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Discussion of a communication-based driver assistance system to prevent accidents with bicycles

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Because Japan has a higher rate of fatalities while walking and riding a bicycle than other countries, efforts should be made to reduce the number of those fatalities. One effective means to reduce the number of deaths and severe injuries while riding a bicycle is to take countermeasures against head-on accidents, which is a typical accident type. However, there is a limit in detecting a bicycle only with sensors mounted on an automobile. Thus, accident prevention measures using a cooperative driving assistance system utilizing communication technology must be evaluated. A previous study evaluated the driving method of a driver at the scene of an intersection where a bicycle is expected to rush out. The study reported that older adult drivers have a slow deceleration start timing compared to young, middle-aged, and skilled drivers. Moreover, the study found that young drivers have a less braking operation (holding on to the brake pedal) than middle-aged, older adult, and skilled drivers when the speed limit is low. Therefore, these aspects should be examined to reduce the accident risk, especially for young and older adult drivers. Thus, this study investigated the effects of different assistance levels (no assistance, information provision, heads-up) and different age groups (young and older adult) on driving behavior. The study was conducted using a driving simulator to examine what type of driver assistance effectively reduces bicycle accidents.

A total of 26 people who drive cars on a daily basis participated in the experiment. The participants were 13 young (7 men, 6 women, average age 22.2 years, SD = 1.6 years) and 13 older adults (7 men, 6 women, average age 71.3 years, SD = 4.0 years). The content and safety of this experiment were deliberated in advance with and approved by the Experimental Ethics Committee established by the Japan Automobile Research Institute. In addition, informed consent was obtained from the experimental participants before the experiment was conducted.

The driving environment was an urban road with one lane on each side (lane width 3.0 m), with alternating straight single roads and intersections. Moreover, the participants drove straight at a speed limit of 40 km/h. An experimental scene where a bicycle rushes out was set regarding the situation in which a car-to-bicycle traffic accident is prone to occur (Fig. 1).

The experiments considered two conditions of assistance level of a communication-based driving assistance system (information provision conditions/heads-up conditions). The assistance levels were presented using different audiovisual displays. The presentation timing of these driving assistances occurred when the distance between the vehicle and the virtual collision point reached 88.9 m.

As a result of the experiments, deceleration behavior occurred in most trials regardless of age group by presenting information provision or heads-up at the intersection where the bicycle is expected to rush out. The results showed that the deceleration timing became faster in information provision and heads-up than in the case without driving assistance. In particular, there was no significant difference in the effect by the age group and assistance level. Furthermore, no significant difference was observed (Fig. 2) even though the deceleration required to avoid a collision when the bicycle appeared was 0.4 m/s^2 higher in the information provision than in the heads-up. This result shows that providing driving assistance by information provision and heads-up increases the deceleration behavior before the appearance of the bicycle, speeds up the deceleration behavior, and increases the degree of deceleration. Moreover, the collision risk when the bicycle appears after that can be reduced. Finally, no significant differences were found with respect to the driver's age group (young/older adults).

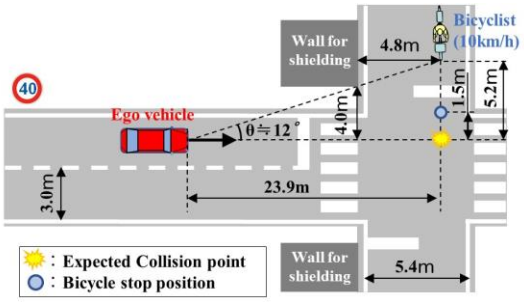

Fig.1 Experimental scene

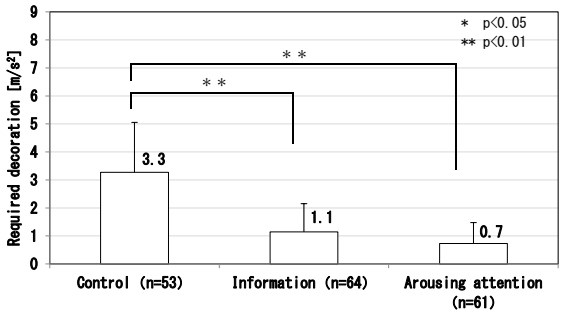

Fig.2 Required deceleration at time instance that bicycle appears