Relationship between attentional resources and driving behavior when using an automotive peripheral vision device

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KEY WORDS Human engineering, **Human interface**, **Field of visibility**, CMS, Attentional resources, Cognition [C2]

The usability of camera monitoring systems (CMS) has been evaluated in many previous studies. However, there are very few examples of studies that have analyzed in detail the risk avoidance behavior and attention resources of drivers. In addition, the authors' previous studies have found that it is difficult for drivers to instantly grasp the relative position of the vehicle behind them and their own vehicle. Based on these backgrounds, we analyzed the relationship between driver attentional resources and risk avoidance ability when using CMS and conventional normal mirror. We also examined the effect of supporting driver's visual search behavior when translucent vehicle pillars are superimposed on the rearward image displayed on the CMS.

(b)　Normal Mirror

(a)　CMS　(Without See-through)

(c)　CMS　(With See-through)

Fig.1 Mirror conditions

We conducted two experiments using a driving simulator: the attentional resource quantification experiment and the risk avoidance ability quantification experiment. In both experiments, the mirror image conditions were: Normal, CMS (Without see-through), and CMS (With see-through) as shown in Figure 1. The test participants in the experiment were 15 male drivers (mean age: 23.3 years, SD: 1.29) who had a regular driver's license and drove a car on a regular basis. In the attentional resource quantification experiment, the results show that the number of correct responses to the Stroop interference task is higher in the CMS than in the normal mirror condition, indicating that drivers can have a greater margin for attentional resources. In the risk avoidance quantification experiment, the driver's risk avoidance ability was quantitatively analyzed based on the cognitive reaction time to the vehicle behind and the steering reaction time to avoid collision risk. The results showed that both the cognitive reaction time and steering reaction time to collision risk were shorter in CMS (without see-through) and CMS (with see-through) than in the normal mirror.

Based on the above experimental results, we analyzed the correlation between the number of correct responses in the Stroop interference task and cognitive or steering reaction time, and obtained the results shown in Figures 2 and 3. The results confirm the possibility of a correlation between the amount of attentional resources and the ability to avoid collision risk. We also confirmed that the display of translucent vehicle pillars on the CMS is not effective in reducing the consumption of the driver's attention resources, but it is effective in helping the driver to understand the position of the vehicle in relation to surrounding vehicles.
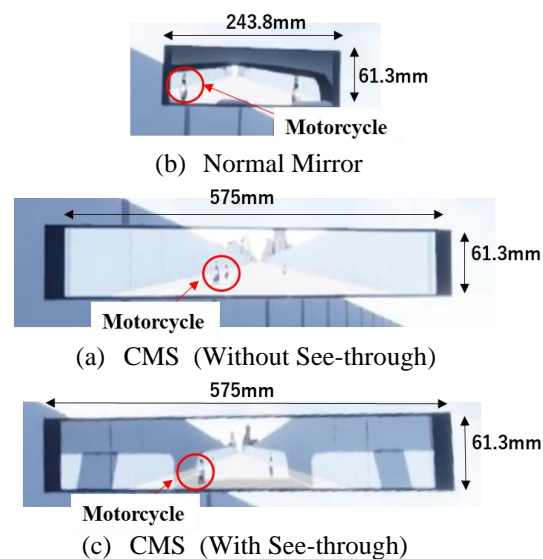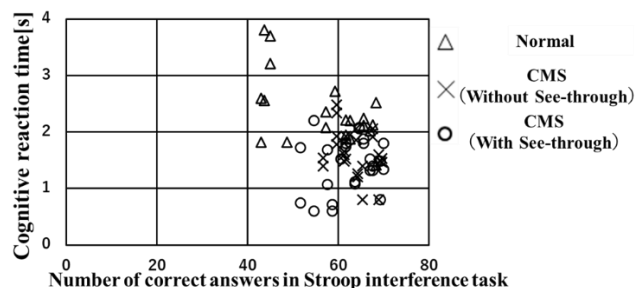

Fig.2 Correlations between cognitive reaction time and number of correct responses to the Stroop Interference Task in each mirror conditions
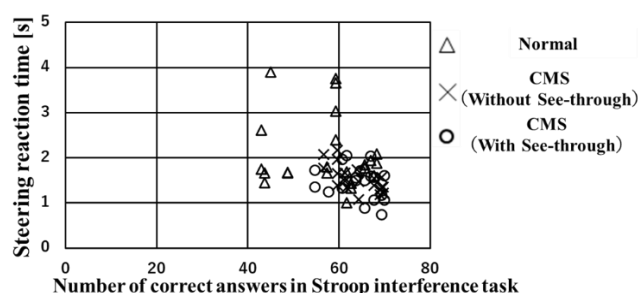

Fig.3 Correlation between steering reaction time and the number of correct responses in a Stroop Interference Task in each mirror conditions