

Measuring the Effects of Moods and Heart Rate Variability when Playing Video Games

Subtitle: Video Games Impact on HRV and Moods

Fang-Yu Pai

Department of Medical Informatics
Chung Shan Medical University
Taichung, Taiwan
E-mail: jonan0607@gmail.com

Ching-Hsiang Lai

Department of Medical Informatics
Chung Shan Medical University
Taichung, Taiwan
E-mail: liay@csmu.edu.tw

Abstract—In this study, we recruited 20 college students who are video games enthusiasts and assigned them to two groups, namely, video game playing (as a testing group), and book-reading (as a control group). We use profile of mood state (POMS) scale and electrocardiography (ECG) patch physiological signal device as tools to measure moods and heart rate variability (HRV) before and after the experiment, and we assessed the effects of playing video games on physical and mental health. We expect that the low frequency (LF) and high frequency (HF) powers for HRV in testing group to be significantly higher than the value in the control one after the experiment and to have 30 minutes duration in the following sleep stage. We show that playing video games may excite the sympathetic and parasympathetic systems during and after playing. This will disturb sleep and increase the risk of chronic diseases. Based on these findings, we recommend avoiding playing video games for extended periods of time.

Keywords—video game; mood; heart rate variability (HRV); sympathetic; parasympathetic.

I. BACKGROUND

As computers and the Internet have become more popular, teenagers and students often fall vulnerable to cyber risks [1]. Researchers [2][3][4] who studied junior and senior high school students have found that those who indulged in the cyber world are more likely to confront health, academic or even family problems. Since video games is one of the key reasons behind cyber time, it has played a more dominant role even against sleep. Other studies point out that devoted gamers lose their temper easier, and often exhibit signs of aggression, absentmindedness, lack of discipline, low self-esteem, plummeting social skills, and anxiety toward the society.

A. Motivation

Compared to other stages of personal development, the teenage stage is not only a turning point in one's life, it also lays down a foundation for a durable healthy lifestyle. With a motive to promote health, this research is dedicated to look into the physical and psychological experiences of teenagers playing video games, and how the video games impact their physical and psychological well-being, self-esteem, and personal relationships. With this research, we assess the video game impacts on players' physical and

emotional conditions, and try to re-evaluate the recreational and entertaining merits of video games.

B. Objectives

Objectives of this research are as follows:

- To use profile of mood state (POMS) scale to measure the changes of emotions before and after playing video games.
- To find the effects on the sympathetic and parasympathetic systems before and after playing video games exhibited in heart rate variability (HRV).
- To find the time duration of effects after playing video games.

The flowchart of this research is displayed below in Figure 1:

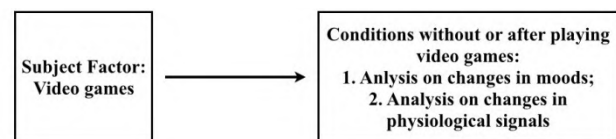


Figure 1. Research flowchart

C. Limitations

Given restrictions in time and manpower, this research is subject to limits and has a restricted scope, as follows:

- As subjects of this research are college students, and the desired trial period begins when the activity starts and ends when the person goes to sleep, only students residing in central Taiwan are selected for this research.
- The research was designed to take place when college students play video games, with the trial period between 9 and 12 pm, followed by a sleeping period of about five hours, for a total of around 9 hours.
- Given limitations in time, budget and manpower, this research consists of 20 subjects. Each subject is assigned to video game playing group once (as a testing group), and motionless book-reading group (as a control group), and for a total of sample collected data of 40.

II. RESEARCH STEPS

This research used POMS scale and electrocardiography (ECG) patch to measure moods and HRV for effects of playing video games on mental and physical health. The processes of the experiment related to the testing and control groups are shown in Figure 2 and Figure 3, respectively, with each group undertaking three steps, as follows:

A. Testing Group

- Subjects fill out a questionnaire on POMS, before they do the ECG device for the trial.
- After a ten-minute recess, subjects proceed into one-hour video game playing, and they repeat the entire process consisting of recess and game playing.
- When the second-round of game-playing is finished, the subjects take another ten-minute recess and then fill out the POMS for the second time. After another ten-minute recess, they sleep.

B. Control Group

- Subjects fill out two questionnaires: Questionnaire on Internet Addiction and POMS, before they do the ECG device for the trial.
- After a ten-minute recess, subjects proceed into a one-hour sedentary reading, and repeat the entire process consisting of recess and reading.
- When the second-round sedentary reading is finished, the subjects take another ten-minute recess and then fill out the POMS for the second time. After another ten-minute recess, they sleep.

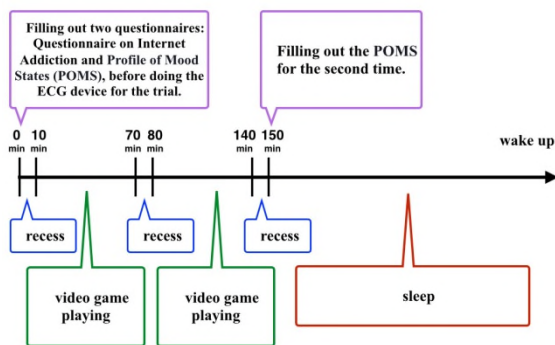


Figure 2. Steps undertaken by the testing group.

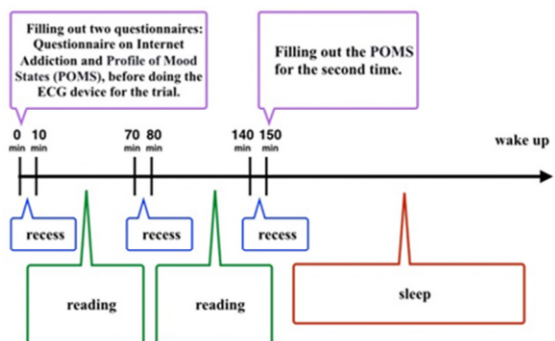


Figure 3. Steps undertaken by the control group.

III. RESEARCH METHODS

The physiological signals obtained from the ECG patch are digitalized into figures, before being analyzed by SPSS statistical software. Analysis are given on the physiological signals generated from the video game playing/book-reading of the testing and control groups, and including all the sleep stage.

The independent sample t test is used to compare the PMOS data and physiological signals before video game playing/book-reading of two group to ensure absence of discrepancy. However, paired- t test is used to test the data before and after experiment for each group to examine the effect of video game playing/book-reading.

IV. PROJECTED RESULTS

Our projected results are shown in Figure 4, Figure 5, Figure 6 and Figure 7:

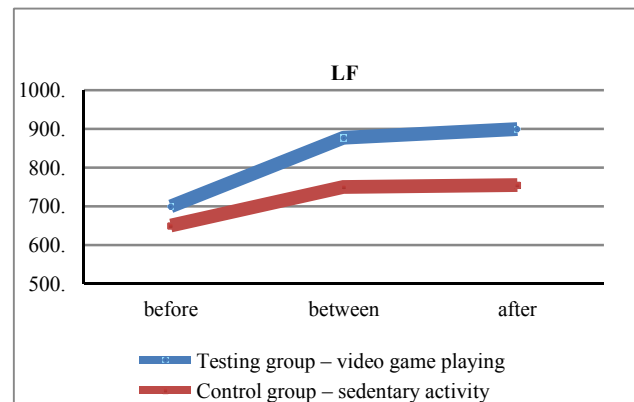


Figure 4. LF collected from the testing and control stages before, in between and after the video game playing and sedentary activity.

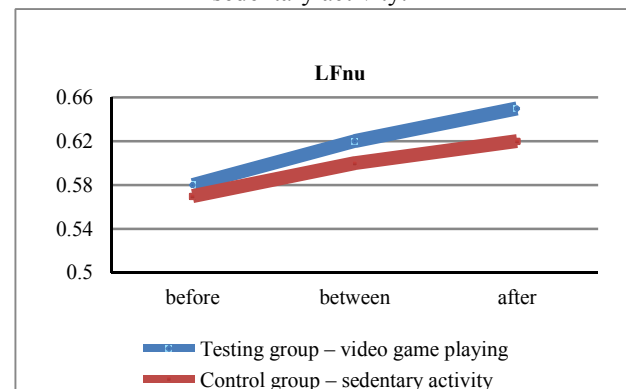


Figure 5. LFnu collected from the testing and control stages before, in between and after the video game playing and sedentary activity.

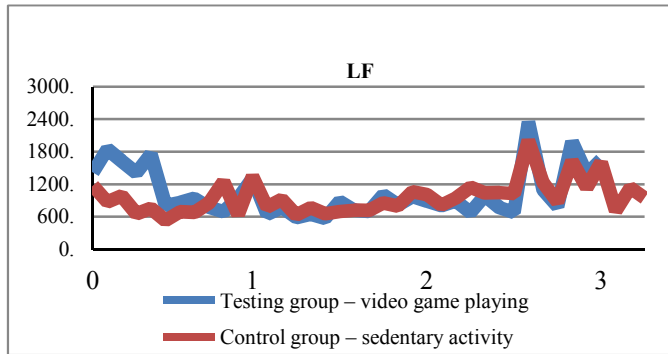


Figure 6. LF collected during the sleep of the testing and control stages.

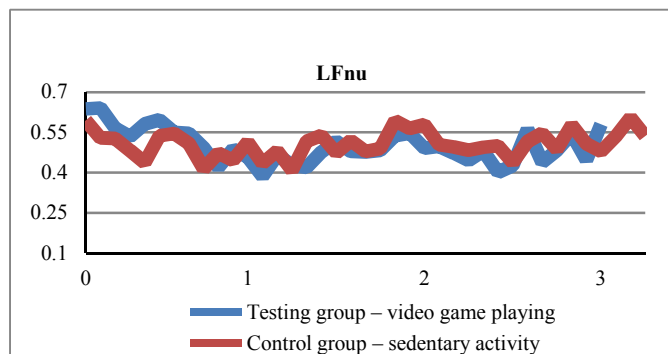


Figure 7. LFnu collected during the sleep of the testing and control stages.

V. CONCLUSION

The conclusion inferred from this research is the following:

- Based on the PMOS data collected before and after video game playing, the scores for fatigue of the testing stage increase notably, while the scores for vigor fall significantly. This dramatic change in scores is absent in the PMOS data of the control stage. It is concluded that after long-time video game playing, players start to feel higher level of fatigue and lower level of vigor.
- The physiological signals collected from the testing stage are not significantly different from that of the control stage. Still, the testing stage generates stronger physiological signals like LF and Lfnu, against the signals generated by the control stage. This suggests that, after long-time video game playing, players start to experience sympathetic and parasympathetic elevations.
- Within a thirty minutes period before sleeping, the testing stage generate higher LF, Lfnu and HF against the control stage. The assenting LFnu implies elevation of the sympathetic and parasympathetic energies, of which the former imposes greater impact on subjects. We thus can conclude that after playing the video games, players start to experience temporary sympathetic elevations that prevent sleeping or leads to

poor sleeping quality, and consequentially impose detrimental impacts on the physical well-being of players. That is why video game players should avoid playing video games for a long time or in the night so that their physical and mental well-being can be better protected.

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