Does Driver-Passenger Conversation Affect Safety on The Road?

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Abstract

Distraction to driving activity can arise from inside or outside the vehicle. Passenger presence is believed to be one of the in-vehicle distractions. However, the existence of a passenger also crucial for drivers to minimize the monotony ambiance. In this study, the conversation between the passenger and driver will be the focus of discussion in determining the distraction phenomenon. This study uncovers the effect on the conversation to the driver's performance through laboratory simulation experiments. Three types of conditions were studied, i.e., driving alone with no passenger, driving with a passive passenger, and driving with an actively speaking passenger. Driver's alertness and performance while driving was monitored as the distraction effect on transportation safety. The alertness was indicated by the level of sleepiness obtained from ratio of α/β indicator using electroencephalograph measurement. The performance was monitored from accident frequency through the crash and near-crash indicator along the driving period. As expected, results showed that driving alone experienced the highest level of sleepiness than others. Surprisingly, the driving activity with an actively speaking passenger brought the highest number of accidents than others.

Keywords
Driver, passenger, distraction, safety and transportation.

1. Introduction
Distraction can be described as anything that redirects the driver's attention to the normative characteristics. Distraction may reduce the performance and concentration of the driver. According to Carney et al. (2018), 59% of accidents are related to distraction affecting the driver. Distraction usually occurs outside the vehicle, such as billboards, collisions, or other occurrences that attract particular attention from the driver, lower his/her performance and attention (Mahachandra et al., 2020). Nevertheless, distraction can also come from inside the car. Some of the significant in-vehicle distractions are the use of smartphones and the existence of passengers inside the vehicle (Carney et al., 2018). Passenger presence may reduce the driver's performance and the driver's concentration, thereby increasing the risk of traffic accidents. Driving with passengers increases the risk of collision of vehicles by 96% (Rosenbloom and Perlman, 2016).

The distraction caused by passengers' presence can be considered based on the behavioral factor (presence or absence of passengers), gender, and age. As far as behavioral factors are concerned, teenage drivers are likely to be involved in traffic violations while driving alone than when driving with passengers (Rosenbloom and Perlman, 2016). It is similar to the studies conducted by (Simons-Morton et al., 2005), which claimed that the teenage driver is likely to travel at a higher speed and take more risk while driving alone. Besides, some research observed teen driver behavior while driving with an adult passenger. Driving with adults is 67% less likely to be involved in an accident than driving with friends, which has an 18% chance (Rosenbloom and Perlman, 2016). Driving with friends increases the risk-taking conduct of a teenage driver relative to driving alone. The actions and attitude of the passenger often affect the performance of the driver. When a passenger communicates positively and at the same time, being in a good mood, the driver appears to get faster (Rhodes et al., 2015).

Considering the gender issue, when being with a male passenger, the male driver prefers to travel at a higher speed with 21.7% greater risk-taking compared to a 5.5% probability of being with a female passenger. On the other hand, a female is expected to drive at a slower pace despite being 15.5% at the same gender driving risk compared to 12% at the same time as a male passenger. This study suggests that there is a higher chance of driving with the same gender of passengers than driving with the opposite (Simons-Morton et al., 2005).

Previous research on passenger interference's impact on driver performance has yet to show a connection between driver performance and the presence or absence of passengers. Observation of the driver state without a passenger requires the level of output in an undistracted climate. In the meantime, this study will examine the effect of passengers involves the impact on the efficiency of the driver with the presence of a passenger, of which the experiment would be divided into two sections: passive passenger and actively engaged passenger. Passive passenger is restricted to passengers who do not communicate with the driver during the entire experiment. In contrast, the active passenger is described as someone who is actively engaged in conversation with the driver during the observation period. Distraction will be monitored as the driver's alertness and performance level. Alertness will be measured through electroencephalograph apparatus, while the performance level will be monitored via the frequency of crash and near crash along the driving period. In the end, the driver-passenger optimum performance level will be concluded.

2. Method

2.1. Study Participants

This study concentrated on the safety aspect of driving under the influence of passenger presence. The safety issue was monitored through the driver's alertness and performance. Participants consisted of 10 males, aged between 18 to 25 years, chosen randomly from students in our departments. This age group is thought to lead to many traffic collisions, based on (NHTSA, 2009). All of the participants have a minimum of one-year car driving experience routinely. Before the study, each participant filled in informed consent, describing their activity and rights. Participants have entered a simulation in which they can select which route they should take. The scenario in which the passenger was involved was simulated as if it were a real-life situation.

2.2. Alertness Level

As cognitive neurosciences have indicated, alertness is the ability to remain intact over a given period (Oken et al., 2006) or can also be described as the ability to recognize unforeseeable events. The electroencephalogram (EEG) alertness was observed as it was the most accurate measurement of the human physiological system (Moorcroft, 2005; Craig et al., 2012).

Two electrodes of Emotiv EPOC+ EEG observed the drivers' alertness level along with the driving activity. The standard 10-20 system was applied in attaching electrodes to frontal lobes (F3 and F4), where human alertness can be easily detected, as stated by Burgess et al. (2001). Each of those electrodes was referenced and grounded to the ear lobe. The sampling frequency applied was 128 Hz. The data bandwidth was set on 0.16-43 Hz, while the digital filter was arranged between 50-60 Hz.

EEG data collection from the two electrodes were combined into a single value. Raw data were obtained from the EEG record and evaluated using Matlab software. Data analysis was performed the sequence of noise and artifact filtering, Fast Fourier Transform (FFT) processing, and finally calculating the Power Spectral Density (PSD) on alpha (8-13 Hz) and beta (13-30 Hz) waves. Evaluation of the α/β wave ratio was then performed for every 10 minutes to configure the rate of changes during the duration of driving.

2.3. Performance Level

Performance is the result of accomplishing a task or function for a specific purpose (Rivai, 2004) or the effort that a person has made to perform a task. The driver performance in this study was monitored using the Crashes and Near Crashes (CNC) measurement (Dingus et al., 2006). Crashes were due to physical contact with the target during the impact, regardless of the speed of the car, whereas the near crash was close to the crash, but without any physical contact. CNC can be used to achieve an output rating by measuring the number of crashes and near crashes. This performance level was determined from the overall crash, and the near crash was occurring over the entire course of the experiment.

2.4. Experimental Design

Laboratory simulation and experiment were performed to examine the impact of passengers' presence and their manner of contact on the alertness and efficiency of drivers. According to Syaefudin (2005), simulation is characterized as replicating or representing how the system behaves in a given situation. Therefore, it can be concluded that a simulation is a model containing a variable that can illustrate a real-life scenario. Jaedun (2011) informed that the experimental analysis was purposefully carried out by researchers by applying a particular technique to the topic to which the effect will be observed and calculated accordingly. Simulation is carried out in this research due to risk in the collection of real traffic data. The simulation uses a program called City Car Driving. It should be done so that the participant will have the same experience as driving in real life.

This study was performed using a counterbalance arrangement to minimize any bias caused by the order of experiment. The first part of the study was undertaken with the driver alone (Study 1), and the second part was conducted with one driver and one passenger. In the second part of the report, passengers were split into two categories: passive passenger (Study 2A) and actively speaking passenger (Study 2B).

The experiments started since the participants arrived at the laboratory, sited in the Department of Industrial Engineering, Diponegoro University. The first stage was planning, which took 10 minutes to complete. During the planning process, participants obtained informed consent and briefing on the collection of data. The next stage was the collection of data, which took 60 minutes to complete. At this point, the participant went through the driving simulator using one of the three scenarios described above. CNC data was collected from a record created by city car software, combined with a manual data collection. EEG data has been registered for the entire time of driving.

3. Results and Discussions

Laboratory experiments were run out for several days in the driving simulator. As mentioned, each simulation was performed for one hour in a free driving mode, which means that driver can choose wherever the route he wants. Also, road congestion was set at 50% in the program to mimic the actual traffic situation here in Semarang, Indonesia. The display of the simulation can be seen in Figure 1.

Figure 1: Simulation display in this study

3.1. Alertness Level Through EEG

As mentioned before, brainwave data from frontal lobes F3 and F4 were calculated together. After removing the noise and artifact, data were transformed from time-based into frequency-based data via the Fast Fourier Transform formula. Later on, the Power Spectral Density was calculated for each alpha and beta wave at the frequency of 8-30 Hz (Yeo, 2009), with a 10-min window of observation. Finally, the ratio of α/β was configured as displayed in Figure 2 for an example of Study 1, when a driver drives alone without a passenger. The ratio was then compared for each experiment, i.e., driving alone, driving with a passive passenger, and driving with an actively speaking passenger, as graphed in Figure 3.

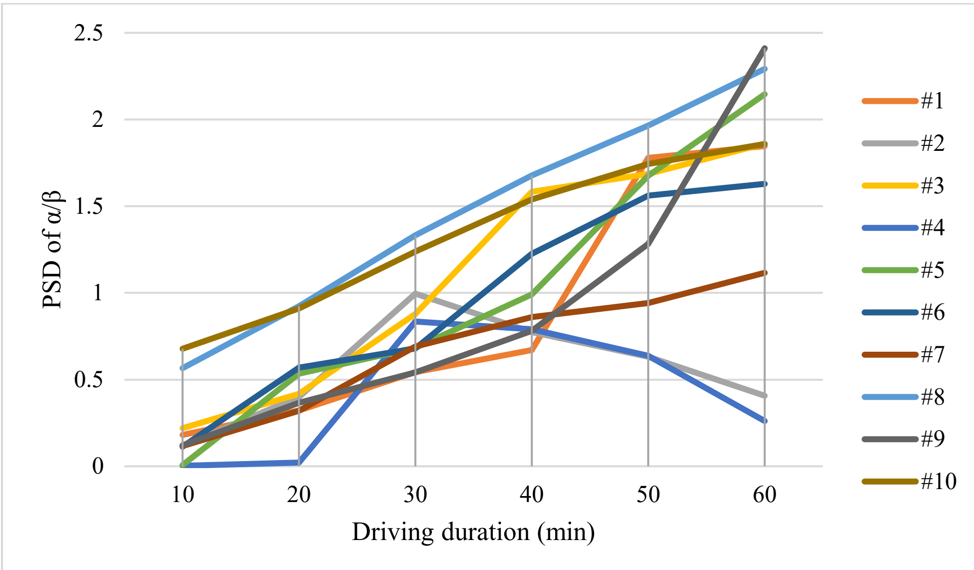

Figure 2. The alertness changes during the driving in Study 1 (driving alone)

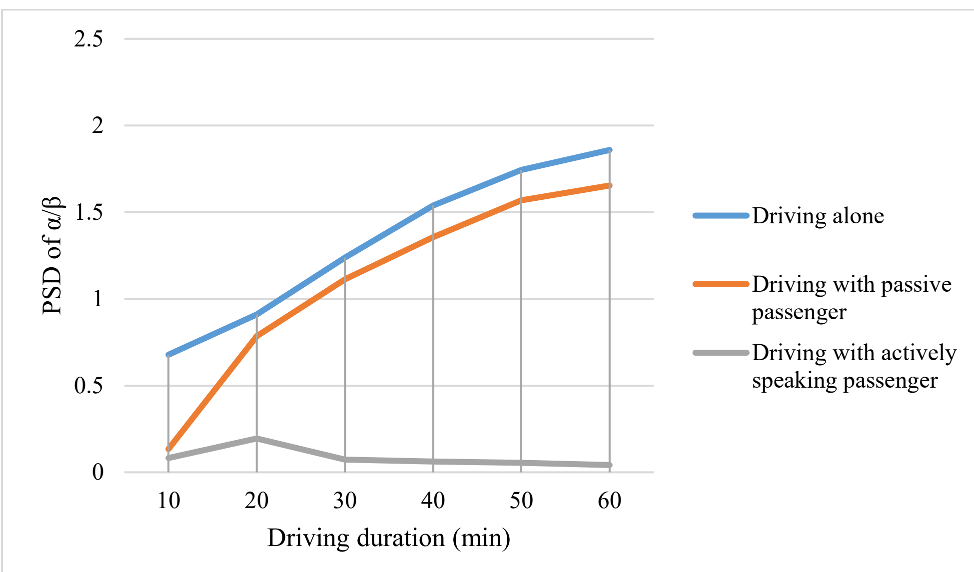

Figure 3. An example of the alertness changes for each type of experiment for participant #10

Visually, there were increment of PSD of α/β ratio along the driving duration. The higher the value of the ratio obtained, the more tendency of the participant to get sleepier. It is because the decline in brain activity is characterized by a shift in the wave frequency from β to α (Rivera, 2013). Of the three experiments conducted, the value of α/β ratio was respectively Study 1 with a mean wave α/β of 5.93, Study 2A with a mean wave α/β of 4.44, and Study 2B with a mean of 0.64 from the highest shown in Figure 4. It shows that the participants while in Study 1 tended to experience higher levels of sleepiness than while driving in Study 2A and Study 2B. In contrast, it means that participants in Study 2B had a higher level of vigilance and more awake than participants in Study 1 and Study 2A. These results were calculated using pairwise comparison tests, which resulted in Study 2B showing a significant difference to Study 1 and Study 2A, as shown in Table 1. When Study 1 compared with Study 2A, there was no significant difference found. Based on the comparison test results, it can be concluded that the driver tends to be sleepier if driving alone than accompanied by a passenger. Furthermore, driving in an ambiance where any passenger was actively speaking was proven to maintain the level of drivers' alertness, rather than drivers with passive passengers or driving with no passenger.

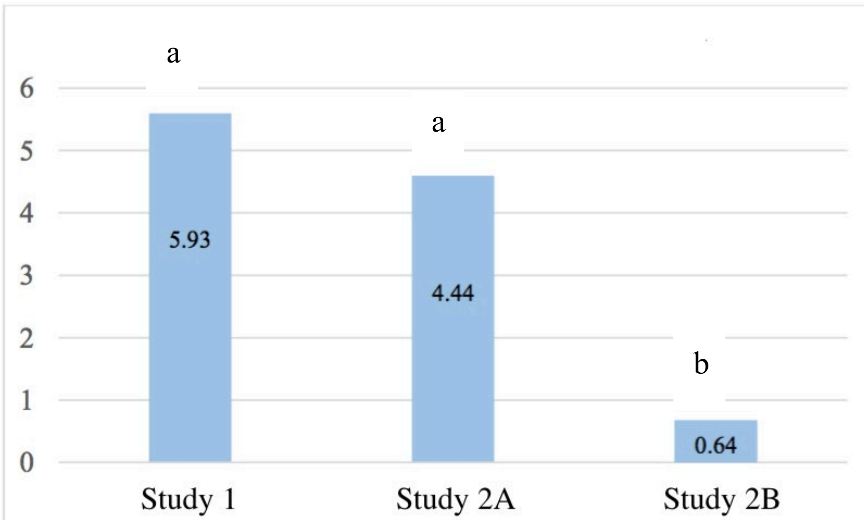

Figure 4. Mean comparison of power spectral density of α/β ratio

Table 1. Pairwise comparison test results of alertness level

	Study 1 vs Study 2A	**Study 1 vs Study 2B**	**Study 2A vs Study 2B**
t	1.424	8.778*	5.454*
p-value	0.188	0.000	0.000
df	9	9	9

* significantly differ at α 0.05

Drivers without passengers experience the highest level of drowsiness influenced by the monotony experienced by drivers during simulations (Schmidt, 2019). That is because the simulation is carried out quite a long time, i.e., for one hour and allows the driver to take the same route several times. Furthermore, in the EEG, the α/β wave ratio shows a relationship that is in line with the level of drowsiness, namely the shift of the β wave to the α wave. Drivers without passengers have a high α/β ratio, meaning that the drowsiness level is felt.

Moreover, drivers without passengers do not experience visual, physical, or cognitive distractions that can keep drivers from drowsiness (Dehzangi, 2018). The distraction was felt by the driver, who was accompanied by a passenger who asked to speak. The driver gets visual distraction because sometimes he talks to the passenger and also feels cognitive distraction because the driver performs a cognitive process when listening to and responding to passengers. Talking with passengers will trigger the brain to store, process, and analyze information of the conversation. Brain activity is identical to β waves, where these waves indicate the driver is in a state of alert and concentration. So, if the driver talks continuously with the passenger during the simulation, the driver can maintain β waves in the brain. In other words, the change in the β wave to the α wave does not occur or even though the change does not occur too significantly, meaning that the driver with the passenger can be more alert and awake from sleepiness.

3.2. Performance Level Through CNC

For this analysis, the driving performance was derived from the amount of crash and near-crash (CNC) incidents that occurred during the simulation (Dingus et al., 2006). CNC data was obtained using a dash camera mounted at the back of the driver facing the computer simulator.

Table 2. Pairwise comparison test results of performance level

	Study 1 vs Study 2A		**Study 1 vs Study 2B**		**Study 2A vs Study 2B**	
	Crash	**Near-Crash**	**Crash**	**Near-Crash**	**Crash**	**Near-Crash**
t	-0.688	-1.168	-0.328*	-3.612*	-2.121	-0.886
p-value	0.509	0.273	0.010	0.006	0.063	0.399
df	9	9	9	9	9	9

* significantly differ at α 0.05

For each study, the CNC value of each participant varied, as altered. For example, participant C witnessed four crashes in Study 1, five crashes in Study 2A, and seven crashes in Study 2B. More paired comparisons were made to clarify the effect of passenger involvement on driving performance in each study. The combined analysis found that there was no substantial difference between the CNC in Study 1 and Study 2A, as well as Study 2A and Study 2B. The finding revealed the reverse when comparing Study 1 and Study 2B, where there was a significant difference between the two experiments. It indicates that the presence of active passengers may increase the number of accidents and the near-accident, relative to the situation in which the driver is alone, and the passenger is passive. The result is relevant to McEvoy et al. (2007) study, which claimed that a passenger who is actively engaging with the driver could increase the risk of collision compared to a passive passenger.

When driving without a passenger, the mean crash value was 5.7, compared to 7.3 while driving with an active-speaking passenger. Meanwhile, the mean near-crash value was 3.7 when driving alone and 5.6 when driving with an active-speaking passenger. There was a 16% rise in the crash and a 19% increase in the near crash when an actively speaking passenger accompanied the driver. It is in line with the Simmons & Ouimet (2017) study, which suggests that CNC value would be higher when accompanied by passengers compared to driving alone.

Furthermore, when the driver was driving alone, there seems to be less crash and near crash than driving with any passenger. It was because the driver would only focus on the road and, thus, the likelihood of a crash and a near-crash accident. The lone driver appears to be risk-averse to the road situation (Bingham et al., 2016), thus the low likelihood of a collision and near a collision. On the other side, the active passenger showed that the driver would encounter a higher crash and near-crash risk. Factors that contribute to this are the presence of noise, loss of attention, and cognitive load. Distraction happened as the passenger attempted to engage in a conversation. This diversion led to a lack of concentration, as the driver frequently diverted attention away from the road to respond to a passenger conversation. As a result, a higher crash and a smaller crash occurred. Besides, Bingham et al. (2016) reported that, when accompanied by actively involved passengers, the driver is likely to be at higher risk. It means that active passengers' involvement will possibly increase the risk of a crash and a near-crash.

3.3. Problem Solution

Based on the scenario, the problem solutions were designed to fix the problem statement and the possibility of crash and near crash. Any preventive measures can be placed in place to avoid sleepiness while the driver is alone. When the driver has exhaustion that leads to sleepiness, it is best to pull over and take a quick break. Short breaks should be used for moderate stretching and increased water consumption to minimize sleepiness and exhaustion (Schmidt et al., 2019). Additionally, the driver may listen to music to minimize sleepiness by using a radio or mobile phone while driving. Listening to music will lead to a feeling of relaxation and increasing the level of concentration. The driver can also avoid fatigue by adding essential aromatherapy in the vehicle, such as peppermint, as experimented by Mahachandra et al. (2015), or ylang-ylang, as researched by Moss et al. (2008). in-vehicle aromatherapy can increase the β-wave in the brain to promote alertness. Last but not least, sleepy drivers can also take fast, reasonably inexpensive, quick countermeasures such as coffee, as Mahachandra et al. (2017) suggested.

According to the findings of this study, it is possible to minimize the likelihood of a car crash by reducing the interaction between the driver and the passenger. The study found that a conversation with a passenger helps keep the driver alert, raising the likelihood of a crash. That being said, it is not advised to have a continuous conversation between the driver and the passenger while driving to reduce the risk. The topic of the conversation should be kept light and not involve any serious matter. The discussion involved may lead to a lack of concentration on the road. If passengers can comply with this, the distraction effect can be reduced. Therefore, when interference is held minimal, the driver's attention can be concentrated solely on the road. Hence, the lower risk of the vehicle collision.

This research also found a higher level of sleepiness when driving alone than when accompanied by a passenger. On the other side, when the passenger was actively engaged in a conversation with the driver, the sleepiness was minimized while the likelihood of a car collision was at the same time. The optimum condition is evaluated based on the assessment and the problem-solution described above. The ideal condition is then extended to the driver with the passenger, but with a minimum of contact and mild conversation. Under this situation, the driver might remain alert and encourage a lower risk of the vehicle accident.

4. Conclusion

The presence of actively speaking passengers could affect the driver's level of alertness, suggested by the rate of change in the α/β ratio of the drivers' brainwave, monitored by an electroencephalograph (EEG). The lone driver had a higher significance compared to the active passenger driver ($t = 8{,}778$, $df = 9$, p-value = 0.000). In comparison, the passive passenger driver was of higher importance relative to the active passenger driver ($t = 5.454$, $df = 9$, p-value = 0.000). It means that driving with active passengers is significantly lower the level of sleepiness of the driver.

The involvement of actively speaking passengers has affected driving efficiency as tested in the crash and near-crash (CNC) indicator. Driver with active passenger had higher crash significance ($t = -0.328$, $df = 9$, p-value = 0.010) and near-crash significance ($t = -3.612$, $df = 9$, p-value = 0.006) than when the driver was alone. There was a 16% rise in the crash and a 19% increase in the near crash when an actively speaking passenger accompanied the driver. It is inferred that active passengers' presence may lead to a higher risk of vehicle collision.

From the study, it can be concluded that the desired behavior is to drive with the passenger, but with a minimum contact and a mild conversation. In this case, the driver can remain alert and encourage a lower risk of a vehicle accident.

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6. References

Bingham, R., Simmon - Morton, B., Pradhan, A., Li, K., Almani, F., Falk, E., . . . Albert, P. (2016). Peer passenger norms and pressure: Experimental effects. *Transportation Research,* 41, 124-137.

Budiawan W, Prastawa H, Kusumaningsari A, Sari D. (2016). Pengaruh Monoton, Kualitas Tidur, Psikofisiologi, Distraksi, dan Kelelahan Kerja Terhadap Tingkat Kewaspadaan. *J@ti Undip : Jurnal Teknik Industri,* 11(1), 37-44.

Burgess, P., Quayle, A., Frith C. D. (2001). Brain regions involved in prospective memory as determined by positron emission tomography. *Neuropsychologia*, 39, 545-555.

Carney C, Harland KK, McGehee DV Examining teen driver crashes and the prevalence of distraction: Recent trends, 2007–2015 2018 *Journal of Safety Research* 64 21–7.

Craig, A., Tran, Y., Wijesuriya, N., Nguyen, H. (2012). Regional brain wave activity changes associated with fatigue. *Psychophysiology*, 49, 574-582.

Dehzangi, O., Rajendra, V., Taherisadr, M. (2018). Wearable driver distraction identification on-the-road via continuous decomposition of galvanic skin responses. *Sensors*, 18, 503.

Dingus TA, Klauer SG, Neale VL, Petersen A, Lee SE, Sudweeks J, et al. The 100-Car Naturalistic Driving Study: Phase II - Results of the 100-Car Field Experiment. PsycEXTRA Dataset 2006 *American Psychological Association (APA).*

Jaedun A Metodologi Penelitian Eksperimen, Pelatihan, Penulisan Artikel Ilmiah 2011 *LPMP Propinsi Daerah Istimewa Yogyakarta*.

Kaida, K., Takahashi, M., Akerstedt, T., Nakata, A., Otsuka, Y., Haratami, T., & Fukusawa, K. (2006). Validation of the Karolinska sleepiness scale against performance. *Clinical Neurophysiology, 117*, 1574-1581.

Mahachandra M, Aji TW, Prastawa H, Suryoputro MR Assessing driver distraction on simulated driving 2020 *Int J Adv Sci Technol* 29(3) 2714-20.

Mahachandra M, Munzayanah S, Yassierli. The efficacy of one-time and intermittent intake of coffee as a countermeasure to sleepiness on partially sleep-deprived drivers. Int J Technol 2017, 8(2), 300-310.

Mahachandra M, Yassierli, Garnaby ED. The Effectiveness of In-vehicle Peppermint Fragrance to Maintain Car Driver's Alertness. Procedia Manuf 2015, 4, 471-477.

Mahachandra, M., Sutalaksana, K., & Suryadi, K. (2011). Sleepiness pattern of indonesian professional driver based on subjective scale and eye closure activity. *International Journal of Basic & Applied Sciences, 11*, 87-96.

Matthews RW, Kontou TG, Naweed A, Sargent C, Roach GD Driving when distracted and sleepy: The effect of phone and passenger conversations on driving performance 2018 *Chronobiology International* 35(6) 750–3.

McEVoy, S., Stevenson, M., & Woodward, M. (2007). The contribution of passengers versus mobile phone use to motor vehicle crashes resulting in hospital attendance by the driver. *Accid Anal Prev, 39*, 1170-76.

Moorcroft W H (2005). Understanding Sleep and Dreaming. New York: Springer USA.

Moss, M., Hevitt, S., & Moss, L. (2008). Modulation of cognitive performance and mood by aromas of pepermint and ylang-ylang. *International Journal of Neuroscience*, 118, 59-77.

NHTSA Traffic Safety Facts 2009 *National Highway Traffic Safety Administration*.

Oken B, Zajdel D, Kishiyama S, Flegal K, Dehen C, Haas M et al. (2006). Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and quality of life. *Alternative Therapies in Health and Medicine,* 12, 40-47.

Rhodes N, Pivik K, Sutton M Risky driving among young male drivers: The effects of mood and passengers 2015 *Transportation Research Part F: Traffic Psychology and Behaviour* 28 65–76.

Rivai V *Manajemen Sumber Daya Manusia Untuk Perusahaan* 2004 PT. Raja Grafindo Persada.

Rivera, M. (2013). Monitoring of micro-sleep and sleepiness for the drivers using EEG signal. *Thesis*. School of Innovation, Design and Engineering, Mälardalen University, Västerås, Sweden.

Rosenbloom T, Perlman A Tendency to commit traffic violations and presence of passengers in the car 2016 *Transportation Research Part F: Traffic Psychology and Behaviour* 39 10–8.

Schmidt, E. A., Schrauf, M., Simon, M., Fritzsche, M., Buchner, A., & Kincses, W. E. (2009). Drivers' misjudgement of vigilance state during prolonged monotonous daytime driving. *Accident Analysis & Prevention*, 41(5), 1087-1093.

Simmons, B., & Ouimet, M. (2017). Teen driving risk in the presence of passengers. *Research, Practice, Policy, and Directions*, 80-97.

Simons-Morton B, Lerner N, Singer J The observed effects of teenage passengers on the risky driving behavior of teenage drivers 2005 *Accident Analysis & Prevention* 37(6) 973–82.

Syaefudin U, Syamsuddin A Perencanaan Pendidikan Pendekatan Komprehensif 2005 *PT Remaja Rosdakarya*.

Yeo, M. V., Li, X., Shen, K., & Wilder - Smith, E. P. (2009). Can SVM be used for automatic EEG detection of drowsiness. *Safety Science*, 47, 115-124.

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