

Proposal of a quantitative evaluation method for response characteristics to visual and auditory stimuli in motorcycle forward collision warning HMIs

Takato Yamamoto¹⁾ Keisuke Suzuki¹⁾ Naotoshi Takemura²⁾ Joohyeong Lee²⁾ Tomoki Minami²⁾

1) Kagawa University
2217-20 Hayashi-cho, Takamatsu, Kagawa, 761-0396, Japan
2) Honda R&D Co., Ltd.
1-4-1 Chuo, Wako, Saitama, 351-0193, Japan

KEY WORDS: Human machine interface, Risk recognition, Workload, Cognitive reaction time, Riding simulator [C2]

Motorcycle forward collision warning (FCW) systems need to alert riders quickly when a collision risk is detected. Depending on vehicle design and riding posture, the instrument cluster on some motorcycles is located 40–50° below the horizontal line of sight. Visual warnings are therefore presented in the lower peripheral visual field when the rider looks ahead. However, quantitative methods for comparing initial warning responses at controlled downward viewing angles have not been fully established.

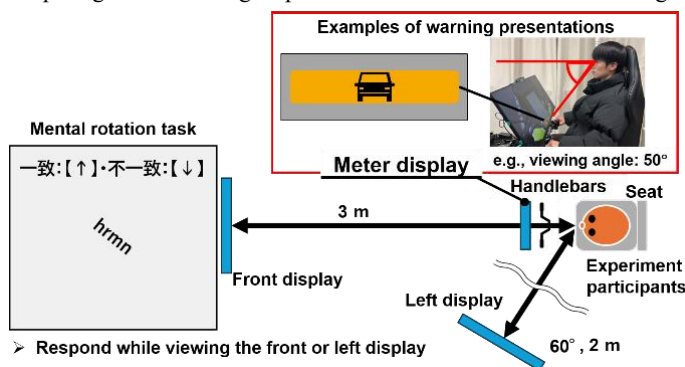


Fig. 1 Overview of the experimental setup

times, brake response times, and non-responses were recorded. Trials with no accelerator release within 3.0 s were classified as non-responses.

The number of characters and rotation angle were adjusted according to individual performance, and participants continued responding throughout the task. Accelerator-off response-time distributions at 30° and 40° were broadly similar. At 50°, the distribution shifted toward longer times, and the non-response rate was 23.4% (Fig. 2). Non-responses were more frequent among participants aged 55–64. When the MR task was presented on the left-front display, visual-only warnings resulted in a 20.8% non-response rate. With audiovisual warnings, response times were shorter, no non-responses occurred, and all responses were under 1.8 s (Fig. 3).

In this experiment, response times were longer and the non-response rate was higher at 50° than at 30° and 40°. Results for participants aged 55–64 were consistent with previous findings on reduced peripheral stimulus detection with age and cognitive load^[1]. When the MR task was presented on the left-front display, audiovisual warnings yielded shorter response times and no non-responses compared with visual-only warnings. These results support the validity of the proposed method for quantitatively evaluating motorcycle FCW response characteristics.

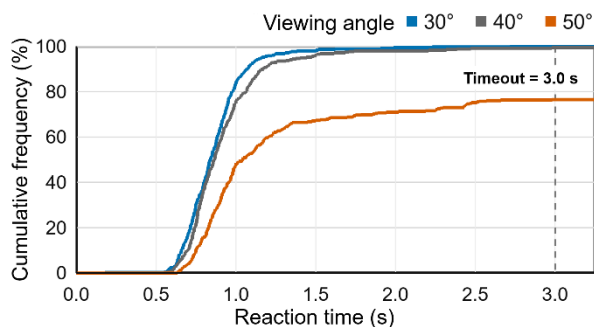


Fig. 2 Accelerator-off response distribution by downward viewing angle (visual-only warning)

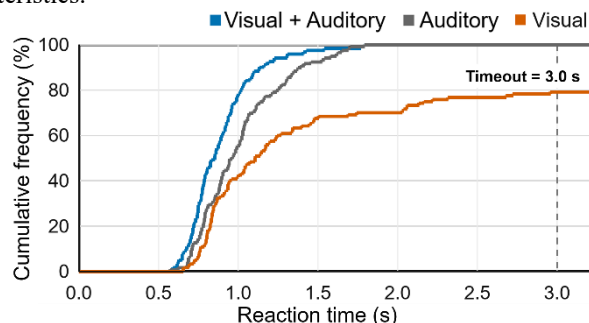


Fig. 3 Accelerator-off response distribution by warning modality with the MR task on the left-front display (visual warning position: 40°)

References

[1] S. W. Savage, L. P. Spano, and A. R. Bowers: The effects of age and cognitive load on peripheral-detection performance, *Journal of Vision*, 19(1), 15, 2019.