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Drivers' Attitude Towards Caffeine Chewing Gum As Countermeasure To Driver Task-Related Fatigue

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Abstract

Driver fatigue is one of the major contributors to road accidents. In this study, we refer to task-related fatigue, in contrast to sleep-related fatigue. Sleep-related fatigue decrements in driving performance are related to the circadian rhythm, sleep disorders, and sleep deprivation or restriction. Task-related fatigue depends on driving conditions: active and passive task-related fatigue may arise according to the combination of driving task and driving environment. Active task-related fatigue is related to overload driving conditions, and passive task-related fatigue with underload ones. Several countermeasures have been proposed to face the problem of driver fatigue, such as taking a nap or caffeine beverages. The intake of caffeine has shown the enhancement of vigilance and choice reaction time. Those enhancements have an effect within 5-10 min in a caffeine chewing gum compared with 30 to 45 min in coffee. The enhancement in alertness within 5 min is crucial and potentially can reduce sleep related car accidents. Recent study showed that the caffeine effect is directly related to driving performance in monotonous conditions. In this study, two groups of drivers were asked to provide their preferences on several products that might positively affect their driving performance on long and monotonous conditions. The first group composed of participants that drove a driving simulator and actually consumed the products. The second group was composed of questionnaire responders that were presented with animations replicating the first group's actual driving. Both groups' participants preferred to consume coffee or regular chewing-gum over caffeine chewing gum when asked at the beginning of the experiment (or survey). Drivers that actually consumed the products changed their attitude in favour of caffeine chewing-gum. On the other hand, the drivers that participated in the survey did not change their attitude, but rather changed their attitude with regards to the safety in using caffeine chewing-gum.

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1. Introduction

Driver fatigue is one of the major contributors to road accidents (MacLean, Davies et al. 2003). Fatigue is an internal situational factor associated with road safety behavior and, as the result of research, is today known to be a dominant factor in road accidents (Sagberg 1999).

The term "fatigue" includes physical and mental sensations that encourage the individual to moderate his or her physical and mental actions. There is no specific acceptable definition of fatigue in the context of road accidents in the relevant literature. Usually fatigue is defined by subjective terms such as a feeling of tiredness or by an objective measurement of reaction time (Dinges and Kribbs 1991, Dinges 1992, Dinges 1995). Fatigue is one of the most significant causative factors in road accidents and a tendency to fall asleep at the wheel is a deciding factor in one fifth of road accidents that occur (Shteer, Vinker et al. 2003). Research findings indicate that fatigue has a detrimental effect on driving even when the driver does not fall asleep at the wheel (Dinges 1995, Gillberg and Åkerstedt 1998) and that cognitive and psychomotor function decreases as manifested by distraction, loss of concentration, poor judgment, slowed reactions and performance errors. Additionally, findings showed that over-fatigued individuals have a 2.7 greater risk of being involved in road accidents (Weissberg, Oxenberg et al. 2007).

As mentioned previously, in recent years, numerous studies have been carried out on the many effects of fatigue on driving, the results of driving while fatigued (McConnell, Bretz et al. 2003) and risk perception when driving in a fatigued state (Lucidi, Russo et al. 2006).

The analysis presented here is based on the study by May and Baldwin (2009), who proposed a sub-categorization for fatigue based on its causal factors, making a distinction between sleep-related and task-related fatigue. Sleep-related fatigue decrements in driving performance are related to the circadian rhythm, sleep disorders, and sleep deprivation or restriction. Task-related fatigue depends on driving conditions: active and passive task-related fatigue may arise according to the combination of driving task and driving environment. Active task-related fatigue is related to overload driving conditions, and passive task-related fatigue with underload ones.

According to this sub-categorization of fatigue, this paper examines the passive task-related effect of prolonged driving in a monotonous highway environment. Safe handling of a vehicle requires sustained attention, but monotony leads to the opposite (Thiffault and Bergeron 2003, Ting, Hwang et al. 2008). This factor, in particular, plays a fundamental role in the onset of passive task-related fatigue: situations of mental underload and monotonous driving may mean that the driving task becomes automated (Desmond, Hancock et al. 1998). The time of day effects also gradually impairs driving performance and leads to an increase in accident risk (Connor, Norton et al. 2001).

Several countermeasures have been proposed to face the problem of driver fatigue (Dinges, Maislin et al. 2005), such as taking a nap (Philip, Taillard et al. 2006) or caffeine beverages (Mets, Ketzer et al. 2011, Mets, Baas et al. 2012). The intake of caffeine has showed the enhancement of vigilance and choice reaction time (Lieberman, Tharion et al. 2002, McLellan, Kamimori et al. 2005). As the onset of action of the caffeine is reliant on the speed of delivery, a faster absorption results in a shorter duration for an active response. The absorption of caffeine in a liquid or capsules is mainly via the intestinal and hepatic first pass. However, the caffeine in a chewing gum is absorbed via the mouth tissues, which results in bypassing the intestinal and hepatic first pass metabolism. This bypass consequence in onset of action of the caffeine within 5-10 min in a caffeine chewing gum compared with 30 to 45 min in capsules (Kamimori, Karyekar et al. 2002). The enhancement in alertness within 5 min is crucial and potentially can reduce sleep related car accidents.

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