

EVALUATION OF FEELINGS OF EXCITEMENT IN DRIVING SIMULATOR BY ECG

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ABSTRACT In recent years, Japanese young people are exhibiting less interest in driving. Since we believe their increase can be raised by using in-vehicle systems, in this study, we prepared a driving course that features exciting scenes and measured the biological signals of participants while they drove a driving simulator (DS). We focused on the thrills of driving scenes in experiments using a DS and evaluated the feelings of excitement by the heart rate variability (HRV) of ECGs. We concluded that SDNN and RRV indexes identify feelings of excitement.

1. INTRODUCTION

In recent years, young people seem to be losing interest in driving (Yotsumoto, 2012). Since we want to increase its attractiveness to young people through in-vehicle systems, in this study, we prepared a driving course that featured thrilling scenes and evaluated the biological signals of participants while they drove a driving simulator (DS) (Uchiumi et al., 2012) and (Harada et al., 2014). We focused on exciting driving scenes in experiments with a DS and evaluated the feelings of excitement by the heart rate variability (HRV) of ECGs.

2. EXPERIMENTAL

We created exciting contents in which participants drove a car in a DS through nine tunnels. They received short voice messages (information) related to the upcoming scenes after tunnels while driving in the tunnels (Fig.1). We used the following three scenes after passing

through tunnels:

- A) Cherry blossoms (Fig.2)
- B) Autumn colors (Fig.3)
- C) Snow (Fig.4)

We employed two biological indexes from ECG signals: SDNN and RRV (Takahashi et al., 2013) and (Harada et al., 2015) and (Harada et al., 2014). SDNN means the standard deviation of the intervals between the R-waves (RRI) of ECGs, and RRV denotes the ratio of the standard deviation of RRI and its average. We performed experiments with eight male students in their twenties. The following are the experiment's procedures:

- I. Experimenter explained the content.
- II. Experimenter placed the measuring instruments on the participant bodies.
- III. Participants practiced driving with the DS.
- IV. They drove the DS and experienced the three kinds of contents (Fig. 5).
- V. Experimenter removed the instruments.



Fig.1 In the tunnels



Fig.2 Cherry blossoms



Fig.3 Autumn colors



Fig.4 Snow



Fig. 5 Driving with a DS and experiencing contents

3. EXPERIMENT Results And Discussion

We divided each biological signal time sequence into the following two sections:

- In-tunnel: while driving in the tunnel
- After passing through the tunnel: driving after passing through the tunnel

For the SDNN, the t-test results show significant differences between the with/without information conditions of each scene in the tunnel (Fig. 6). The SDNNs of the section after passing through the tunnel (Fig. 7) and the RRVs of both sections show similar results. These results suggest that SDNN and RRV might be indexes for feelings of excitement for tasks under driving conditions.

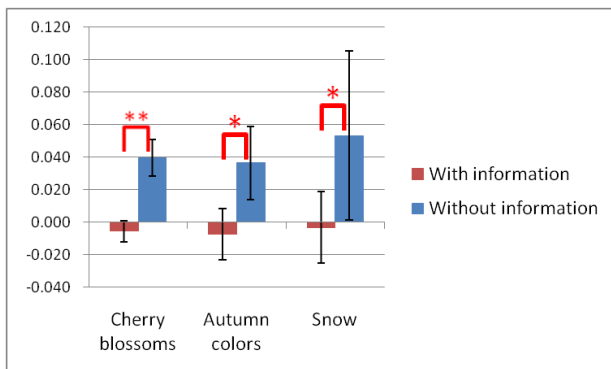


Fig. 6 Averaged SDNNs in each scene while driving in tunnels

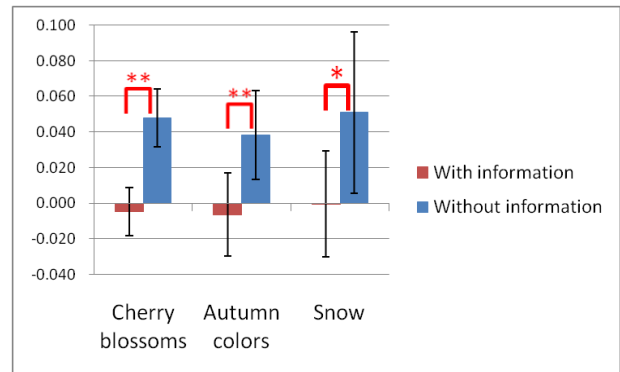


Fig. 7 Averaged SDNNs in each scene after passing through tunnels

CONCLUSION

We obtained the following conclusions:

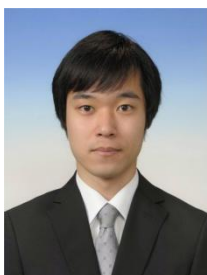
- SDNN might be an index of feelings of excitement for tasks under driving conditions.
- RRV might be an index of feelings of excitement for tasks under driving conditions.

Future work will reveal exciting in-vehicle systems for young people using these biological indexes.

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