

Car Follow Behavior as Safety Driving Messages

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ABSTRACT— *Car following behavior is a function of the response from stimulus affected by the relative distance and velocity. The obedience of a driver toward a brief message to keep the safety distance is identified based on the variant of distance and velocity between the lead vehicle and the following one. The message made as the warning to keep the safety distance is put at the rear part of the lead experimental car equipped with a camera of the android cellphone and ionroad professional application. It aims to explore both distance and velocity and drivers' behavior, at the conditions, before and after the experimental car is equipped with a safety driving message. There is found a significant difference on the variant of distance and velocity between the following car with the lead car, before and after the safety driving message intalled. This finding indicates that the providing of a safety driving message to keep safety distance and velocity affects the drivers' behavior. It also simply states that the message can make drivers compliance to the following cars.*

Keywords— Car follow, behavior, safety drive, compliance

1. INTRODUCTION

The safety driving message directed for the drivers are normally in the form of a traffic sign placed at the sides of road. Some media can help as well to persuade the drivers in being cautious for the risks of traffic accidents. However, some studies begin to question the effectiveness of the warning traffic signs especially the static ones placed at the road sides.

There had been conducted some studies related to the effectiveness of the warning traffic signs which aim to remind the danger of passing the icy road and explicitly telling the number of traffic accidents happened in Washington. The studies proved that the warning traffic signs regarded could not be an effective problem solving in decreasing the frequency of traffic accidents [1].

The most dominant reason emerged relating to that condition is that the drivers normally are not aware toward the information, thus, they do not feel necessary to find its urgency, even if they have got good skill on perception to detect the information they see from the traffic signs provided [2]. The number of traffic signs only rise the doubt toward their effectiveness in contributing to inform the safety messages in driving, since they can not attract the drivers' attention from time to time [3].

The traffic signs are effective, if they are able to communicate the messages to the drivers [4][3], based on some specific characteristics of situations, people and the warning conveyed [5]. Generally, they function effectively based on the non-design and design factors [6]. Another requirement in judging the effectiveness of the traffic signs is the drivers' obedience toward the warning (warning compliance) regarded [6]

There needs a new innovation in elevating the effectiveness of a safety message. One of the solutions is to place a warning message on the back or rear vehicles. The warning message regarded can be installed at the rear of a vehicle, thus will make other drivers following easy to see and give attention.

How one single car following another is the effect of same velocity and lane with the lead one. It is characterized by the headway (the same time or distance traversed by a vehicle) and how far it undergoes a conversion following the lead one [7]. The drivers' obedience toward the warning is distinguished based on the car following theory which bridges both

microscopic and macroscopic theories on the traffic flow, the integrated contribution, and a sufficient reference theories formulated by some internal and external researchers of General Motor [8].

2. METODE

The research data are gained from the experiment toward responses of distance and velocity of the following vehicles, before and after the safety driving message is attached at the rear part of the lead experimental one. The sample taken randomly comes from the vehicles following the experimental one on the same lane and recorded by the camera set up at its rear. The system of camera setting is made invisible, thus, the drivers of the following vehicles will only show natural responses without any kind of pretense.

3. MATERIAL

3.1 Safety Driving Message Design

The traffic sign or safety driving message directed to all drivers used in this experiment design with a writing of “KEEP SAFETY DISTANCE” (JAGA JARAK AMAN) installed at the rear of the experimental car, with the dimension equals to (46 x 69) cm, font size equals to 5 cm and font type used is clearview as **Figure 1** shows.



Figure 1: The Design of Safety Message

The reason why this study conducted using the design shown at Figure 1 is based on the easiness in doing measurement regarding to distance and procedure to explore the responses of the drivers after reading the safety driving message. The design made has been tested based on some considerations, including comprehension, conspicuity, learnability and relevance of the design to the drivers' behavior. The result of testing shows credible result to be brought up to an experimental follow up [9].

3.2 Materials of Survey and Data Analysis

The primary materials used in conducting a survey is a passenger car attached with a board of a safety driving message and camera at the rear. The camera is set invisible, thus will not contribute too much influence toward the drivers' unnatural behavior in being aware of the safety driving message.

Another supporting materials used are cellphone camera functioned as a video recorder completed with a holder. The android cellphone used is featured with some applications, including google map, ion road augmented driving professional and screen recording. The type of vehicles targetted in collecting the data belongs to the motor vehicles except motorcycles, as in compliance to the main function of the application used, ionroad pro. The data analysis is conducted based on the sorting of responses based on the distance and velocity recorder in per second unit which are counted using VSDC Video Editor application.

4. PROCEDURE

4.1 Preparation

- 1) Providing the experimental vehicle, which is a passenger car for conducting 2 kinds of survey. The passenger car used in this survey enables the attachment of a safety driving message written “Keep Safety Distance” as this research has designed at its rear to explore the distance and velocity responses of car following behavior before and after the message is installed.
- 2) Determining the routes for 2 kinds of survey.

- 3) Determining the schedule to conduct the experiment at the off peak condition, in the afternoon around 09.00 up to 12.00 for the first survey and 14.00 up to 16.00 for the second survey.
- 4) Ensuring that the traffic is at the normal condition, to avoid the jam at the routes determined.

4.2 Experiment

- 1) Setting the camera at the rear of the experimental car to record the mobility of other vehicles following, except motorcycles, at the same lane.
- 2) Installing ionroad professional application set at the velocity unit of kph (kilometer per hour) and distance unit of meter.
- 3) driving the experimental car at the stable condition of 30 mph or 50 kph, except at deceleration caused by the delay or acceleration caused by overtaking another vehicle in front.

4.3 Data Input

- 1) The recording taken during the process of experiment is assisted by screen recording application.
- 2) The car following behavior of every vehicle is sorted in per second unit.
- 3) The display shown on ionroad application in per second unit indicates the velocity and distance between the experimental car and other vehicles following.

5. RESULTS

The formula proposed by General Motor can be used to measure both distance and velocity of the vehicles following the lead experimental car. The variant of both distance of velocity of two vehicles regarded then comes into the process of analysis in order to explore the responses of the drivers of the following vehicles.

The comparison of the variants of distance and velocity of the following vehicles is considered before and after the experimental one is attached with a safety driving message. This way, the car following behavior can be analyzed.

The result of analysis toward the distance between the experimental car and the other ones following, at the condition of before and after the attachment of a safety driving message, indicates the influence of the message toward the responses of other vehicles following.

Mean of variant of distance without safety driving message are 18.96 meters with 95% confidence interval for mean lower bound 17.32 meters and upper bound 20.60 meters. Mean of variant of distance for installed the safety driving message are 27.27 meters with 95% confidence interval for mean lower bound 25.66 meters and upper bound 28.87 meters and both data not normaly distributed. Mann-Witney test result that the two samples independent are different. The describe of result analysis is shown in **Figure 2**.

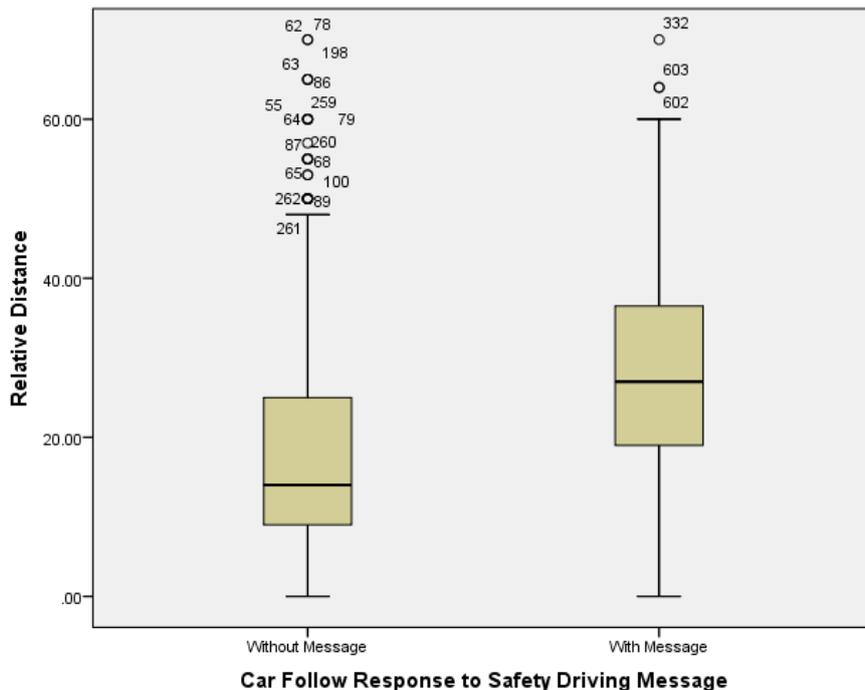


Figure 2: The Variant of Distance

Mean of variant of velocity without safety driving message are 2.53 meters/second with 95% confidence interval for mean lower bound 2.19 meters/second and upper bound 2.87 meters/second. Mean of variant of velocity for installed the safety driving message are 3.31 meter/second with 95% confidence interval for mean lower bound 2.91 meters/second and upper bound 3.71 meters/second and both data not normally distributed. Mann-Witney test result that the two samples independent are different. The describe of result analysis is shown in **Figure 3**.

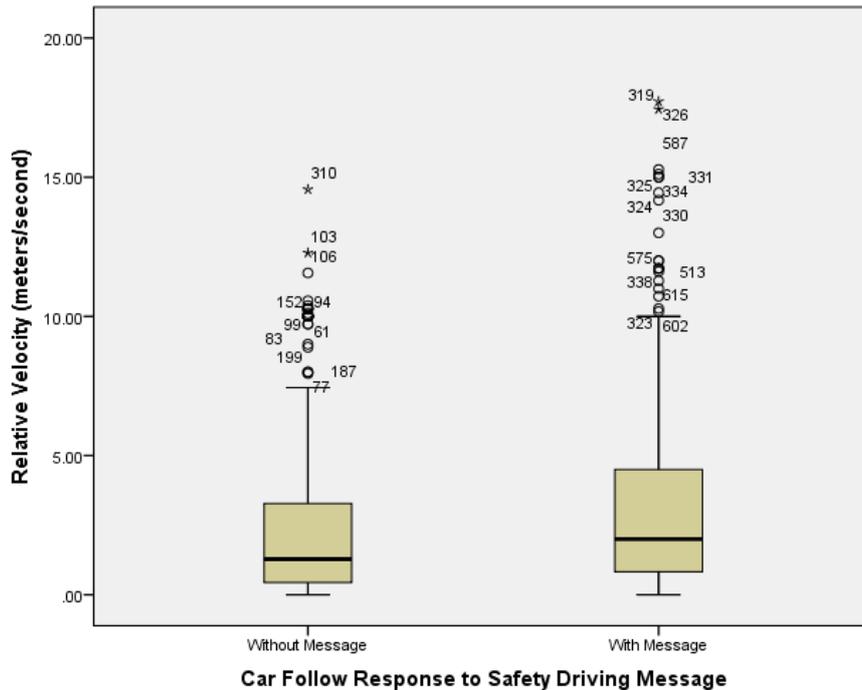


Figure 3: The Variant of Velocity

6. DISCUSSION

The model of car following developed by General Motor research team simply represents the function of response coming from the sensitivity and stimulus. The responses regarded means as either deceleration or acceleration of the following vehicles, while the stimulus means as relative velocity of the lead car compared to the following vehicles. There are 3 components in formulating the sensitivity, including: the constant α (dimensionless), velocity of the following vehicles and distance headway.

The velocity and distance relativity of the lead car and the following vehicles indicate the car following behavior. Something which means as an eye-catching object can emerge 2 kinds of probability, either attracting the attention or just giving usual sense for common people. This analogy is straight to the attachment of the safety driving message of the lead car which can influence the behavior of other following vehicles.

This research proves briefly that there is different of distance and velocity between the lead experimental car and the following vehicles, at the condition before and after the safety driving message written “*keep safety distance*” is intalled at the rear of the lead experimental car. This result indicates that the install of the safety driving message regarded can influence the drivers’ behavior to show their obedience in following the message.

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