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The effectiveness of in-vehicle peppermint fragrance to maintain car driver's alertness

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Abstract

The numbers of the traffic accidents related to human factors are increasing rapidly. Among all contributing factors to the accident, fatigue and sleepiness on wheel are the most common reasons. Both conditions decrease drivers' alertness, resulting in performance decrement and accident risk increment. The alertness degradation is usually not well recognized by the drivers. Peppermint fragrance is commonly known on its freshness as medicine or aromatherapy. This research was conducted to examine the effectiveness of peppermint as a car freshener in order to maintain drivers' alertness level. A within-subject design experiment was carried out in a car-driving simulator laboratory engaging twelve male participants. There were two driving conditions: with placebo and with peppermint fragrance. Placebo and peppermint fragrance was released continuously using an electric vaporizer. The participants' alertness level was monitored via brainwave activities using electroencephalograph (EEG) along 30 minutes of driving. Frequency analysis on EEG data was conducted to determine the alpha, theta, and beta power band on F3 and F4 of lobus frontal to generate the $(\alpha+\theta)/\beta$ ratio. Results of this study demonstrated that the application of the peppermint car freshener resulted in lower slope of $(\alpha+\theta)/\beta$ ratio rather than placebo condition (0.018 vs. 0.026), though the difference was not significant ($p = 0.216$). The results suggest that the peppermint is promising to be applied as in-vehicle fragrance in order to maintain drivers' alertness. Further research can be conducted to test various method of fragrance exposure to get more substantial increase of alertness level.

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Keywords: Driver, alertness, intervention, peppermint

1. Introduction

In recent years, traffic accidents have become the third largest killer in Indonesia, after coronary heart disease and tuberculosis, as published by [1]. As many as 67% of traffic accident victims are in the productive age, i.e.

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22-50 years. There are about 400,000 victims under the age of 25 years who died on the highway, with an average mortality of 1,000 people every day. Traffic accidents are also the leading cause of death of people aging between 10 to 24 years old in the world. In Indonesia, statistical data recorded 2,246 accidents per 100,000 populations. The prevalence of the accident is significantly higher than that of Japan, which only 4 accidents per 100,000 populations. The high number of traffic accidents is indeed worrying.

A study by [2] suggests that there are three factors that cause traffic accidents, i.e. road, human (road users), and vehicles. According to [3], human factor is the main factor of traffic accidents. The causes include sleepiness, fatigue, breaking the speed limit, not keeping distance, alcohol or drugs, illness, cell phone or electronic device usage, etc. Among these conditions, sleepiness and fatigue are the most common and unique factors [3]. Both arise from human activities which incompatible with the biological rhythm of the human body. Disruption on circadian rhythms can lead to short-term disturbances such as sleepiness at inappropriate times and long-term health problems such as depression, as stated by [4]. There is a need for technological intervention in maintaining drivers' alertness level.

There are some active and passive stimuli which are considered to be able to maintain the driver's alertness. Active stimulus requires awareness of the driver to do so, such as drinking coffee, smoking, chewing, doing sports, and singing [5]. Unfortunately, these active stimuli are known to be less effective to countermeasure sleepiness, as mentioned by [6] suggesting that humans have incapacity to detect or predict their sleepiness status. Therefore, passive stimuli seem to be more advisable to maintain vigilance, by manipulating the environment inside the cabin. Light, alarm, music, air, caffeine, candy, and fragrance are example of passive stimuli. Studies found that cold air and radio were only effective to countermeasure sleepiness in short period of time [7], whilst caffeine and napping could act longer [8].

Among the passive methods, aroma exposure showed good results in maintaining alertness in comparison with light and alarm [5]. Furthermore, peppermint scent were proven to significantly increase alertness in activities that require continuous attention [9], on athletic performance [10], while administered on cognitive tests [11] [12], or to prevent drowsiness [13]. Nonetheless, the empirical evidence of the peppermint aroma effectiveness in maintaining drivers' alertness was not conclusively known. Therefore, this research was conducted to examine the effectiveness of the peppermint as a car freshener to maintain drivers' alertness.

2. Method

To test the effectiveness of the peppermint, a study was conducted in laboratory experiments, using a car-driving simulator of the Laboratory for Work System Design and Ergonomics, ITB. A laboratory experiment was chosen as the test method since the participants can still be given intervention during driving and do not pose a risk of traffic accidents, as when experiments are done in the field (highway).

2.1. Participants

Twelve male participants with a minimum of one year driving experience were voluntarily involved as participants. They were all healthy men, with no experience in any traffic accident related to sleepiness. All of them are students of Institut Teknologi Bandung.

2.2. Apparatus

Electronic vaporizer aroma, as shown by Fig. 1, was used to emit continuous fragrance during driving, either in peppermint exposure or non-fragrance situation. Peppermint oil utilized in this study was contained 30.70% of L-Menthol, 27.08% of L-Methone, 4.95% of Menthyl Acetate, 4.35% of Iso-Menthone, 4.79% of Mentha Furan, and 5.76% of Cineol. The aroma strength was justified by two random participants until they could smell the peppermint [14].

Electroencephalograph (EEG) was utilized to get brainwave data to monitor participants' alertness level. EEG by Emotiv with gold electrodes was chosen, because of the flexible and portable feature. Brainwave data transmission was conducted wirelessly with a receiver mounted on the laptop. Two area of the frontal lobe, i.e. F3 and F4, were