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Effect of emotion on galvanic skin response and vehicle control data during simulated driving

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ABSTRACT

Purpose: This study aims to investigate the effect of driver emotion on the physiological and vehicle control data and the possibility of predicting the driver emotion to enhance the driving experience.

Method: The driver emotions in the driving context were classified into eight categories depending on high and low levels of arousal and valence: happiness, surprise, fear, anger, depression, boredom, relief, and neutrality. Fourteen male and female volunteers with ages between 22 and 34 y participated in the test, and approximately 540 min of image, physiological, and vehicle data were collected. After inducing the participants' target emotion through the viewing of a film and writing of passages, we asked the participants to drive on a highway through a driving simulator and self-evaluate their emotion. After the test, the participants were allowed to go home after emotion neutralization.

Result: The participants' self-evaluated emotions correlated highly with the intended induced emotions. High arousal and negative valence emotions such as anger and low arousal and positive valence emotions such as relief exhibited a statistically significant elevation for the following indicators: galvanic skin response amplitude, longitudinal vehicle control data such as throttling and braking, and lateral vehicle control data.

Conclusions: The test results confirmed that a driver's emotional state could be reflected in the differences between the biometric data or vehicle control data. In particular, the emotion associated with a high arousal and negative valence could be clearly distinguished from that associated with a low arousal and positive valence. Therefore, the driver's emotional state affects the traffic condition, and the detection of potentially risky emotions such as those associated with road rage and development of a suitable driving mode can help enhance the driving safety.

Applications: Drivers' emotions can be identified based on physiological data and vehicle control data and integrated into the system to formulate appropriate responses. For instance, anger anticipated from a driver can be alleviated by a preemptive measure, thereby enhancing the traffic safety.

1. Introduction

According to the National Highway Traffic Safety Administration (NHTSA), 38,680 people died in motor vehicle crashes in 2020, which is estimated to be the highest number of fatalities since 2007 (NHTSA, 2020). According to the accident report published by the World Health Organization (WHO, 2018), the number of traffic deaths gradually increased to 1.35 million in 2016. Traffic accidents

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