

Analysis of Speeding Behaviour During Approaching the U-Turn Facility Road Segment Based On Driving Simulation Test

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Abstract. The main purpose of this study is to analyse the speeding behavior during approaching the U-turn facility road segment based on driving simulation test. In previous studies, it has been shown that speeding behavior is a complex problem that requires a full understanding of drivers' attitudes and beliefs. Such understanding is needed to improve the speeding behavior of drivers that comes from the effective design and interventions. Therefore, this study will analyse the speeding behavior in approaching the U-turn facility as a key variable in this study which may affect the collision result. Totally 50 participants were recruited in this experiments based on driving simulator. The scenarios and road environment in the driving simulator were based on site location at FT050 Jalan Batu Pahat – Kluang, Johor. Results shows significant increase in speed of up to 40.01% more than the speed limit at the approaching the U-turn facility road segment. The paper concluded that speeding behavior during approaching the U-turn facility road segment based on driving simulation test will trigger significant increasing of speed.

1 Introduction

This study is conducted to find out the driver speeding behavior in the area of U-turn at FT050 from Batu Pahat to Kluang. FT050 has six (6) midblock U-turn facility in total from Batu Pahat to Parit Raja with only two (2) U-turn facility available for heavy vehicles. The speed profile is an important tool for road safety especially in the evaluations and in design process of existing road because it can be used for safety considerations. The data recorded by Royal Malaysia Police in 2012 [1] showed that accident rate were increasing every year where in year 2012 the number of accident was 62,316 with 1,073 fatal and location for this study which is in Batu Pahat, where it is the second highest in Johor the number of accident recorded was 7,439 with 176 fatal recorded which is the highest in Johor during that year. Sadly, in 2015 it keeps increasing with the 197 fatal. Abdul Manan [2] and Abdul Manan & Várhelyi [3] also mentioned that Batu Pahat – Kluang FT050 road recorded 1000 accidents and 36 deaths since 2006. This study was using the driving simulator to collect the data.

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However, when drivers driving in actual driving situations rear-end risk still exists. The development of driving simulator with character safer driving environment, easier to use, and lower cost makes the experiment for data collection in a more convenient way. Studies using driving simulator have been conducted in many fields such as using driving simulator in model development and to examine the effect of intersection and as stated by Md Diah et al. [4] and Nemmag and Rahman [5].

Speed choice is one of the most studied driver behaviors. One reason may be because speed is strongly related to accident risk. Therefore, the studies on speeding behavior are important in this road especially in approaching the U-turn facility because the speed limit in the U-turn area are 60km/h where is at the roadway before and approaching U-turn segment was 90km/hr the reduction and increasing speed can lead the accident as studied by Rahman and Ben-Edigbe [6]. Studies of speeding behavior have been conducted in many aspects. Mehmood, [7] studies the speeding behavior used radar gun to measure the spot speed of randomly selected vehicles from three major arterial roads in order to assess the current extent of the speeding problem in Al Ain. The results indicated that speeding behavior contributing to 37% of severe road crashes. While Montella et al. [8] studies speeding behavior in rural intersections using driving simulator and the results showed that that intersections significantly affect drivers' speed behavior.

Some researchers also study about the travel speed at the multilane. Rahman and Ben-Edigbe [6] trigger significant travel speed reduction in median openings zone facilities irrespective of their traffic conflicts minimization merits. While Daniel et al. [9] studies about the speed patterns on traffic calmed. They provided that driver choice of speed not only when traversing the devices but also as they move towards and away from the devices that affected into the effects of traffic calming devices on driver behavior. Mashros et al. [10] explore about the mean speed at the dry and rainfall condition. The research successfully finds out the speed reduction in dry and rainfall condition. Moreover, Rohani et al. [11] assess the impact of business and non-business hours on speed and acceleration of car drivers. The researcher divided the road into four (4) segment and find out the speed in every segment during the business hour and non-business hour. Speed study have been familiar for the researchers in order to reduce the number of accident and find out the driver behavior in choosing the speed. Usually, mean speed will be used to find out the average speed of driver tend to drive in certain area such as in U-turn area. Mean speed is calculated as the sum of all speeds divided by the number of speed observations and a measure of the central tendency of the data. This speed is believed as an indicator of average travel speed. Therefore, this studies find out the speed behavior of drivers in order to minimize the probability of accident especially in U-turn area.

2 Methodology

In this paper, the methodology in collecting the data is divided into 3 steps.

Step 1: Participant

The process begins with a recruited a total of 20 participants to use the driving simulator as a sample. During the selection of the participants, gender (10 males vs 10 females). The participants were given time to practice the driving simulator to make sure they are familiar with the road and condition. The most important thing this group of people should have a valid Malaysian driving license and must in 19 years old and above. In order to ensure the availability of the data, participants were excluded for sickness and for the sleep debt which may influence a normal driving.

Step 2: Apparatus

The apparatus in this experiment was conducted by a fixed- basis driving simulator in University Teknologi Mara (UITM) by using Automotive Simulator for Driver's Behavior and Competency Evaluation (ASIS). The driving simulator (Fig. 1) give the participant drive like driving a real car on a real road because it can simulate driving scenarios and various kinds of road traffic environments. The vehicle cockpit is based on the true steering simulation system, accelerated and brake pedal system, real instrument control interface, vibration and noise simulation system and the vehicle is located in a 180 degree rearview that can display virtual road environment.



Fig. 1. Area of research study at FT050



Fig. 2. Driving simulator screen simulation

Step 3: Scenarios

The purpose of this study is to study the drivers speeding behavior in approaching the U-turn facility. Thus the scenarios or road environment are based on the road environment of FT050 as shown in Fig. 2. To meet the requirements of designing scenarios and simulating virtual traffic environment, a set of software as shown in Fig. 3 are adopted. Other than that, the roads design was dual carriageway highway with a median that give participants choose the best lane and speed for their driving. The road and the U-turn area development has a midblock in the middle of the road. The road providing the U-turn signboard which is 150m before the U-turn area and at the U-turn itself that given the driver warning and guide

that U-turn area at the front. The length of the road was 700m which is 500m before the U-turn area and 200m after the U-turn. It gives the driver a chance to get momentum on the speed of the vehicle in approaching the U-turn area. Therefore, driver will be driving with their own intentions without any disruptions from the road design.

3 Results and findings

3.1 Analysis of drivers speeding behavior

In this paper, the analysis of driver behavior focuses on the speeding behavior of the driver in the U-turn area. Table 1 presents the mean speed of driver driving from the driving simulation based on the road environment of FT050 from Batu Pahat to Kluang at the U-turn area of KM15. The speed limit in the area of U-turn area which is 150m from the U-turn is 60km/h. From the Fig. 3, the histogram shows that the driver behavior tends to speeding in the U-turn area where the graph nearly uniforms from all the drivers. The highest average speed is 91.95km/h which is 31.95km/h more than the speed limit. The lowest average speed comes from the driver 19 with speed 62.87km/h.

Table 1. Mean speed of driver

Drivers	Mean Speed (km/h)	Drivers	Mean Speed (km/h)
Driver 1	86.88	Driver 11	78.15
Driver 2	88.17	Driver 12	85.93
Driver 3	85.29	Driver 13	90.41
Driver 4	91.95	Driver 14	87.22
Driver 5	90.60	Driver 15	87.26
Driver 6	83.16	Driver 16	91.52
Driver 7	86.55	Driver 17	62.91
Driver 8	88.06	Driver 18	83.99
Driver 9	87.72	Driver 19	62.87
Driver 10	87.72	Driver 20	74.83



Fig. 3. Mean speed histogram

Graphical view of the speeding behavior of the driver shown in Fig. 4. It shows that the speeding behavior in the area of U-turn nearly closed between all the drivers as shown in the graph line for speed differences that formed nearly flat line from driver 1 to driver 16. Only driver 16 and 19 have speed nearly 60km/h that follows the speed limit of the area. It shows that drivers tend to speeding in this area where it can bring into an accident.

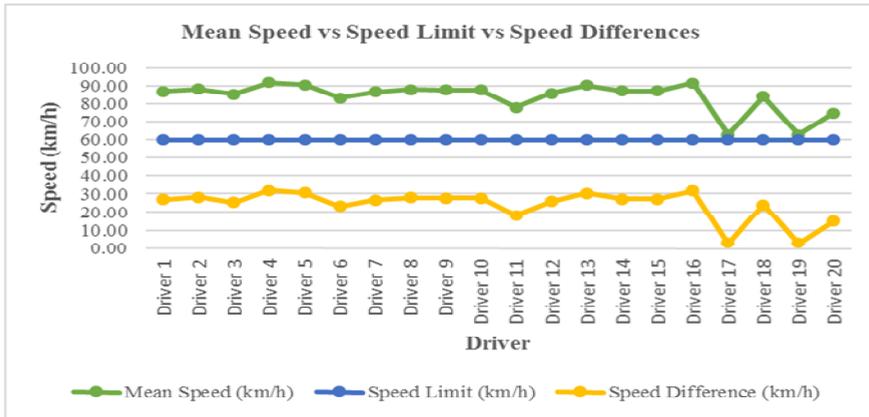


Fig. 4. Graphical view of mean speed vs speed limit vs speed differences

The summary of average speeds is presented in Table 2. Result shown that average speeds in the U-turn area increasing in 40.01% which is the average speed is 84.06km/h. T-test was performed on these speed data and the result is given in Table 3. Result indicated that the speed increasing in average speed was found to be statistically significant.

Table 2. Descriptive analysis of speeding

	N	Mean	Std. Deviation	Std. Error Mean
Mean_Speed	20	84.0595	8.32670	1.86191
Speed_Differences	20	24.0595	8.32670	1.86191

Table 3. T-test for speeding behavior

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Mean_Speed	45.147	19	.000	84.05950	80.1625	87.9565
Speed_Differences	12.922	19	.000	24.05950	20.1625	27.9565

3.2 Speeding behavior based on gender

Descriptive statistics on gender was shown in Table 4. It was found that male drivers seemed to have a higher speed than the female drivers. It shows that mean speed for male drivers is 89 km/h while female drivers has a mean speed 79 km/h which is about 10 km/h lower than male drivers. The significance T-test as shown in Table 5 shows that speeding

behavior between male and female drivers has a significant differences where the P value is 0.005 which is lower than 0.05.

Table 4. The descriptive statistics of speeding behavior by gender

Gender	N	Mean	Std. Deviation
Male	10	88.9340	1.95528
Female	10	79.1850	9.47347
Total	20	84.0595	8.32670

Table 5. The significance T-test of speeding behavior by gender

		Sum of Squares	df	Mean Square	F	Sig.
Mean_Speed * Gender	Between Groups (Combined)	475.215	1	475.215	10.157	.005
	Within Groups	842.128	18	46.785		
	Total	1317.343	19			

4 Conclusion

Research findings suggested that in general, speeding behavior of the driver in the area of the U-turn not affected by the signboard and the speed limit. Even though all the drivers have been given warning by all the signboard, drivers were ignored all the signboard where the research found that drivers were drive up to 40.01% significantly faster than the speed limit. It shows that, drivers tend to speeding without notices the signboard and speed limit that may cause to an accident with the U-turn vehicles. Other than that, speeding behavior based on gender shows that male drivers tend to speeding where it is higher than a female driver when approaching the U-turn facility road segment.

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