

Analysis of Driving Behavior of Automobile Drivers During Sudden Visual Field Changes Using a Driving Simulator (Report 1)

- Investigation of a Method for Reproducing Sudden Visual Field Changes and the Effectiveness of the Blind Spot Monitor (BSM) -

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According to Japan's Ministry of Land, Infrastructure, Transport and Tourism, traffic accidents attributable to drivers' health conditions have been increasing. Driver monitoring systems (DMSs), which monitor drivers' physical conditions, may be effective in responding to sudden health-related events; however, their adoption remains limited.

In this study, driver behavior during sudden visual-field impairment was evaluated in a driving simulator (DS) using a glasses-type device designed to simulate the impairment. In addition, the effectiveness of a Blind Spot Monitor (BSM) under sudden visual-field impairment was investigated.

Sixteen participants in their 20s were recruited. All participants held a standard driver's license for at least one year and drove at least once per month. The participants were divided into two groups: Group A, in which BSM information was displayed only in the left-side mirror and accompanied by an audible warning; and Group B, in which BSM information was displayed both in the left-side mirror and in front of the driver, accompanied by an audible warning.

To evaluate reaction times to an instruction and to sudden visual-field impairment, timing points were defined for each scenario, as shown in Figure 1. While driving in the second lane at 80 km/h, the onset of the instruction or sudden visual-field impairment was defined as T_1 . The time at which the vehicle entered the first lane was defined as T_2 , and the time at which the vehicle subsequently entered the shoulder was defined as T_3 .

To examine the effects of instructions and sudden visual-field impairment on each maneuver, as well as the effects of the BSM presentation method, we calculated the time from the instruction or onset of visual-field impairment to entry into the first lane ($T_2 - T_1$) and the time from the instruction or onset of visual-field impairment to entry onto the shoulder ($T_3 - T_1$).

To compare the effects of instructions and sudden visual-field impairment on entry into the first lane, $T_2 - T_1$ was analyzed. The results are shown in Figure 2. A one-tailed paired t -test was performed separately for Groups A and B. A significant difference was observed only in Group B ($p = 0.049$). Specifically, in Group B, participants took longer to enter the first lane following sudden visual-field impairment than following an instruction.

Furthermore, to evaluate the effect of the BSM presentation method, a one-tailed independent-samples t -test was conducted between Groups A and B. A significant difference was observed only under the sudden visual-field impairment condition ($p = 0.039$). Specifically, under sudden visual-field impairment, Group B took longer than Group A to enter the first lane.

The results indicated that drivers with a stronger tendency toward anxiety took longer to stop following sudden visual-field impairment than when they were instructed to stop. In addition, participants expressed generally positive views regarding audible warnings as a driver-assistance feature, suggesting that such warnings may affect driving behavior under sudden visual-field impairment.

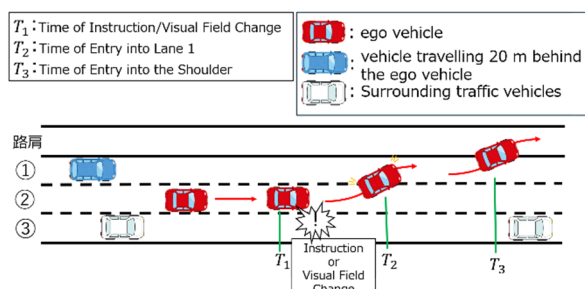


Fig.1 Definitions of Time Points

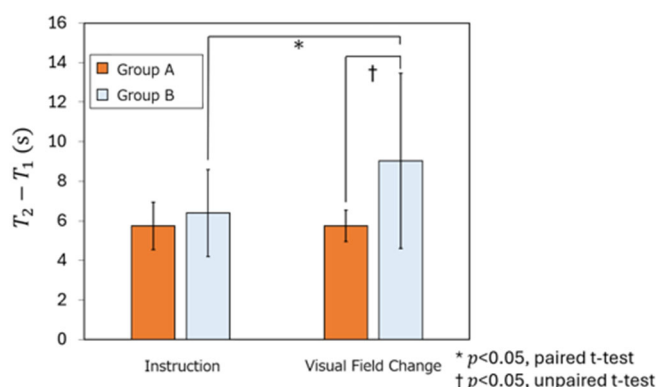


Fig.2 Time Difference between Lane 1 Entry and Instruction/Visual Field Change