

Evaluation of Effects of Eyes-Off Function in Traffic Congestion on Driver Workload

-An On-Road Driving Experiment-

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1. Introduction

Advanced Driver Assistance Systems are expected not only to reduce driver workload but also to improve comfort and convenience during travel. The authors have previously reported the workload reduction effects of Hands-Off functions using subjective and physiological evaluations. As driving assistance technologies continue to advance, systems equipped with Eyes-Off functions have been introduced. Under specific operating conditions, these functions allow drivers to be released not only from steering operations but also from continuous forward monitoring. Therefore, further reductions in driver workload can be expected compared with conventional Hands-Off systems. However, the value of Eyes-Off functions may extend beyond simple workload reduction. By releasing drivers from continuous forward monitoring, these systems may reduce feelings of driving constraint, provide greater psychological margin, and increase flexibility in how travel time is experienced. Despite these potential benefits, appropriate methods for evaluating such value have not yet been sufficiently established. In particular, perspectives related to “freedom from driving” and “changes in the value of travel time” have received limited quantitative investigation. Therefore, this study compares Hands-Off and Eyes-Off driving conditions through an on-road driving experiment and explores evaluation approaches for assessing both driver workload and the value provided by Eyes-Off driving.

2. Method

Twenty-one male participants aged in their 30s to 50s were recruited. To minimize the influence of differences in system familiarity, participants were selected from employees who were familiar with the target vehicle and driving assistance functions. Two driving conditions were evaluated: a Hands-Off condition, in which drivers were released from steering operations while continuously monitoring the roadway, and an Eyes-Off condition, in which drivers were additionally released from forward monitoring under system-operating conditions. The experiment was conducted on public highways between Moriya Service Area and Niikura Parking Area (approximately 40 km), where traffic congestion frequently occurs during weekday mornings. Subjective ratings, physiological measures, vehicle data, and eye-tracking data were collected. Subjective evaluations included fatigue, Rating Scale of Arousal State, perceived value and trust, and freedom from driving. Physiological measures included electromyography (EMG), electrocardiography (ECG), and electrodermal activity (EDA).

3. Preliminary Results

Preliminary analyses were conducted using data obtained from a subset of participants. No clear differences were observed in fatigue or arousal-related measures between the Hands-Off and Eyes-Off conditions. Several evaluation items related to perceived value, however, showed different tendencies between the two conditions. Figure 1 presents the ratings of an item related to freedom from driving: “I could forget that I had to drive.” Participants in the Eyes-Off condition tended to report higher ratings than those in the Hands-Off condition. In addition, items associated with psychological margin and trust showed tendencies suggesting differences between conditions. These preliminary findings indicate that the value of an Eyes-Off function may be associated not only with workload reduction but also with a subjective feeling of freedom from driving. Because data collection and detailed analyses are still in progress, these findings should be regarded as preliminary observations.

4. Conclusion

An on-road driving experiment was conducted to compare Hands-Off and Eyes-Off driving conditions under traffic congestion. In addition to conventional workload measures, evaluation perspectives related to freedom from driving, psychological margin, and perceived value were introduced. Preliminary analyses suggested possible differences in subjective evaluations related to freedom from driving and perceived value, although no clear differences were observed in fatigue-related measures. Further analyses integrating subjective evaluations and physiological measures will be conducted to clarify the value provided by Eyes-Off driving and to establish appropriate evaluation approaches.

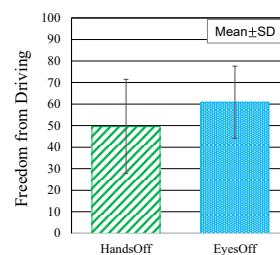


Fig.1 Freedom from Driving