

A Study of Careful Driving Behavior in Right-Turn Maneuvers at Intersections by General Human Drivers

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The purpose of this study was to contribute to the development of requirements for automated driving vehicle functions and driving safety by investigating the driving behavior of general human drivers when surrounding vehicles exhibit hazardous behavior, including violations of traffic regulations, while driving on public roads. Among vehicle-to-vehicle crashes at intersections, this study focused on crashes between right-turning and oncoming straight-going vehicles, which occur relatively frequently. The scenario was reproduced using a driving simulator (DS), and an experiment was conducted with 22 general human drivers. Based on the experimental results, the characteristics of careful driving behavior of general human drivers when making a right turn at an intersection were identified.

Figure 1 shows an overview of the experiment. In this scenario, while the vehicle driven by the participant (Ego) was making a right turn, an oncoming straight-going vehicle (Sub) passed through the intersection at a speed exceeding the speed limit. Three speed conditions were tested for Sub: no speeding, 20 km/h above the speed limit, and 40 km/h above the speed limit. In each experimental condition, three Subs appeared one at a time with a time interval between them. Between these Subs, several groups of traffic vehicles passed through the intersection with gaps too short for Ego to make a right turn. In addition, when the traffic vehicle immediately preceding each Sub passed through the intersection, the distance between that vehicle and Sub was set to approximately 120 m.

In this experimental scenario, none of the participants collided with Sub. Figure 2 shows the proportions of driving behaviors exhibited by the participants. Although there was no significant difference in driving behavior, the proportion of participants who did not make a right turn tended to increase as the speed of Sub increased, in the order of the no-speeding, +20 km/h, and +40 km/h conditions. Among these participants, four participants, ID: 04, ID: 05, ID: 06, and ID: 15, did not make a right turn under any of the conditions. Three participants, ID: 07, ID: 09, and ID: 13, did not make a right turn under the +20 km/h and +40 km/h conditions, while two participants, ID: 12 and ID: 14, did not make a right turn only under the +40 km/h condition.

Based on these results, the results suggest that the five participants, ID: 07, ID: 09, ID: 12, ID: 13, and ID: 14, recognized that one of the oncoming vehicles was exceeding the speed limit and then determined whether it was possible to make a right turn in each situation.

Figure 3 shows the maximum accelerator opening during the right turn for the participants who made a right turn at the first opportunity.

The maximum accelerator opening of Ego tended to increase slightly as the speed of Sub increased, and there was a significant difference in the maximum accelerator opening of Ego between the no-speeding and +40 km/h conditions. These results indicate that many of the participants who made a right turn at the first opportunity recognized the higher speed of Sub when it approached while exceeding the speed limit and took driving actions to pass through the intersection promptly.

In addition, another scenario examined a motorcycle that passed alongside a stopped oncoming vehicle, emerged from behind it, and entered the intersection while Ego was making a right turn.

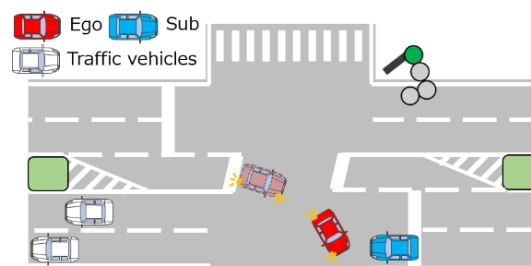


Fig. 1 Outline of Scene 1

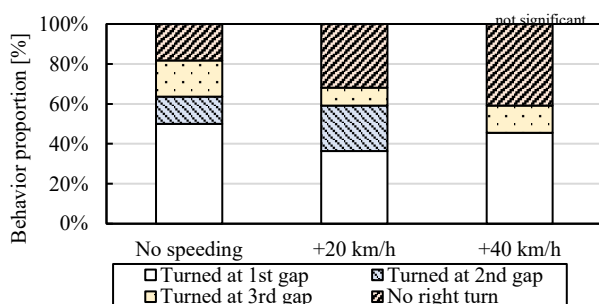


Fig. 2 Behavior proportion of participants (Scene 1)

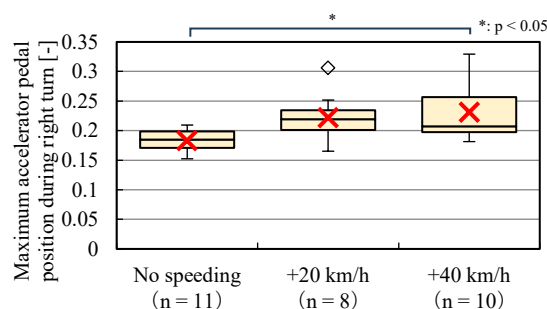


Fig. 3 Max. accelerator pedal position during right turn