Visual Recognition Assessment of Road Barriers in Metro Manila

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ABSTRACT

According to an article in Manila Standard, 2.5 million vehicles are registered in the Philippines as of the year 2015. A total of 94 reports of barrier-related accidents were recorded in 2011, ranking second in object collision incidents in Metro Manila. According to the Metro Manila Accident Report and Analysis System by the MMDA, barrier-related collisions make up 30.62% of the total recorded accidents with declared category. Furthermore, poor visibility of road barriers is one of the commonly cited causes for these incidents. With the increasing number of registered vehicles, the study aims to assess the visual acuity of existing traffic barriers in Metro Manila's major roads, particularly in Epifanio de los Santos Avenue (EDSA) and to provide recommendations that will help improve visibility and recognition of traffic barriers under various road environments which can reduce traffic barrier-related accidents. The assessment was conducted through a simulation of a light traffic condition in EDSA with the combination of three factors (time of day, weather condition, and type of barrier). Three common barriers, currently installed in the past few years, were tested. These are the 1) Orange Water-Filled Plastic Jersey Barriers, 2) white-and-black-striped Concrete Jersey Barrier and 3) yellow small-block concrete delineator. Participants were asked to detect the presence of the traffic barrier while counting the number of vehicles in the simulated video. A total of fifteen male and female participants, ranging from 17 to 24 years old, were asked to participate in the study, none of which have poor eye conditions. Analysis of results, using ANOVA, showed that only the barrier type has a significant effect on the visual recognition time (F=8.07, P=0.007). Result shows that recognition times for Orange Jersey Barrier (X-bar=12.31, Sd=7.64) were significantly faster compared to the other two barriers. Thus, it is recommended that the Orange Jersey Barrier be the standard road barrier in Metro Manila.

Keywords: Visual Recognition, Road barriers, Metro Manila

1. Introduction

According to an article in Manila Standard, 2.5 million vehicles are registered in the Philippines as of the year 2015 (Zurbano, 2015). With the increasing number of registered vehicles, traffic has become a major issue in Metro Manila. In order to control the traffic flow, road barriers are deployed on major roads, one of which is the Epifanio de los Santos Avenue (EDSA). These barriers direct the lane of vehicles, u-turn slots, and left and right turn slots. Although these have been installed in the length of EDSA, barriers are not uniform in every part of the long avenue.

There are a total of 94 recorded reports of barrier-related accidents in the year 2011, ranking second in object collision incidents in Metro Manila. The first in the list is the general object collisions, which may still include undeclared accidents related to traffic barriers. Barrier-related collisions in Metro Manila make up 30.62% of the total recorded accidents with declared category according to the Metro Manila Accident Report and Analysis System by the MMDA. There are multiple incidents of traffic barrier collision-related accidents due to poor visibility conditions and poor design of the barriers as stated by the motorists (Carlos, 2014 & Frialde, 2016).

Different types of traffic barriers are being used in the major roads of Metro Manila as implemented by the Metro Manila Development Authority. Three common barriers that are currently installed in the past few years are 1) Orange Water-Filled Plastic Jersey Barriers, 2) White-and-black-striped Concrete Jersey Barrier and 3) the yellow small-block concrete delineator. There are
other variants that are being used by the MMDA although there are no stated rules or law on the standardization of barriers in Metro Manila (Brizuela, 2016).

Object color and outline (shape) are two important physical properties to be considered in visual recognition. This was simulated in a study where the color and shape were used as cues for traffic sign recognition (Guo et al., 2011). The claim that color enhances object perception and recognition is further supported by Tanaka, Wieskopf, & Williams’ research (Tanaka et al., 2001).

Consequently, the study aims to assess the visual acuity of traffic barriers in Metro Manila’s major roads, particularly in EDSA and provide recommendations that will aid in the reduction of traffic barrier-related road accidents in Metro Manila and improve visibility and design recognition under various road environments.

2. Method

Fifteen healthy male and female participants ranging from 17 to 24 years old participated in the study. These are mix of participants who have driving experience to non-drivers. Nearsighted and farsighted participants wore proper visual aid during the experiment.

The driver’s visual attention is affected by environmental conditions namely time of the day and weather; although visual searching strategies were both affected by impeded visibility (Konstantopoulos, 2010). Therefore, three factors were used in the study: the time of day (day/night), weather condition (clear/rainy) and the type of barrier (Orange Plastic Jersey Barrier/ White-Black-striped Concrete Jersey Barrier/ Yellow Concrete Delineator).

Videos that simulate the motion of the vehicle in the first-person point of view were made in Adobe After Effects. Concrete walls were added by the proponents on the left side to replicate the long walls of the Metro Rail Transit system (MRT). Other elements were added to the video simulation to produce a more realistic effect. Lighting and a horizon projecting similar view in real life were also placed in the simulation. A 152 pt / meter ratio was set in Adobe After Effects program to effectively represent road dimensions. A moderately light traffic EDSA was made as a basis for the speed of the camera movement, which is 30 km/h (8.33 m/s). Converted in terms of the program’s units, the camera movement is at 1292.43 pt/second.

To prevent the anticipation in detecting barrier, starting times for the appearance of the barrier were randomized. The number and arrangement of cars also significantly varied.

The participants were asked to sit comfortably in front of the 27-inch iMac with Retina display, approximately 1.0m away, and were requested to detect road barriers from the video presented.

Visual recognition task while driving is a mix of divided and sustained attention task. Paying attention to different elements in the road environment creates separate tasks to be performed simultaneously. To simulate attention during driving, the participants were also asked to count the number of cars throughout the simulation video while remaining vigilant on the incoming barriers.

Recognition time of the barrier was recorded from the point when the barriers start to appear in the simulation video until the participant raises his response stick, indicating detection of the barrier.

Survey forms were given to the participants before and after the experiment. An evaluation on the realism and accuracy of the simulated environment was also included in the survey in a scale of 1 to 5, with 5 being realistic. A comments and suggestions section was also placed at the end of the form.

3. Results

Analysis of Variance (ANOVA) was used to analyze the data with General Factorial as the experimental design setup with three (3) factors, namely, type of barrier (Orange Jersey Barrier/Black and White Jersey Barrier/ Yellow Delineator), weather condition (Clear/Rainy) and time of day (Day/Night). There was also a blocking on driving experience since according to a study by Konstantopoulos (2009), this factor had an effect on visual recognition. In order to ensure that the data analyzed were independent from one another, responses for each factor combination were randomly chosen from the pool of data. The analysis had two (2) replicates with alpha equal to 0.05. Minitab software was used to process the data and generate the ANOVA table which was used to analyze the results.

Based on the ANOVA generated with the use of Minitab, there was a significant effect from the type of road barrier (F=8.07, P=0.007). This result showed that
the recognition time of the participants had a difference based on the type of barrier present in the simulation. Tukey’s Studentized Range Statistic Method revealed that recognition times for Black and White Jersey Barrier (X-bar=18.40, Sd=6.38) and Yellow Delineator (X-bar=18.16, Sd=6.73) were relatively similar. In contrast, recognition times for Orange Jersey Barrier (X-bar=12.31, Sd=7.64) were significantly faster compared to the other two barriers. Figure 1 shows that comparison of mean recognition for the three types of barriers. These findings denote that orange barriers were easier to recognize in the roads. The analysis on the effect of time of day showed that it did not have a significant effect on the recognition times of the participants (F=1.01, P=0.338). The response times of the participants in relation to the time of day were as follows: Day (x-bar=15.75, Sd=7.41), Night (x-bar=16.83, Sd=7.50). For the effect of weather condition, the analysis revealed that it also did not have a significant effect on the recognition times (F=1.03, Sd=0.331). The response times of the participants in relation to the time of day were as follows: Clear (X-bar=15.78, Sd=7.78), Rainy (X-bar=16.80, Sd=7.13). In addition, the blocked factor on considered did not have a significant effect but its p-value was the closest to the alpha value (F3=3.69, P=0.081).

Interactions between factors did not show any significant effect to the recognition times. Although there is no difference statistically, the means from one condition to another can still be compared and contrasted. All of the data were used for the comparison of mean recognition times. For all of the four (4) conditions which are Day and Clear, Day and Rainy, Night and Clear, and Night and Rainy, recognition time of the Orange Jersey Barrier was fastest compared to the other types of barrier. Figures 2 to 5 show the comparisons of recognition times for all cases. This implies that the Orange Jersey Barrier is the best type of barrier that should be installed on the roads since it can be recognized faster for all the conditions considered in this study.
4. Conclusion

Only barrier type has a significant effect on the visual recognition time of road barriers. Using Tukey’s Studentized Range Test, the Orange Jersey Barrier had a significantly faster recognition time than the other types. This type also has the least visual recognition time with a mean of 12.31 seconds. The findings of this study imply that the best type of barrier to be used as the standard in Metro Manila is the Orange Jersey Barrier.

References


