

SIMULATOR STUDY ON THE RESPONSE TIME AND DEFENSIVE BEHAVIOR OF DRIVERS IN A CUT-IN SITUATION

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ABSTRACT–The purpose of this study was to record and analyze various reaction times and behaviors of drivers in response to cut-in situations in a driving simulator. A total of 105 male and female volunteers between the age of 20 and 49 participated in an experiment in a driving simulator with an installed eye-tracking system. The participants experienced a scenario in which a vehicle parked on a shoulder unexpectedly cut in while they were driving on a city road. The mean perceived reaction time was 1.05 s with a standard deviation of 0.43 s. The mean brake/steering reaction time after perceiving the danger was 0.59/0.56 s with a standard deviation of 0.40/0.42 s. The influence of age and gender was observed only in the steering reaction time. No interaction effects were found in any reaction times. Approximately half the drivers steered first and then braked to avoid collision. The perceived reaction time in accident cases was longer than in no-accident cases. A rich dataset was established based on the 93 valid participants who completed the experiment, and established database can be used as a look-up table to identify the percentile of a certain cut-in case.

KEY WORDS : Traffic accident, Reaction, Perception, Steering, Braking

1. INTRODUCTION

According to the World Health Organization (WHO), the fatalities from traffic accidents worldwide numbered 1.25 million in 2013 and 1.35 million in 2016 (WHO, 2015; WHO, 2018). In this study, the response times and behavioral characteristics of drivers in response to cut-in/lane changes were investigated; because cut-in/lane changes cause dangerous conditions and have led to many accidents, they should be thoroughly studied.

Traffic accidents caused by lane changes account for approximately 4 to 10 % of all traffic accidents in the European Union; 75 % of these accidents are caused by human factors. (Shan *et al.*, 2017). According to the US traffic accident data analyzed by the Santarosa Lawyer Group, 8.5 % of fatal car accidents are caused by veering into another lane; this cause ranks 3rd in the causes of car accidents (Santarosa-Lawyer Group, 2020). According to the National Highway Traffic Safety Administration (NHTSA, 2001), there are between 240,000 and 610,000 reported lane-change crashes every year, which result in 60,000 annual injuries (Zhao *et al.*, 2015). In the Republic of Korea, lane-change accidents accounted for 19.8 % of all traffic accidents between 2012 and 2016 (Park *et al.*, 2017);

this percentage increases each year (Park *et al.*, 2017). According to the Dammam traffic police department (Saudi Arabia), between 2009 and 2016, 25.2 % of all traffic accidents were caused by sudden lane changes (Jamal *et al.*, 2020).

These data show that cut-in/lane changes by ego or nearby vehicles are a common cause of traffic accidents worldwide. Moreover, according to the 2014 ~ 2015 statistics provided by the Korean Financial Supervisory Service, 2.6 % of all automobile insurance frauds were committed by drivers who intentionally caused traffic accidents via cut-in/lane changes and claimed insurance money (Financial Supervisory Service, 2015). Unfortunately, these automobile insurance fraud cases are becoming increasingly furtive and frequent (Financial Supervisory Service, 2014).

Collecting data related to the driver's response time and behavior during cut-in/lane change situations and constructing a relevant database will help analyze the causes of traffic accidents and determine whether accidents have been caused intentionally. The following section presents some of the most relevant studies that best represent the premise of this study.

1.1. Related Research Studies

Benderius *et al.* (2014) studied the steering behavior of truck drivers in cut-in driving scenarios. The 24 participants

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