International Journal of Automotive Technology, Vol. 23, No. 2, pp. 315–326 (2022)
DOI 10.1007/s12239–022–0029–7

pISSN 1229–9138/ eISSN 1976–3832

EFFECT OF DRIVING TENDENCIES ON DRIVING CHARACTERISTICS IN CUT-IN AND EMERGENCY BRAKING SITUATIONS

Seungjoon Lee[1)], Sejoon Lim[2)] and Ji Hyun Yang[3)*]

[1)]Graduate School of Automotive Engineering, Kookmin University, Seoul 02707, Korea
[2)]Department of Automobile and IT Convergence, Kookmin University, Seoul 02707, Korea
[3)]Department of Automotive Engineering, Kookmin University, Seoul 02707, Korea

(Received 22 March 2021; Revised 5 June 2021; Accepted 22 June 2021)

ABSTRACT–The correlation between the driving tendencies and driving characteristics in dangerous driving situations was investigated. A human-in-the-loop experiments were conducted with a driving simulator; in the two simulated driving situations, the vehicle ahead did an emergency break, and another vehicle cut in, thereby forcing the participant to evade. A total of 52 drivers participated in the experiment. In the cut-in situation, aggressive drivers had a higher maximum longitudinal acceleration (MLOA), maximum brake pedal force (MBF) and maximum lateral acceleration (MLAA) than mild drivers; mild drivers changed the lane with a wider turning angle at the maximum steering wheel angle (MSA). Regarding the driving environment, the high-speed scenario showed a higher MBF, while the low-speed scenario showed a greater MSA. The interaction between the driving tendencies and driving environment led to significantly different MBFs and MLAAs. In the emergency braking situation, aggressive drivers showed a higher MLOA, MBF, and MLAA than mild drivers. Regarding the driving environment, the high-speed scenario exhibited a higher MBF, while the low-speed scenario showed a greater MSA. The experiment results confirm that the driving characteristics depend on the driving tendencies and driving environment. This correlation should be exploited to develop a driving mode based on the actual tendencies of the driver.

KEY WORDS : Driving tendency, Traffic flow, Driving characteristic, Cut-in, Emergency braking

1. INTRODUCTION

In the Fourth Industrial Revolution, autonomous driving technology is advancing at a remarkable speed; some technologies have already been applied to mass-produced semi-autonomous vehicles that are used on actual roads. However, autonomous driving must overcome several challenges such as the lack of public trust (Pettigrew *et al*., 2019). For example, the driving pattern of an autonomous vehicle differs from the user's driving pattern. In that case, The user may experience anxiety, frustration, and/or unpleasantness while using an autonomous vehicle. As a result, passengers may suffer motion sickness. Advanced autonomous vehicles should allow users to adjust the driving pattern (Miyajima *et al*., 2007) to their driving patterns; this requires understanding the various driving tendencies and representing them in different autonomous driving modes (Kuge *et al*., 2000; Al-Shihabi and Mourant, 2003). Although the factors that must be considered to analyze the actual driving patterns of drivers include various demographic characteristics such as age and gender, this study aims to identify driving patterns in dangerous situations according to the aggressive behavior of the drivers. The results can be used to develop driving patterns that match those of actual drivers in autonomous vehicles (Bellem *et al*., 2016; Li *et al*., 2018).

The following studies were reviewed. Park *et al*. (2006) surveyed 180 male and female adults (between the ages of 20 and 70) and studied the correlation between the personality type and unsafe behavior for each type with the Korean Driver Behavior Questionnaire (KDBQ) and Myers–Briggs Type Indicator. The KDBQ is the Korean version of the DBQ 50 questions created by Reason *et al*. (1990) Moreover, Park and Park (2017) studied the characteristics of aggressive drivers by converging a machine learning model and survey results. They gathered data on the subjective driving aggressiveness of 30 drivers with the Modified Driver Behavior Questionnaire. In addition, they gathered data on the objective driving aggressiveness from the brake position sensor and acceleration position sensor of the vehicle through the controller area network. The collected data were preprocessed and classified into three driving tendencies: tough, soft, and normal. The Pearson correlation between the data of the subjective and objective driving aggressiveness showed a high Pearson correlation coefficient.

Teh *et al*. (2014) used a driving simulator to study the change in the driver's workload according to five traffic flow

**Corresponding author*. e-mail: yangjh@kookmin.ac.kr