Driver Compliance to the New Traffic Warning Signs Installation

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Abstract. The current installation of traffic signs is placing on the shoulder of the road and above the road. New traffic warning signs installation are installed at the back of the vehicle. So when the vehicle moves, the back of the vehicle can be seen by the following driver behind. The installation of a sign at the back of the vehicle means that the beacons are in the area and the sight panel and are in the driver’s viewing angle that can be seen clearly by the next vehicles and get used to remind of safe drive behavior. A car follower’s distance, velocity, and sensitivity are marked by its speed conversion that will generate either an acceleration or deceleration. The study equipped a hidden camera operated with the iOnRoad Augmented Driving Professional Program to find out the following vehicles' response. The difference in distance, speed, and sensitivity of the vehicle that follows the car observer before the installation of traffic warning sign and after the installation of traffic warning sign can be interpreted that there is an effect of compliance of the vehicle driver that follows when there are traffic warning sign installed on the back of the car observer.

Keywords: traffic warning, driver, compliance

INTRODUCTION

The effectiveness of traffic warning signs depends on its feature to communicate the message to the drivers [1]. In order to afford the aim of communication, the warning sign legibility is the first basic requirement that must be fulfilled. The legibility of traffic warning signs is affected the most by both legibility distance and glance legibility [2], as well as the drivers’ capability to detect the warning and how long the time required to respond it [3].

The warning signs are normally installed either at the edge or above the road. However, there are couple of factors affecting the drivers’ capability to comprehend those signs, including area and perceiving panel, cone vision, legibility distance and glance legibility. Nowadays, most of the existing traffic warning signs prioritize contents that warn the happening of traffic accidents and the road track conditions, such as road constriction, slick road, winding road and steep slope that potentially cause harm.

The basic principle of new installation traffic warning signs works through the installation of the signs at the rear car. When the car moves on the road, the signs will be legible by the drivers behind. The position of the installation should be at the exact angle of perceiving panel to make the drivers convenient in seeing and catching the meaning of those signs clearly. The variants of the car speed will always be in minimum value, since both sign-installed car and the following ones move in line. The more often the sign-installed car moves, the more other cars behind can see the signs.

In general, the following vehicle’s reaction depends on several things, which include the speed and track. It is recognized from the headway, including time and distance between two vehicles and how far the vehicle will converge its speed to follow the leading vehicle. The relatively simple and common driving task of one vehicle following another on a straight roadway where there is no passing (neglecting all other subsidiary tasks such as steering, routing, etc.) can be categorized in three specific subtasks [4]: 1) Perception: the driver collects visual information, primarily from the motion of the leading car (leader). At the simultaneous time, the driver’s car (follower) will be affected by the information relating to velocity, acceleration, space between vehicles, etc.; 2) Decision making: the driver interprets the information and relates it with the previous knowledge as an attempt to develop strategies in maintaining a safe and practical movement, and 3) Control: the experienced driver can perform management actions with skill and coordination, relying on the previous information.

The drivers’ viewer reaction time toward the traffic sign means as the interval of time that is required to detect, read and respond the message of the traffic signs captured by the vision cone. After the viewer reaction distance toward the traffic sign is adjusted, the distance between the traffic sign and following car can be defined. The defining of viewer reaction distance is needed to find out the legibility. The distance between the driver and traffic sign at the first time of legibility will decline due to the speed of moving car [5].

The peripheral perceiving panel of the drivers consists of three sides, including left-front, straight-front and right-front [6]. The analysis of percentage of eye focus that using eye tracking confirms the result that the drivers mostly take their time to focus at the straight-front side while driving. This statement is in accordance that the drivers have more effortless job to catch the perceiving panel at the straight-front side compared to the right and left sides. Generally, the more information gathered will affect to the slower visual searching. In
other side, the drivers will have the maximum accuracy in reminding the pictured-traffic warning signs and minimum accuracy to process the information [7].

The variations of displays can affect the different system of searching. The evaluation of works can indicate the drivers’ capability to see and process the information of the warning signs within a short time in less visual requirement [8]. There are two things attracted the drivers’ attention in the peripheral perceiving panel, including the other cars at the front, right or left sides [9].

METHOD

This experiment aims to explore the application of new installation of traffic warning signs by determining the safe distance between two moving cars. The car observer is the type of public transportation as Figure 1 shows. The mobile traffic warning sign applied in this research functions to remind the drivers of the safety distance. It is designed in a rectangular shape which is (46x69) cm in size printed with 2 inch or 3 cm clearview fontsize. The tested car video camera installed inside rear car and then recorded the vehicles following the tested car.

![Figure 1. Installed Warning Sign Design On Back Car](image1)

The procedure of the study aimed to find out the following vehicles' distance, velocity, and sensitivity at two conditions. The first condition was made by installing the warning sign at the back of the tester car, while the second condition was at the time of the sign removal. The observation deployed a moving car observer on the real road condition. The tester car was equipped with a video camera to record its following vehicles' movement.

The study included the tester car's speed based on the number pointed by the speedometer or the number pointed by the iOnRoad monitoring. Meanwhile, the distance among the tester car and its following vehicles was completely recorded by iOnRoad. The speed of the following vehicles was determined based on the calculation of distance per unit of time (second). Meanwhile, their acceleration and deceleration were determined based on the calculation of distance and speed of the tester car and following vehicles.

The following vehicles’ response was recorded by the camera and proved through the calculation of speed, as either the following vehicles improved their speed ($V = +$), moved constantly with null velocity ($V = 0$), slowed down ($V = -$), or decelerated their movement. The cutting videos of vehicle follower on road as shown by Figure 2.

![Figure 2. Vehicle Follower from rear Camera on IOnRoad Monitoring Video](image2)

The following vehicles’ sensitivity at fourth conditions showed various values in the sensitivity parameter ($\alpha$). The interpretation of sensitivity value referred to General Motor's as Equation 1 showed.

$$\alpha = \frac{\dot{X}_{n+1}(t + \Delta t)}{\dot{X}_n(t) - \dot{X}_{n+1}(t)}$$

- $\dot{X}_n(t)$ = the tester car's speed at the time interval of $t$
- $\dot{X}_{n+1}(t)$ = the following car's speed at the time interval of $t$
- $\dot{X}_{n+1}(t + \Delta t)$ = the acceleration or deceleration of the following car

RESULT

Analysis of statistical data on the difference in distance between vehicles that are in front with vehicles that follow in conditions without installed signs on road sections averages 18.82 m, with a standard deviation of 14.24. Whereas the distance between the vehicle in front and the vehicle that follows in the condition of the test vehicle has installed traffic warning sign at an average of 27.61 m, with a standard deviation of 13.86 m. Whereas the difference in velocity between the vehicle in front
and the vehicle that follows in the condition without the installed signs for arterial roads is an average of -1.53 kmh, with a standard deviation of 3.02. While the difference in speed between the vehicle in front and the vehicle that follows in the condition of the test vehicle installed warning sign is an average of -2.19 kmh with a standard deviation of 4.13. Negative speed difference indicates that vehicles that follow the average speed faster than the test vehicle. Figure 3 and Figure 4 show the relative distance and velocity distance when the car observer is installed and uninstalled the warning sign.

Figure 3. Relative distance mean for installed and uninstalled warning sign

Figure 4. Relative distance and velocity distance when the back of car observer is installed and uninstalled sign

DISCUSSION

The driver's response to safe distance guard signs is indicated by the magnitude of the distance and speed difference when in conditions with and without warning signs installed on the test vehicle. The difference in distance and speed referred to is as follows: 1) The difference in the average distance of the vehicle that follows when the vehicle in front is installed with a safety distance guard of 27.61 m and when the vehicle in the front is uninstalled the difference in average distance is 18.82 m, and 2) Relative difference in average speed between the test vehicles when the vehicle in front is installed warning sign of 7.91 kmh and when the signs are not installed, the difference in speed is 5.50 kmh.

Sensitivity value (γ) occurs as the relationship between speed, distance and acceleration that occurs between the test vehicle in front of the vehicle that follows in various conditions are: 1) When the front vehicle is without signs, the sensitivity is positive at 0.622 and the negative value is -4.045, and 2) When the front vehicle is installed with signs, the sensitivity value is positive at 1.143 and the negative value is -3.566.

CONCLUSION

The sensitivity value (γ) is positive means a slowdown in the no-sign condition, with the distance guard sign indicating a greater value, meaning the driver is more careful in maintaining distance, braking with a slowdown is greater than without signs. While the value of sensitivity (γ) negative means acceleration in the condition without signs, with a distance guard sign installed, the value of γ becomes smaller. This means that the acceleration carried out by vehicles that follow is smaller than without signs, meaning that the driver will be more at a distance. It can be concluded that with the signs, the driver will keep more distance than without signs.

The difference in distance, speed, and sensitivity of the vehicle that follows the car observer before the installation of traffic warning sign and after the installation of traffic warning sign can be interpreted that there is an effect of compliance of the vehicle driver that follows when there are traffic warning sign installed on the back of the car observer.

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