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Effects of Motorcycle Flashing Brake Lamp on The Rear Vehicle Based on Video Simulation

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Abstract: Accidents regarding vehicle collision occurs very often and a study was conducted and the results showed that warning systems (visual, audible and/or tactile) would lead to reduced crashes and shorter brake response times. The purpose of this study is to evaluate the effectiveness of motorcycle brake lamp when applying flashing brake lamp by using survey based in video simulation. The survey was made using Google Form and sent to random 50 respondent in Edu Hub Pagoh population. A few factors that brought major influence to Brake Reaction Time such as Age, Gender, Traumatic Experience, Medicinal Prescription and Driving Experience were chose as variable for this study. Statistical Package for the Social Sciences (SPSS) software is used to sort and analyze the obtained data. Results shows that flashing brake light seems to improve the Brake Reaction Time in most cases in all factors that is discussed. This study majorly adds to the body of knowledge relating to flashing brake light with brake reaction time.

Keywords: Flashing Brake Light, Brake Reaction Time, Response Time, Conventional Brake Light

1. Introduction

Over the last 20 to 30 years, the use of impact absorbing technology has been very successful in reducing injuries to vehicle occupants. However, it does not succeed in reducing the risk of collision. A study was conducted by Rumar [1], in which drivers were asked why accidents happen so often. They think they saw other pedestrians too late to avoid a collision. Lack of attention seems to be the main reason behind this issue. Heejin Jeong and Paul Green [2] conducted this study, which covered 27 experiments involving human factors and front vehicle collision warning. The results showed that warning systems (visual, audible and/or tactile) would lead to reduced crashes and shorter brake response times. That being said, it is more likely that Flashing Brake Light will perform and deliver better results than Conventional Brake Light

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1.1 Flashing Brake Light

Research has been carried out previously on external warnings mainly on brake lights, and the main topic being how to make them more visible by changing their position, size, brightness, and other factor. It is also explained how to provide additional signals, in particular to reduce the speed of the drivers of the vehicle, for example make a few modifications by flashing the brake lights. Flashing brake lamps in the automotive world seems promising since the study and research on this brake lights mostly return a good result. Neurauter [3], performed this study and measured the time it took for a driver to shift their sights from the navigation system screen to the brake lights that alternately blinking with Center High Mounted Stop Light (CHMSL) at 4.75 Hz and found that response times decreased by 1.82 s (30.00 %) than conventional brake lights.

1.2 Brake Reaction Time

Brake reaction time (BRT) has not only attracted the attention of researchers, but is also a very important driving behavior parameter in the road design and accident litigation process. Above all, the BRT is used as reference to measure the stop distance and determine the road design required for a particular design speed.

1.3 Situation Awareness

Different drivers had different road adaptability and compatibility. Situation that each individual driver experience is very different even if it were occurring at the same exact place, surrounding and time. Situational Awareness (SA) has its sampling of timely information which is basically thought process when decision making and, distractions can disrupt this sampling process leading to increased conflicts and traffic accidents.

2. Methodology

The main objective of this study is to perform a survey based on video form simulation to evaluate the effectiveness of flashing brake lights to rear vehicles. Research tools is used to gather the information needed to answer all questions regarding and related to this study. The question is in a form of video questionnaire which is a simple simulation situation demo with question and a set of objective answer for them to select.

2.1 Development of Questionnaire Instrument

To construct this survey, items of research instrument is created and Table 1 shows the items mapping to create this question survey and to develop the questionnaire. This questionnaire contained two parts for the respondents to answer. Part A is demographic element and Part B is situation awareness element. Kumar stated that this research method is the consistent, planned and easy to analyses and the fastest way to receive the information [4]. In addition to gaining information on the intelligence and outcomes of this work, researchers personally distribute questionnaires to respondents residing in the residential areas of UTHM Edu Hub Pagoh.

Table 1: Construct and Items of Research Instrument

Construct of Research Instrument		Items of Research Instrument		
Variables	Factors	Item Code	Items [Mapping with Flashing Brake System]	
Independent Variable 1 (IV1)	Personal Factor (PF)	PF1	Driver's Age	To observed the delayed of response time if it is affected by the age factor.
		PF2	Driver's	To categorized and to sort the

			Gender	gender of the drivers
		PF3	Driver's Experience	Experience of driving on the road may become factor to muscle memory to flashing brake lights.
		PF4	Crashing Experience. (Accidents Trauma)	Being crash survivor might affected the reaction time due to traumatic incidents.
Independent Variables 2 (IV2)	Environmental Factor (EF)	EF1	Distraction	Radio, mobile phone, infotainment system might be a distraction to driver's attention
		EF2	Medical	Being on medical treatment can be an influential to driving attention.
		EF3	Alcohol	Drunk driving being a factor for the driver's unfocused driving.

2.2 Video Form Simulation

For the video simulation, there are 4 sets of video simulation for the respondents to watch and measure their reaction time on 2 different roads which is straight road and corner road, consist of 2 different light which is Conventional Brake Light and Flashing Brake Light. The instruction for respondents to follow is just by pausing the video immediately to capture their reaction time as soon as the brake light is lit up

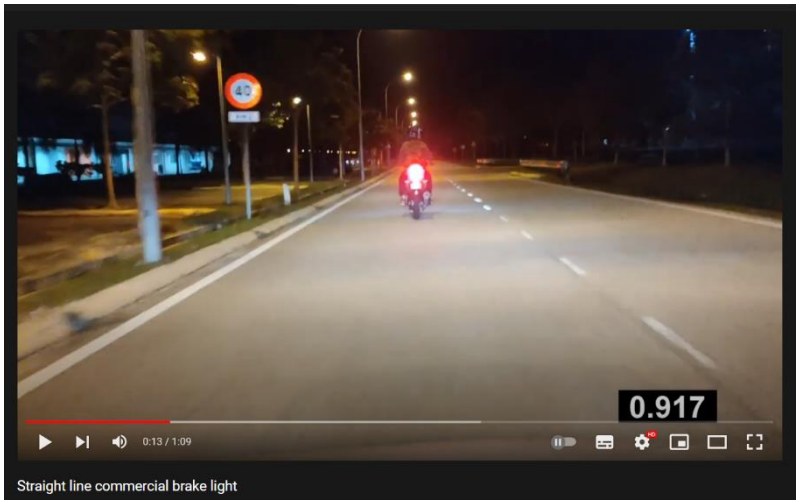

Figure 1: A frame of preview of how the Video Simulation for Straight Road

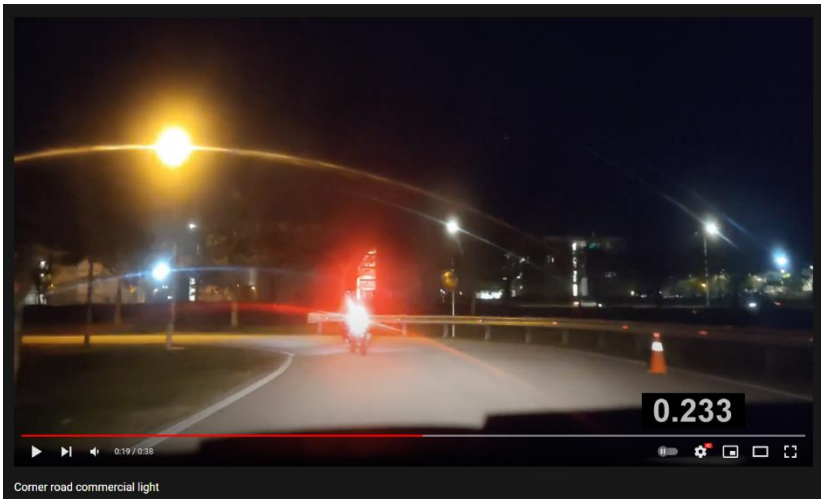

Figure 2: A frame of preview of how the Video Simulation for Corner Road

3. Results and Discussion

3.1 Distribution of Respondent Based on Gender

Table 2 below is the percentage of 2 subgroups which is male and female. After distribution of the question, only 50 is valid for the study out of 54 respondents. Out of 50 respondents, 34 of them which is 68.00 % is male and 16 of them which is 32.00 %, is female.

Table 3: Frequencies of Respondents based on Gender

Gender	Frequency	Percent	Cumulative Percent
Male	33	66.0	66.0
Female	17	34.0	100.0
Total	50	100.0	

3.2 Distribution of Respondent Based on Age

In this group, range of age has been divided into 4 subgroups. The choice of range that has been made is 18-19 (youth), 20-24 (youth), 25-29 (adult) and more than 30 (adult) years old. Table 4 below shows the frequencies of each age subgroups. The respondent that joins this study is only consist of two age groups which is the youth (20-24) 94.00 % and the adult (25-29) 6.00 %.

Table 4: Frequencies of each Age Subgroups

Age Group	Frequency	Percent	Cumulative Percent
20 - 24	47	94.0	94.0
25-29	3	6.0	100.0
Total	50	100.0	

3.3 Distribution of Respondent Based on Year of Driving Experiences

In this group, respondents are categorized into a few subgroupings to identify each of the respondents about how long the driver have been driving. It has been known that driving experience play a huge impact on braking reaction time where during driving, the driver learns more and more

about brake time and know when is the right timing to brake [5]. In Figure 3 below, it shows the frequencies of respondents according to their driving experiences time (including the time before have legal driving licenses).

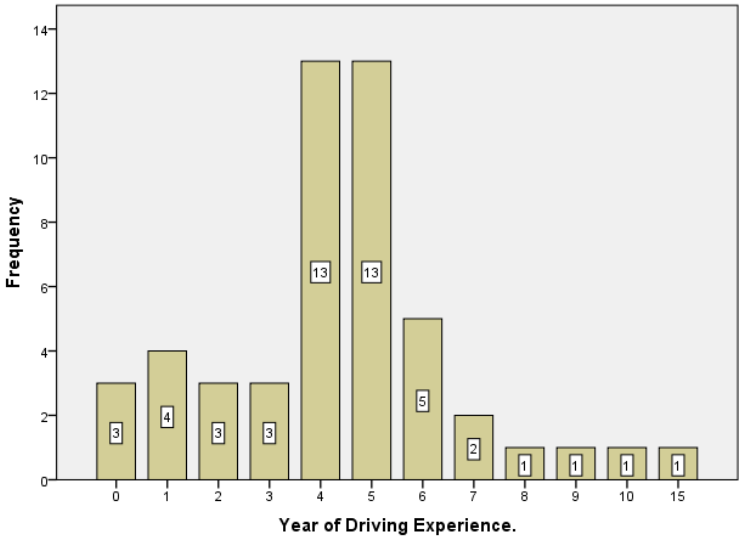

Figure 3: Bar Chart of Respondent Year Driving Experience

3.4 Distribution of Respondent Based on Medicinal Prescriptions

In this group, it is to know whether or not the respondents are on medicinal prescriptions. As a general knowledge that any drugs will affect human focus ability and this is known as major influence in reaction time especially when driving [6]. Table 5 below shows the frequencies of respondent who take medicinal prescriptions and who doesn't. Out of 50 respondents, 48 respondents which is 96.00 %, has not taken any medicinal prescriptions whereas 2 respondents which is 4.00 %, is on medicinal prescriptions.

Table 5: Frequencies of Respondents about Medicinal Prescriptions

On medicinal Prescriptions	Frequency	Percent	Cumulative Percent
No	48	96.0	96.0
Yes	2	4.0	100.0
Total	50	100.0	

3.5 Distribution of Respondent Based on Traumatic Experiences

In this group, the respondent was asked if whether or not, they have had an accident when driving. It is believed that this factor has had major influence in braking reaction time [7]. Table 6 below, shows the percentage of respondent who has been in an accident while driving before. Out of 50 respondents, 34 of them which is 68.00 %, never had been in an accident whereas 16 respondents which is 32.00 % have been at least once, involved in accidents.

Table 6: Frequencies of Respondent who has been in aa Traumatic Experiences

Respondent who has been in an accident	Frequency	Percent	Cumulative Percent
No	34	68.0	68.0

Yes	16	32.0	100.0
Total	50	100.0	

3.6 Evaluation of Brake Reaction Time (BRT) based on Gender

Figure 4 and Figure 5 shows the results the braking reaction time both in straight road and corner road respectively. Data shows that male respondent have much better brake reaction time than female both in conventional brake light and flashing brake light. For conventional brake light in straight road in Figure 4, the male has mean BRT of 0.947s while female mean BRT of 1.164 s. Both has improved in BRT when switched to flashing brake light which for male mean BRT is 0.636 s, improvement of 32.84 % and female mean BRT is 1s, improvement of 14.09 %. In Figure 5, the male mean BRT for conventional brake light in corner road is 0.811 s while female respondent has mean BRT of 0.835 s. When switched to flashing brake light, mean BRT for male is 0.617 s which is improvement of 23.92 % while female BRT has worsened 0.017 % to 0.852 s. The lag between the appearance of the stimulus and the start of muscle contraction is what causes the male-female difference. Males exhibit faster simple reaction time for both auditory and visual stimuli, which is explained by the fact that muscle contraction time is the same for males and females and motor responses in males are significantly stronger than females [8].

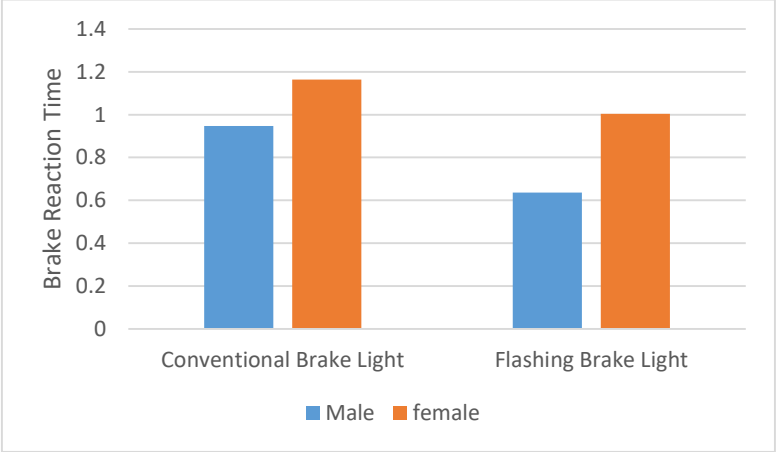

Figure 4: Brake Reaction Time vs Gender on Straight Road Chart

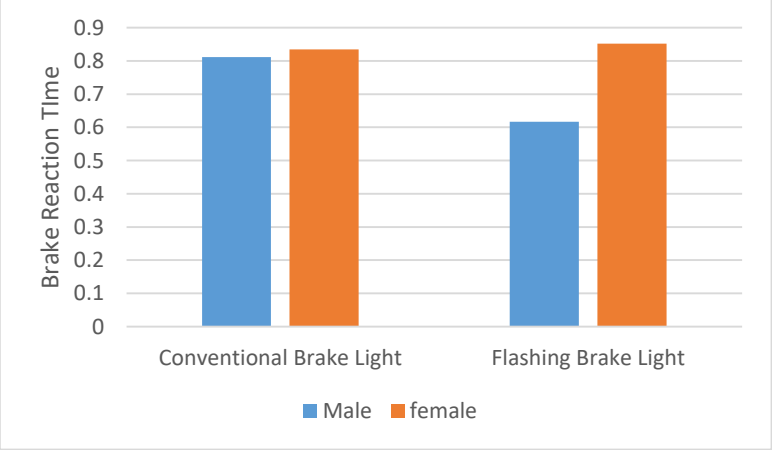

Figure 5: Brake Reaction Time vs Gender on Corner Road

3.7 Evaluation on Brake Reaction Time (BRT) based on Age

Figure 6 and Figure 7 shows the results of BRT based on age on straight road and corner road respectively. Data shows that mean BRT is slightly change in age for youth (20-24) but significant on adult (25-29) categories. For straight road in Figure 6, for youth respondent the mean BRT is 0.985 s and went faster of 20.71 % improvement to 0.781 s while for adult respondent, the mean BRT is 1.592 s and hugely improved to 71.36 % which is 0.456 s. For corner road in Figure 7, youth mean BRT for corner road is 0.807 s improved 12.27 % to 0.708 s., while the adult mean BRT is 1.023 s and also had huge improvement of 48.88 % to 0.523 s. This finding supports the theory that older adults may experience momentary lapses in attention or executive control [9], that lead to increased performance inconsistency. Our findings revealed that the fastest and slowest responses differed by age group.

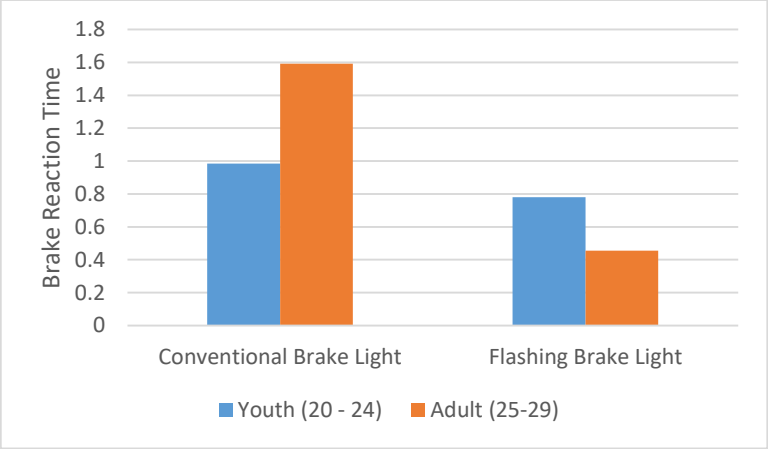

Figure 6: BRT vs Age on Straight Road Chart

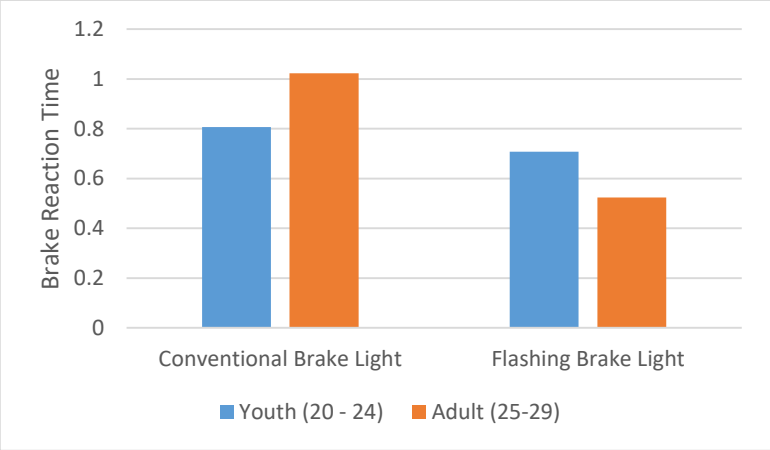

Figure 7: BRT vs Age on Corner Road Chart

3.8 Evaluation on Brake Reaction Time (BRT) based on Traumatic Experience

Figure 8 and Figure 9 below shows the BRT results based on traumatic experience both on straight and corner road. Data shows that traumatic experience have major influence in BRT where the results shown can be seen that respondents who had traumatic accident were react better to flashing brake light compared to conventional braking light. In Figure 8 for straight road, the mean BRT for respondent who have traumatic experience, are improved 47.02 %, from 1.159 s to 0.6146 s while the respondent that have not experienced a traumatic accident mean BRT is also slightly improved 13.18 % from 0.956s to 0.830 s.In Figure 9 for corner road, mean BRT for traumatic respondent is improved 21.67 % from 0.840 s to 0.658 s and mean BRT for the respondent that have not experienced a traumatic accident were slightly improved 11.73 % from 0.81 s to 0.715 s. People who experienced traumatic events are

likely to have better brake reaction time because they are likely to subconsciously be more aware of surrounding to avoid another accident from happening again [7].

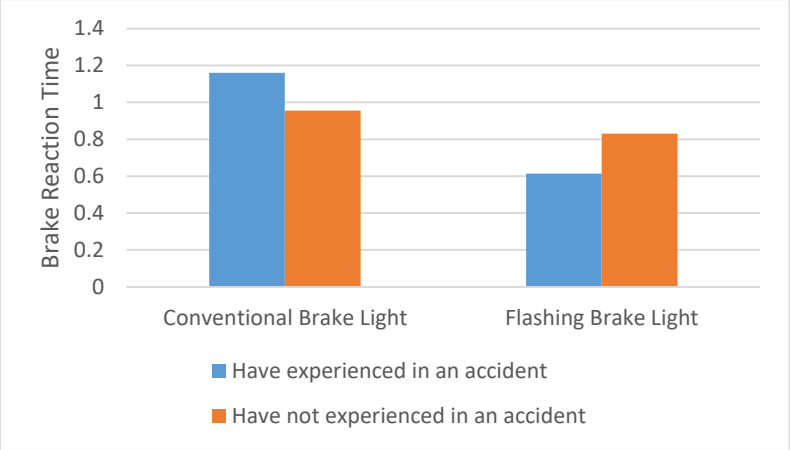

Figure 8: BRT vs Traumatic Experiences on Straight Road

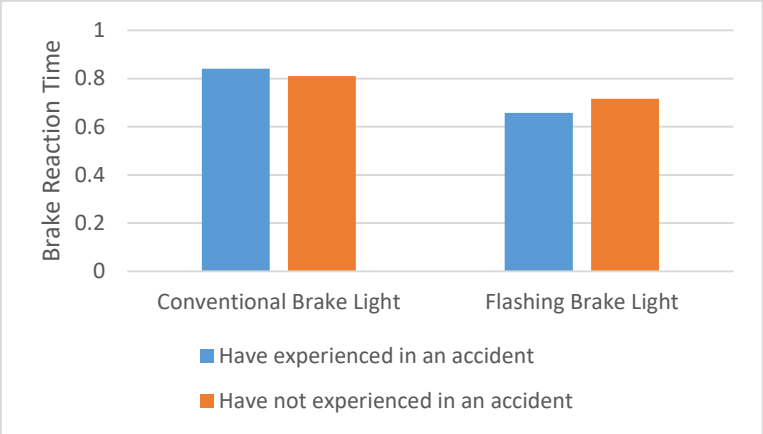

Figure 9: BRT vs Traumatic Experiences on Corner Road

3.9 Evaluation on Brake Reaction Time based on Driving Experiences

Figure 10 and Figure 1 below shows the graph for all age groups in straight and corner road. The data will be divided into several groups which will be 1 to 3 years, 4 to 6 years, 7 to 9 years, 10 to 12 years, 13 to 15 years and 0 year (no experience). For respondent who have no driving experience (0 years), the mean BRT for straight road is slightly improve 2.47 % from 1.216 s to 1.186 s and for corner road is worsen 30.87 % from 0.758 s to 0.992 s. For respondent that have 1 to 3 years of driving experiences, the mean BRT for both straight road and corner road is slightly improve. BRT straight road is improved 11.26 % from 0.586s to 0.520s. For corner road it is improved 5.08 % from 0.590 s to 0.560s. For respondent that have 4 to 6 years of driving experiences, the mean BRT for both straight road and corner road is slightly improve. BRT straight road is improved 22.07 % from 1.065 s to 0.830 s and for corner road, the BRT is improved 12.91 % from 0.852 s to 0.742 s. For respondent that have 7 to 9 years of driving experiences, the mean BRT for both straight road and corner road have major improvement. BRT straight road is improved 79.65 % from 1.543 s to 0.374 s and for corner road BRT it is improved 65.61 % from 1.236 s to 0.425 s. For respondent that have 10 to 12 years of driving experiences, the mean BRT for both straight road and corner road also have improvement. BRT straight road is improved 58.22 % from 0.687 s to 0.287 s and for corner road BRT it is improved from 56.15 % from 0.577 s to 0.253 s. For respondent that have 13 to 15 years of driving experience, the mean BRT for corner road had some improvement but not for straight road BRT. Straight road BRT worsen for

10.40 % from 0.423 s to 0.467 s. Corner Road BRT is had improvement 12.41 % from 0.54 s to 0.473 s. Based on analyze data, it presents that flashing brake light has improve the BRT of following vehicles.

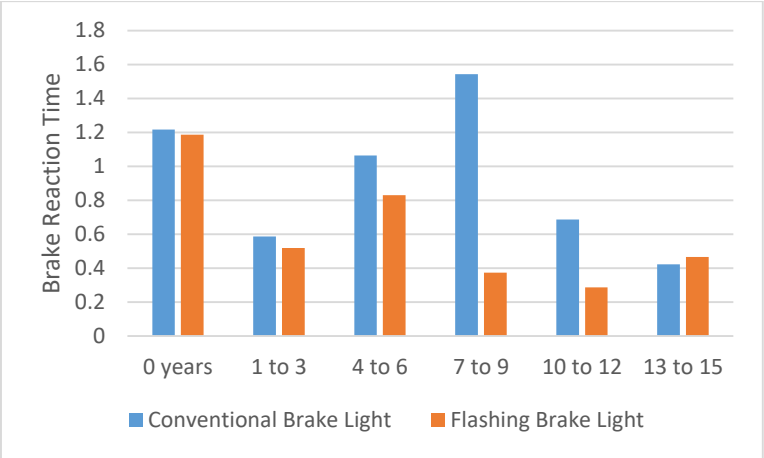

Figure 10: BRT vs Years of Driving Experience in Straight Road

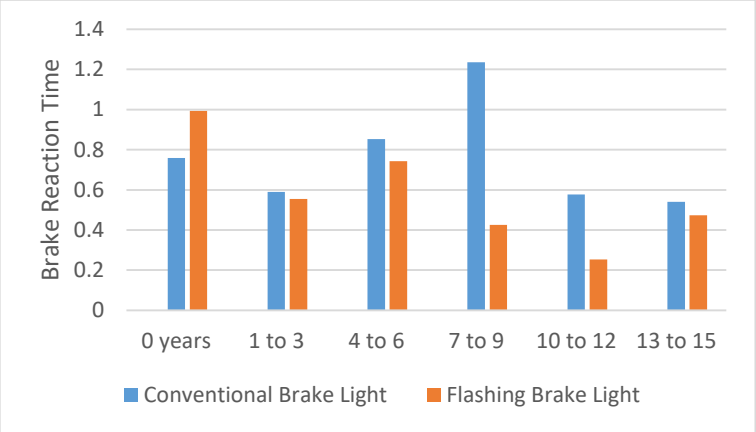

Figure 11: BRT vs Years of Driving Experience in Corner Road

3.10 Evaluation of Brake Reaction Time based on Medicinal Prescription

Figure 12 and Figure13 below shows the chart of the respondent's BRT based on medicinal prescriptions. In straight road that is represent in Figure 12, results show that for respondents that on prescription, the improvement is significant which is 38.91 % from 2.177s to 1.33s on straight road and for the respondents who does not on any medicinal prescription, the BRT on straight road is slightly improved 24.25 % from 0.973 s to 0.737 s. In corner road which was represented by Figure 13, results show that for respondents on prescription, the improvement is huge 66.05% which is from 1.738s to 0.59 s. and for the respondent who don't take prescription, it has improved 10.24 % from 0.781 s to 0.701 s. Result show that respondent that did not have any medicinal prescriptions have better BRT compared to respondent who have [6]. Although, results also shows that flashing brake light have reduced the BRT of respondent who took prescriptions by significant and that shows how effective the flashing brake light is.

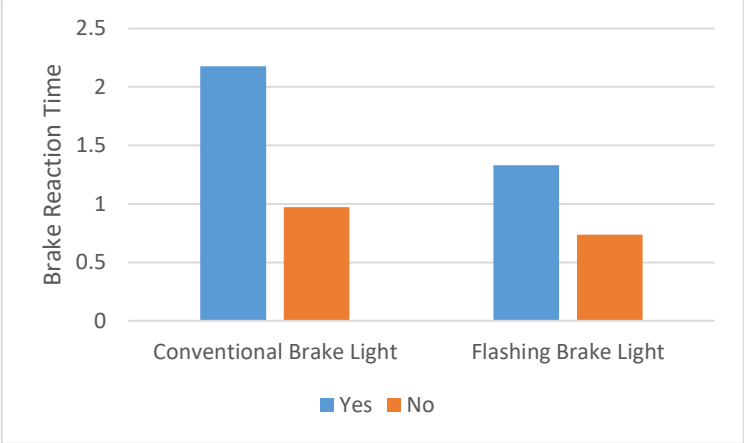

Figure 12: BRT vs Medicinal Prescription Intake on Straight Road

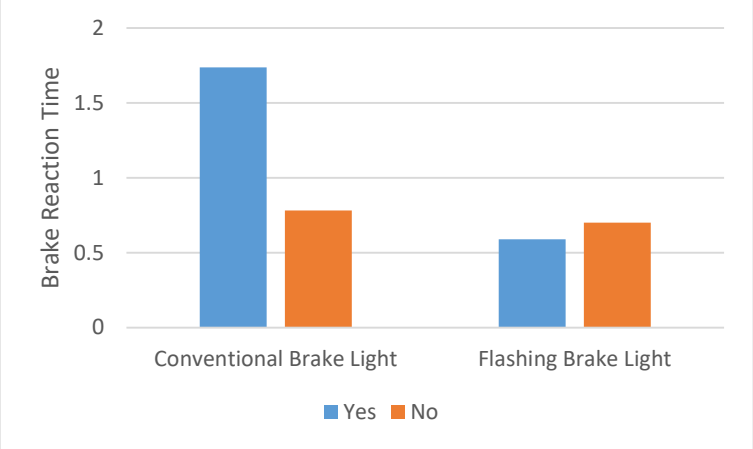

Figure 13: BRT vs Medicinal Prescription Intake on Corner Road

4. Conclusion

In conclusion, all of the results have discussed, and majority test has determined that flashing brake light does improve driver's reaction time. Some data shows that flashing light slightly worsened the reaction time but it is likely due to unknown outside factor that affect the respondents. Although, all the objective of the study has been achieved by the researcher which is to perform video simulation to evaluate the effectiveness of Flashing Brake Light on Rear Vehicle.

Acknowledgement

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