

Preliminary Study on Changes in Cognitive Skills and Heart Rate Variability Indices Due to Playing esports

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Abstract— At present, few studies have been conducted on the relationship between playing electronic sports (esports), cognitive skills, and heart rate variability (HRV) indices. In this study, 20 healthy adult males were monitored to examine the changes in cognitive skills and HRV indices using the Stroop test and RR intervals whilst playing esports. The results suggest that playing esports could improve cognitive skills, and the changing LF/HF ratio could provide insight into the trend of improvement. Further investigation, including other HRV indices, is therefore warranted.

I. INTRODUCTION

In recent years, the rapid development of electronic sports (esports) as an industry has led to their increased interest as a research subject [1]. Using electroencephalograms (EEGs) and Stroop tests, researchers have recently reported that esports can improve cognitive skills [1]. Most studies have been conducted using EEGs, while only few have clarified the relationship between esports and heart rate variability (HRV) indices. Therefore, in this study, we utilized the Stroop test to investigate changes in cognitive skills and HRV indices of 20 healthy adult males playing esports.

II. METHODS

The experimental procedure was reviewed and approved by the Ethics Review Committee of the School of Advanced Science and Technology, Kumamoto University. The subjects were 20 healthy adult males (mean age: 21.9 ± 0.7). Fig. 1 shows the experimental procedure, with the subjects randomly divided evenly into two groups: a training group and a non-training group. For both training and non-training group, we used the Time Attack (TA) and Computer Match (COM) modes of racing three times each (MARIO KART 8 DELUXE, Nintendo, Kyoto, Japan). For the Stroop tests, we used a paper version (ST) (Shin Stroop Kensai, Toyo Physical, Fukuoka, Japan) and an app version (STapp) (Hacaro–Stroop test, Digital Standard, Osaka, Japan) [1]. For these, the number of correct answers for ST and the total reaction time to 20 questions for STapp was employed as the measures of cognitive skills. The RR interval was measured using a telemeter from the subject's standard lead II, and the HRV indices were calculated using a dedicated smartphone application [2].

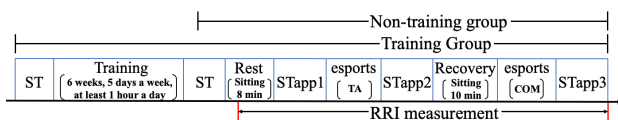


Figure 1. Experimental procedure

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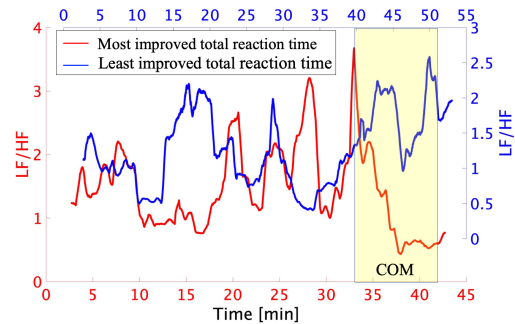


Figure 2. LF/HF time-series plots of the subject with the most improved (red) and least improved (blue) total reaction time between STapp1 and STapp3. The yellow band indicates COM play.

III. RESULTS & DISCUSSION

An unpaired t-test revealed no significant difference in the results of the pre-training and post-training ST ($p > 0.05$), suggesting that training alone does not affect cognitive skills. A Tukey's HSD test incorporating the results of the three STapp tests, which includes the training and non-training groups, showed a significant decrease in total reaction time between STapp1 and STapp3 ($P < 0.05$). This result suggests that playing COM can increase cognitive skills measured by the Stroop tests. Fig. 2 shows the time series plots of the LF/HF ratio, which is an index of sympathetic nerve activity, for the subjects with the most improved (red) and least improved (blue) total reaction times between STapp1 and STapp3. The trends during COM period show that LF/HF decreased for the most improved subject, but increased for the least improved. A similar trend was observed for the five most and five least improved subjects. This suggests that parasympathetic dominance during COM may improve cognitive skills.

IV. CONCLUSION

The results of the Stroop test suggest that playing esports can improve cognitive skills. Additionally, time-series plots of LF/HF indicate potential trends of cognitive skills improvement which warrant further investigation.

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