講演番号	243

文献番号	20226243

Validation of a Driver Drowsiness Assessment Method for Compliance with The EU GSR (General Safety Regulation)

Yo Yamagata[1)] Shizuka Kawada[1)] Hitoshi Uchida[1)] Kosuke Kaida[2)] Toshiki Shimizu[1)]

1) SUZUKI MOTOR CORPORATION
2-1, Sakuranamiki, Tsuzuki, Yokohama, Kanagawa 224-0046, Japan
2）National Institute of Advanced Industrial Science and Technology
1-1-1, Tsukuba Higashi, Ibaraki, 305-8564, Japan

KEY WORDS: Human engineering, Driver condition, Driver monitoring, Drowsiness estimation [C2]

To reduce accidents caused by careless driver behavior such as drowsy driving, the European Union (EU) has, from 2022, mandated the installation of Driver Drowsiness and Attention Warning Systems (DDAW) as a part of their General Safety Regulation (GSR).

EU 2021/1341 (DDAW Technical Requirements) stipulates that the standard measurement method for sleepiness in experiments and the threshold for providing warnings should be determined based on the Karolinska sleepiness scale (KSS), a subjective evaluation with the outcome indicated using numbers from 1 to 9. The standard descriptions for these levels from 1 to 9 are listed in the Appendix to the DDAW Technical Requirements.

To ensure GSR-compatible drowsiness evaluation in Japan, a Japanese version of the KSS that meets the DDAW Technical Requirements was used. However, the currently used version of the KSS does not meet these requirements because only the odd-numbered levels have evaluation descriptions.

To overcome this problem, we created a new Japanese version of the KSS by translating the evaluation descriptions of all the nine levels and verified the equivalence of the Japanese language KSS (KSS-JP) with the EU official language KSS (KSS-EU) described in the DDAW Technical Requirements to assess driver drowsiness.

Vehicle running experiments with 24 participants (13 Japanese speakers and 11 EU official language speakers) were conducted using the methods specified in the DDAW Technical Requirements to measure drowsiness using KSS-JP for Japanese speakers and KSS-EU for EU official language speakers. At the same time, PERCLOS and Trained Observer Rated Sleepiness (ORS), which are drowsiness indices with measurement principles different from KSS, were used as external indices to check whether there was a difference between the KSS-EU participants and KSS-JP participants in the correlation between KSS and the external indices.

Fishir's z-transform was performed on the correlation coefficients (Fig.1) between the KSS scores and the external indices for each participant, and the means were compared using Welch's t-test. No significant difference was observed between the KSS-JP and KSS-EU groups for both the KSS-PERCLOS and KSS-ORS correlations, with a significance level of 5%

(PERCLOS: t (14.62) = 1.58, p = 0.14; ORS: t (14.18) = 1.47, p = 0.16).

For both PERCLOS and ORS (FIg.2), there were significant differences shown in the analysis of Linear mixed model analysis with KSS level and KSS language as fixed effects and participants as random effects in the KSS level factor(PERCLOS: F (1,16.91) = 30.08, p < 0.01; ORS: F (1,13.22) = 89.26, p < 0.01), and no significant differences were found in the cross effects between KSS level and KSS language(PERCLOS: F (1,16.91) = 2.06, p = 0.17; ORS: F (1,13.22) = 1.35, p = 0.27). It can be concluded that the difference in KSS languages causes no significant difference in the correlation between KSS scores and external indices and the variation of external indices in response to the increase or decrease in KSS levels.

These results indicate that in the drowsiness measurements that meet the DDAW Technical Requirements, there is no difference between the drowsiness level of Japanese speakers measured using KSS-JP and that of EU speakers measured using KSS-EU. Hence, the measurements using KSS-JP and KSS-EU are comparable.

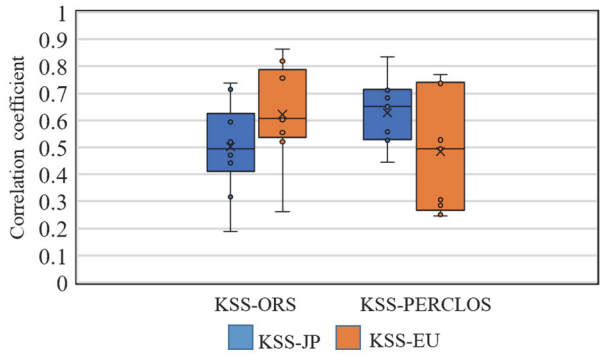

Fig.1 Boxplot of correlation coefficient

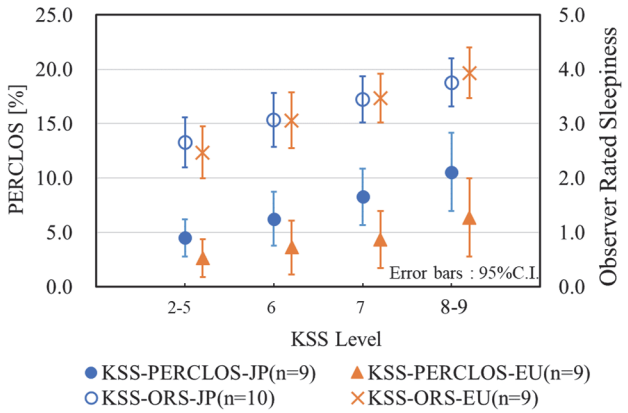

Fig.2 Estimated marginal means of ORS and PERCLOS for KSS level by participant groups with different KSS languages