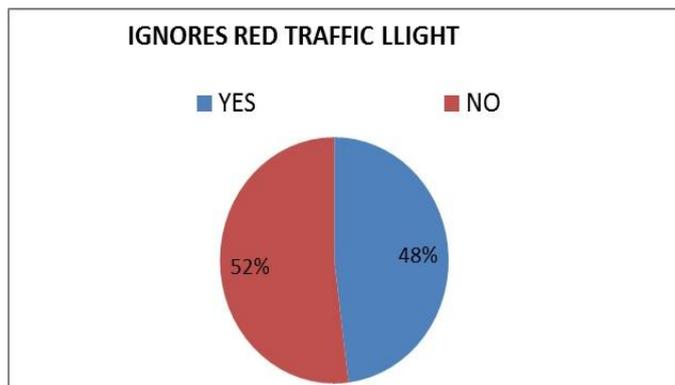**Figure 3.** Knowledge of traffic regulations. Source: authors

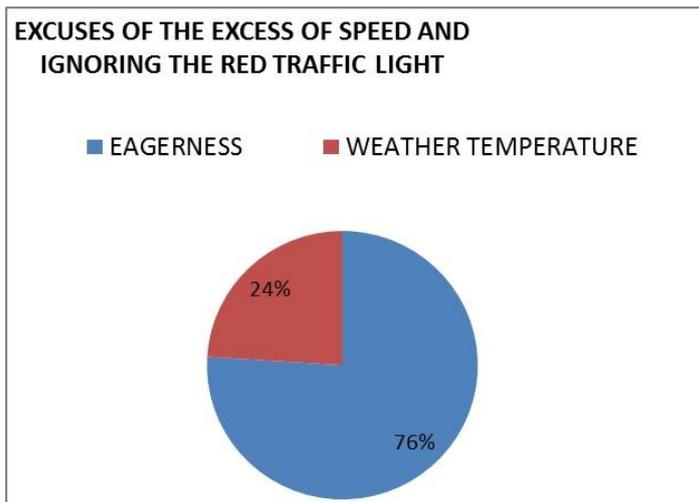**Figure 4.** Ignores red traffic light. Source: authors

Figure 5. Excuses of the speed excess and ignoring the red traffic light. Source: authors
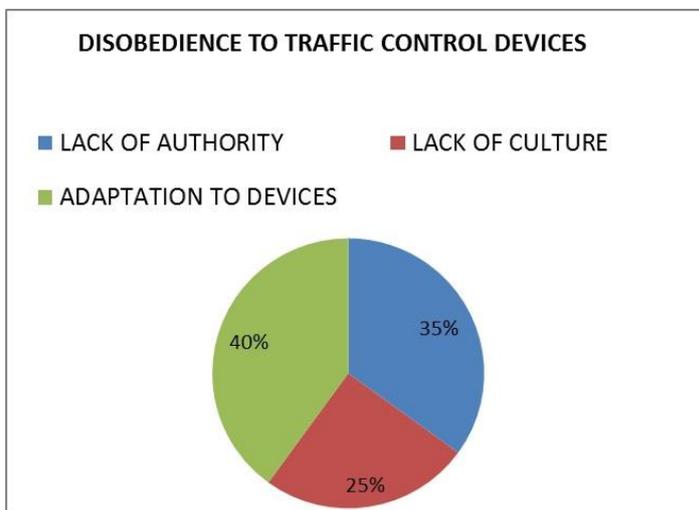
Figure 6. Disobedience to traffic control devices. Source: authors

CONCLUSIONS

The results obtained through the investigation for the study of obedience reflect that the human factor is the main cause of accidents in roads (subject, vehicle and road). The lack of citizen culture and awareness is a cause in actions such as not giving way, exceeding speed limits, practicing dangerous manoeuvres, disrespecting when stopping on the crosswalk at a traffic light intersection, at the intersection of a street, the undue crossing of pedestrians, etc. If the data obtained is observed, there is a close relationship between the traffic infractions committed by the users, the disobedience of the users, the ignorance of the traffic regulations and the reasons stated by them.

Through the field visits it was analyzed that, at the intersections of road 5 with 20th street and in the roundabout of road 5 with 12th street, it is essential to install a new traffic light network since the signaling installed has not provided a

solution to minimize the risks of accidents. And although in the course of the investigation of this study there were no accidents, it is better to prevent it. It is also important that the user knows the correct mobility within the roundabout, therefore, educational campaigns must be done on the site.

The surveys carried out during the process of this study, the behavior against the misuse of control devices —such as, for example, horizontal signaling— were analyzed and identified. Additionally, these elements do not comply with the technical specifications of the INVIAS road marking manual, where at first glance it can be seen that the paint used is not the optimal one for the correct demarcation since microspheres must be applied and it must be reflective so that it is visible during the night hours and seen without any inconvenience during the day. Therefore, roads must be demarcated again and, complying with the technical specifications of the road marking manual of the INVIAS. Vertical signaling in different parts of the city are deteriorated due to common crime, although in other points of the city the signaling is in perfect condition and complies with the road signs manual of INVIAS. However, for the correct use of the roads, campaigns to promote an effective connection of road users with control devices should be promoted.

No type of police sanction is applied to bicycle vehicle drivers, but their participation in the road is as important as any type of driver or pedestrian, since it is also a human life. It was possible to appreciate that when these drivers moved through the different traffic lights and by the routes of the urban helmet, some did not consider any type of precaution, for which pedagogical campaign should be promoted to this type of users along with the pedestrians, letting them know the importance they have on the road.

In the study area, as previously mentioned, the inhabitants have not adapted to meet with a traffic light intersection and, because of their lack of awareness and culture, they exceed the speed limits allowed to reach the green light of the traffic light. Another cause that greatly influences passing red lights are hot temperatures as high as 40°C, and the incidence of sunlight. Nevertheless, it should not be a decisive factor for disobedience, since this decision is assumed by the road user and could cause a traffic accident.

It is also important to check the status of traffic control devices, both vertical and horizontal and see if they are in the optimal state for the user's visualization or correct location. However, nothing should be an excuse to be one of the infractions; on the contrary, the user must be aware of the action that they are going to carry out as a participant of the road to avoid running the risk of generating an accident where they could not only lose their life, but that of others as well.

It is proposed to implement citizen culture through training offered in the main streets of cities, both in private and public educational institutions, through lectures and educational activities involving the direct participation of the citizen. This can help teach in an effective way the transit rules, the existing signaling and the consequences of making risky decisions that may bring physical damage to people. These campaigns could lead to promote the learning of the basic standards of education and road safety, promoting civic culture and road culture.

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