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Assessing Driver Distraction on Simulated Driving

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Abstract

Distraction experienced by the driver while driving is something that can reduce the level of performance, concentration, and attention of the driver. On the other hand, distraction makes driving activity less monotonous, a condition that can end up in sleepiness on wheel. This research was conducted to investigate further the outside distraction effect on drivers' performance, attention, and alertness. The performance level was measured through driver's response time on a simple random stimulus. Spare attentional capacity was quantified by the percentage of eye gaze shifting while driving. Driver alertness was monitored through subjective sleepiness level. Within subject design experiments were conducted in a simulator for ten participants, where they drove with and without distraction. Based on the results, response time and spare attentional capacity showed significantlydifferentresultsbetweendrivingwithandwithoutdistraction, respectively the tests resulted in p=.001 (t=4.518, df=9) and p=.000 (t=5.802, df=9). Driving with distraction were resulted in significantly slower response time and higher spare attentional capacity. However, the alertness level did not indicate a significant difference between driving with and without distraction.

Keywords: *Simulated Driving*

1. Introduction

Distraction experienced by the driver when driving is something that can reduce the level of performance, concentration, and attention of the driver. Based on data from the Polantas in 2013 figures stated that a total of 29.3% of the total accidents that occurred (100,106) were caused by drivers who were negligent or lacking in concentration. Generally, the distraction experienced by the driver is a distraction that occurs in the car such as playing mobile phones while driving, but there are also distractions from outside the car such as advertisements in the form of billboards, billboards, posters, or road side accidents which can also reduce performance and concentration. the driver and can cause traffic accidents (Shaw et al.,2018).

According to Article 1 number 24 of Law Number 22 Year 2009 concerning Road Traffic and Transportation ("LLAJ Law"), traffic accidents are an incident on an unexpected and unintentional road involving a vehicle with or without another road user resulting in a victim humanand/orpropertyloss.AndaccordingtotheBigIndonesianLanguageDictionary(KBBI), advertisementsarenewsormessagestoencourage,persuadethepublictobeinterestedinthe goods and services offered; Notification to the public of goods or services sold, installed in the mass media (such as newspaper sand magazines) or in public places.

Of all types of advertisements that exist, basically the purpose of advertising is to change o influence the attitude of the people who seethead, in this case is the attitude of the consumer. Based on the purpose of the ad, then there is one thing that needs to be considered so that advertising can be accepted as important information for consumers, namely the need for consumer attention. The first theory that explains about attention or attention emphasizes that each individual has attention capacity that can be processed with a limited amount. As is known, road side advertisements such as billboard shave

them a in target of all road users, both drivers of vehicles, passengers in vehicles, and pedestrians who pass through these roads. The time that is owned by vehicle users both driver and passenger is less because it is in a road segment and is only located at that location in passing.

In behavior see also known as spare intentional capacity (SAC) which makes the driver can do some other things while driving. Based on past research, it is known that in most driving situations, driver soften pay attention to objects around the driver's environment the percentage where the driver's attention is diverted by the surrounding environment varies between 20 to 50 percent (Crundall,2006).

This research is an experimental study with the help of simulations where the driver's performance in this study will be measured by several variables, namely the driver's response time to a stimulus given during driving, the percentage of KCV owned by the driver while driving, and the driver's alertness. According to Basner and Dinges (2011) response time is the length of a person's response to a visual or sound stimulus that appears in a random time interval, and according to KBBI, alertness is a noun (noun) state (thing) alert; pre paredness. The results of data processing in this study are objective so that the level of performance degradation experienced by the driver can be obtained due to the distraction outside the vehicle found in the environment around the driver.

2. Methods

The experimental design in this study focuses on driver performance when driving and there are distractions from the environment outside the vehicle. In this study, respondents will carry out driving simulation activities with urban road conditions. In each simulation, the environment around the rider is made to mimic the actual road conditions, and there are distractions from the outside of the vehicle namely roadside billboards and accidents that occur on the road side. This research was conducted in the space of a driving simulator Laboratory of Work System Engineering and Ergonomics at Diponegoro University. Simulator devices used include a driving simulator Logitech G27 with steering wheel fittings, pedal sets, Tran's mission levers, driver's seat, CPU, sound system, and three LCD TV screens. The software used in this research is car driving city, where this game is a simulation of driving using a car in conditions close to real conditions.

Controlled variables in this study are:The type of activity chosen in the simulation is free driving because on free driving all drivers and rive freely without any command that must be fulfilled; The selected simulation area is modern district and country road; The types of intensity that occur include the number of pedestrians, the number of other vehicles that suddenly change the lane, and the number of other road users; Research will be conducted in the morning with a time range between 07.30 - 11.00; Density from outside the accident that will appear before a stimulus is given; The age of respondents to be chosen as respondents ranged from18-25years; The trans mission system on the car will be regulated using automatic transmission; The physical environment around the simulation site will be designed so that there spondent is not disturbed while doing the simulation.

The independent variable in this study is the time the appearance of distractions from outside the vehicle which can be a road side billboard and road side accidents that can appear suddenly because it is part of the city car driving system used in the study. While the dependent variable in this study is the driver's response time; percentage of spare attentional capacity (SAC); Driver's alert level. The SAC were monitored via the time percentage of eye gaze shifting while driving, either saccade, smooth pursuit, vergence, vestinulator, or fixation (Nurcahya, 2015). The alertness level was collected using Karolinska Sleepiness Scale (KSS) in Indonesian language, as practiced by Mahachandra et al. (2011).

Data collection was carried out with the help of recording videos of two cameras and research questionnaires distributed at the beginning and end of the study, including an informed consent. The simulation order were arranged in reverse counterbalance to minimize bias of an within subject experiment.

3. Results

3.1. Comparison of Response Time

In each experiment, four repetitions of the stimulus were carried out to get four response time values and then to find the average response time. The value of response time is measured through the help of video recording scarried out throughout the experiment. The normality test on both experimental data was carried out with the help of SPSS software using the saphiro-wilk method with a 95% confidence level. It was found that all data were normally distributed because the p value > 0.05 was 0.726 for experimental data with distractions and 0.102 for experimental data without distraction. After the normality test is done, a homogeneity test is needed to find out that the data is independent and homogeneous, the homogeneity test is carried out with a confidence level of 95% and looks at the p-value of the two data. The homogeneity test results state that both data are homogeneous because the p-value obtained is0.037 > 0.05.

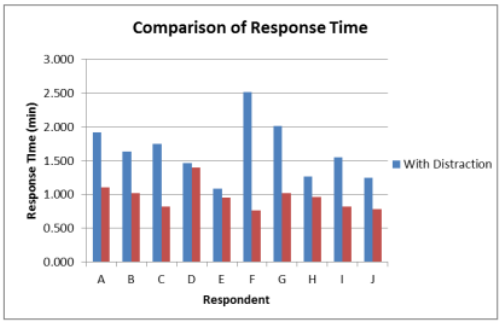

Figure 1 Comparison of Response Time

Pair wise comparison tests were conducted to compare whether there was a difference between the averages in the response time of the experimental data and the distraction and response time data experiment without distraction. The comparison test is carried out with a confidence level of 95% and a p-value of 0.002 is entered into the critical area because of 0.002 <0.05. From the p-value obtained, it can be concluded that there are significant differences in the average response time during experiments with distractions and experiments without distraction, so it can be concluded that the presence of distractions outside the vehicle during driving can affect driver performance as measured by average response time driver.

3.2. Comparison of Spare Attentional Capacity

In each experiment, the time there spondent shifted his eyes was measured with the help of a recording camera and eye tracker that was directed to the respondent's eyes while driving. The normality test on both experimental data was carried out with the help of SPSS software using the saphiro-wilk method with a 95% confidence level that found that the percentage data of SAC experiments with distractions were normally distributed because the p value>0.05 was 0.696 and the SAC percentage data was experimental without distraction obtained normal distribution because the p-value < 0.05 is 0.079. After the normality test is done, a homogeneity test is needed to find out that the data is independent and homogeneous, the homogeneity test is carried out with a confidence level of 95% and looks at the p-value of the two data. The homogeneity test results state that the data is homogeneous because the value of p-value obtained is 0.878 > 0.05.

Pair wise comparison test is conducted to compare whether there is a difference between the percentage of spare attentional capacity in the experiment with distraction and the percentage of spare attentional capacity data in the experiment without distraction. The comparison test was carried out with a confidence level of 95% and a p-value of 0,000 was generated and was statedtobeinacriticalareabecauseof0,000<0.05.From there sults of the p-value obtained, it can be concluded that there are significant differences in the percentage of sparest tensional capacity between experiments with distractions and experiments without distraction so it can be concluded that the presence of distractions outside the vehicle while driving an affect driver performance as measured by the percentage of spare attentional capacity.

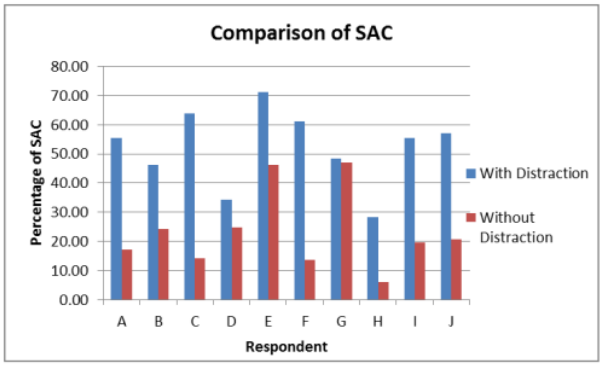

Figure 2 Percentage of Spare Attentional Capacity

3.3. Comparison of Alertness Level

Measuring the level of vigilance is done by measuring the level of sleepiness of respondents in each experiment, carried out twice the measurement of sleepiness with the help of the SSC questionnaire filled in by the respondents at the beginning and end of the experiment, this is done together increase and decrease in sleepiness sleep level gradient of each respondent. The normality test on both experimental data was carried out with the help of SPSS software using the saphiro-wilk method with a confidence level of 95%. Obtained not normally distributed because the p-value < 0.05 is 0.022. After the normality test is done, a homogeneity test is needed to find out that the data is independent and homogeneous, the homogeneity test is carried out with a confidence level of 95% and looks at the p-value of the two data. The homogeneity test results state that both data are homogeneous because the value of p-value obtained is 0.088> 0.05.

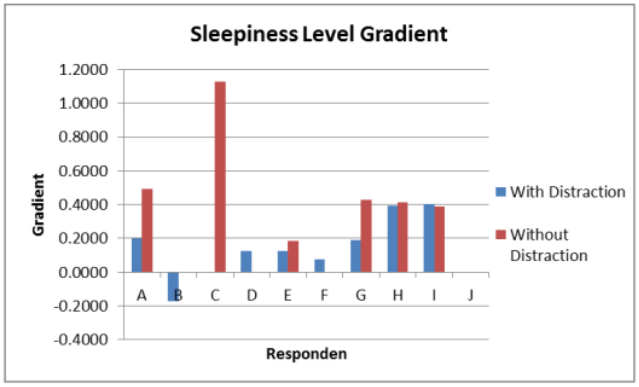

Figure 3 Sleepiness Level gradient

The paired compares on mark test is done to compare whether there is a difference between the level of alertness in the experiment with the distraction and the level of alertness in the experiment without distraction. The comparison signtest is carriedout with a confidence level of 95% and a p-value of 0,170 is produced so that the data is not included in the critical area because 0,170 > 0,05. From the p-value obtained, it can be concluded that there is no significant difference in the level of alertness in experiments with distractions and experiments without distraction, so it can be concluded that the presence of distractions outside the vehicle during driving cannot affect the driver's performance as measured by the driver's alertness.

4. Discussion

Based on the test results on all data collected from experiments with distractions and experiments without distraction, it can be seen that two of the three research variables measured support the research hypothesis, namely the influence of outside vehicle distraction on driver performance. The two variables that support the research hypothesis are the response time variable and the percentage of spare attentional capacity. With this, it can be said that the existence of outside distractions in the form of road side billboards and roadside accidents can interfere with driver performance, so the existence of regulations and implementation of government regulations regarding the size and distance between road side billboards must be reviewed in order to minimize the effect of vehicle distraction towards driver performance. In addition, the percentage of visual attentional capacity can also be licensed by age aspect, as concluded by Zahabiet al. (2017) that older drivers can drive more focus and pay more attention to the main tasks in driving compared to young drivers.

The existence of a roadside billboard has been regulated in the regional regulation of Semarang number 4 of 2015, written in there gulation that the placement distance between billboards with a size of 50 m is closest to 150 m for urban areas, and the placement distance between billboards or shop sign is atleast 5m. The distance between billboard sin city car driving of tware is 170m with a billboard size of 50m2, so it is known that the distance between the advertisements in the simulation is greater than that of the Semarang regulation. It is known that the distance between the advertisements is greater than the distance written by the local regulation, the driver's performance performing the simulation is still affected by the existence of the billboard, so it can be suggested that the design of the distance between the adverts needs to been larged so as not to affect the driver's performance.

Driver performance can also be influenced by various other distractions besides distractions outside the vehicle. As stated by Prat et al. (2017) that most drivers say there are other jobs besides driving such as using mobile phones while driving is a distraction that has the most influence on driver performance and is very risky to cause accidents. In addition, also said by Brodsky (2018)that there are also distractions from the vehicle while driving, such as listening to music while driving because it can position the driver in dangerous conditions.

Distraction that occurs in the driver does not only come from outside the vehicle such as roadside billboards or from inside the vehicle such as listening to music while driving. Distraction on the driver can also come from within the driver itself, such as the quality of the driver's sleep, the type of driver's education, and so on. As said by Budiawan et al. (2017) that sleep quality factors can affect the alertness of drivers before starting work. In addition, said Rezalti (2016) that the type of education in the form of a driving education video is the most effective education in improving driving performance and skills.

5. Conclusion

Based on the results of the research conducted, it can be concluded that: The existence of outside distractions in the form of roadside billboards and roadside accidents can affect driver performance as measured by the average response time of the driver; The percentage of spare attentional capacity when driving is affected by the presence of distractions outside the vehicle in the form of roadside billboards and roadside accidents; The existence of outside vehicle distraction does not affect the driver's performance as measured by the driver's alertness.

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Appendix

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