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Effects of classical, film and video game music on creativity

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ABSTRACT

Classical music is commonly thought to enhance work performance. Previous studies have reported that, compared to the silence, listening to classical music with a positive mood and high arousal enhances creativity, but the effects for other music genres are unknown. Therefore, in addition to classical music, we measured the effects of film and video game music on creativity using the Alternative Uses Test (AUT). We also measured mood changes throughout the experiment and the Affective Value Scale of Music (AVSM) which is used to measure what type of affective values music has. The mood changes and AVSM results were used to analyze the effects of music on creativity. Twenty-four participants were subjected to two conditions for 15 minutes each, the silence and one of the three types of music. The results showed that there was no significant difference between with music and the silence, as well as among the three music types. Therefore, it is difficult to say that creativity can be enhanced by listening to music. However, the number of samples for each condition is insufficient to draw such a conclusion, and further studies are needed.

Keywords: Working Performance, Creativity, Background Music

1. INTRODUCTION

Creativity is needed to cultivate the ability for survival in the future global society [1–3]. Various ways to enhance creativity have been proposed, including brainstorming, listening to music, and the checklist (It was developed as a means of transforming an existing idea into a new one and is consisted of the following 9 questions: “Put to other uses?”, “Adapt?”, “Modify?”, “Magnify?”, “Minimize?”, “Substitute?”, “Rearrange?”, “Reverse?”, and “Combine?”.) developed by Osborn [4]. It has been suggested that music perceived as fun, cheerful, and exciting to the listener can enhance creativity, because listening to music is effective for mood induction [5–7], and a positive correlation has been reported between divergent thinking and increases in dopamine levels [8]. Nevertheless, the attributes of music, such as the tempo, tonality, instrumentation, melody, and loudness, are very complex, and the cognition of creativity differs across countries [9].

We approach this complexity from both the musical and educational aspects as a means of enhancing creativity. Ritter and Ferguson reported that, compared with a silence condition, listening to classical music that elicits positive mood and is high on arousal enhances the creativity score based on the overall divergent thinking score (originality, flexibility, fluency, and usefulness) [10]. Ueda reported that the higher the increase in the production rate of dopamine, the more divergent thinking was enhanced [8]. Therefore, creativity may be enhanced by listening to classical music, which causes the individual to cheer up and feel happier. However, the effects of other genres of music on creativity remain unknown.

According to a survey of creativity education around the world [11], from the viewpoint of education, it has been pointed out that there is no systematically or academically proven system for creative education. Japanese creativity education has been studied since the late 1950s, but the curriculum is not as substantial as that in the United States, the United Kingdom, China, or Finland [11]. In recent years, Science, Technology, Engineering, Art, and Mathematics (STEAM) education for children has spread around the world. STEAM education is one of the education policies enacted to enhance competitiveness in science and technology areas. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan has noted that creativity is one of the important abilities in STEAM education. MEXT has acted to make STEAM part of the mandatory education curriculum for

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all elementary and middle schools in Japan from 2020. However, the per student budget for the information and communication technology (ICT) environments necessary for STEAM education is very small at elementary, middle, and high schools in Japan [12]. It might therefore be possible to minimize the differences in learning environments compared with other foreign countries by increasing the budget for improving the ICT environment; however, teachers at public elementary and middle schools in Japan face additional problems.

The Organization for Economic Co-operation and Development conducted a survey on teachers' working hours at middle schools in 34 countries [13]. The world average was 34 hours a week, but Japan had the highest average, at 54 hours. The working environment for teachers in public elementary and middle schools in Japan is consequently becoming a social problem, especially in terms of death by overwork. Actually, the working time for teachers at public elementary and middle schools has increased monotonically since the latter half of the 1990s [14]. According to a survey conducted on 637 principals and 3289 teachers at public elementary schools from 1998 to 2016, the time spent at school in 2016 has been extended by 71 minutes compared with 1998. According to a survey conducted on 725 principals and 3689 teachers at public middle schools from 1997 to 2016, the time spent at school in 2016 has been extended by 68 minutes compared with 1997. Approximately 90% of public elementary and 83% of public middle school teachers feel that they do not have sufficient time for class preparation [14]. This has led to a decrease in the quality of teaching skills and student motivation during class [13]. White reported that the use of music during class is effective on elementary school students' motivation, positive behavior, relaxation, and staying on-task [15], which suggests that music could improve the quality of the classroom environment for many busy teachers.

Although classical music has been reported to enhance creativity [10], few studies have focused on the effects of other music genres on creativity. Many teachers at public elementary and middle schools are very busy in Japan compared with foreign countries. In our previous study, we investigated what kind of music participants aged 18–24 years old listened to while they were performing tasks such as writing a report or doing homework. We found that students most frequently listened to Japanese popular music and animation theme songs, followed by video game and film music [16]. Therefore, in the present study, in addition to classical music, we aimed to measure the effects of video game and film music on creativity. White reported that listening to music during class improved learning performance in fourth-grade students [15]. Based on the findings from that study, the goal of the present study was to verify whether the use of music during class at public elementary and middle schools is effective on learning motivation.

2. METHODS

2.1 Participants

Twenty-four university students (age range, 18–26 years) who were native speakers of Japanese and had self-reported normal hearing gave written informed consent to participate in the present study.

2.2 Experimental Conditions and Stimuli

The experimental conditions involved four types of music: classical, film music, video game soundtracks, and silence. The music conditions were instrumental, orchestral, and major key music. The details of the music conditions are shown in TABLE 1. Although video game and film music are not defined as a genre, we treated them as a different type of music because the structure of the ascending and descending melodic lines is different.

TABLE 1. Details of the music conditions

Type	Name	Composer
Classical	Tannhäuser, WWV 70: Festive March	Leonard Bernstein
Film	Coming Back Around, "How to train your dragon"	John Powell
Video game	Wind Garden, "Super Mario Galaxy"	Mahiko Yokota
Silence		

We edited classical music, film music, and video game soundtracks to play repeatedly for 15 min

using Audacity software. We normalized the peak magnitude to the value of 0.0 dB Full-Scale (dB FS). The audio file format was a .wav file, and the sampling frequency and bit rate were 44.1 kHz and 16 bits, respectively.

2.3 Creativity Measures

The Alternative Uses Test (AUT) [18] was used to measure the participants' creativity. We conducted the AUT twice to compare the test scores between the music and silence conditions (hereinafter referred to as AUT 1 and AUT 2, respectively). The AUT, in which participants are asked to think of as many uses as possible for a simple object, is one of the most frequency used tests for assessing creativity. A wood pencil and paper cup were used as test questions because no significant differences have been found in the test scores, and both have been shown to have a similar level of difficulty [17]. After listing as many uses as possible other than the original use of a wood pencil and paper cup, the participants had to consider the following three points: crafting should be limited to bonding and cutting, the number of uses of multiple pencils or paper cups is unlimited, and it should be up to 1 product when they bond with other products.

All ideas were calculated based on three characteristic indices of divergent thinking: fluency, flexibility, and originality [19]. Fluency is a measure of creativity production. Only complete ideas were included in the fluency test score; all vague ideas that did not have a purpose were excluded, in accordance with the guidelines (Guilford's Alternate Uses) [19]. Flexibility is the number of distinct idea categories. For example, when asked to list alternative uses for the paper cup, the answer "build a high tower, make a string telephone, use it as a dish" would lead to a score of three, as the ideas are assigned to three different idea categories: 'playing', 'crafting', and 'utensil'. This categorizing should be performed by two or more people to eliminate any categorization bias. However, the flexibility score in the present paper was scored by only one scorer because the experiment had not been completed. Originality is a measure of the uncommonness of an idea. First, all ideas are classified into test (a wood pencil/a paper cup) and experimental conditions (silence and music). If the ratio of the number of ideas answered in each group is 5% or less, 1 point is added, and if 1% or less, 2 points are added. Then, the total points represent the originality score.

2.4 Questionnaires

Questionnaires were divided into three parts. In part 1, we investigated arousal before AUT 1. In part 2, we investigated arousal and mood after AUT 1. In part 3, we investigated arousal and mood after AUT 2. After the participants completed these two questionnaires in part 3, they answered items regarding their study environment in daily life, gender, and age, and then provided free comments about the experiment. Further, we asked the participants to indicate which condition (music or silence) made them feel tired and which condition made them feel as though the experiment had gone quickly. We also asked the participants to evaluate the music condition ("Choose the most appropriate scale. Did you feel that the ascending and descending melodic lines of music influenced your concentration during AUT?") using a five-point Likert scale ranging from 1 (not at all) to 5 (very much) after the AUT under the music condition.

Next, we carried out the General Arousal Checklist (GACL) [20], General Affect Scale (GAS) [21], and Affective Value Scale of Music (AVSM) [22]. The GACL was used to measure arousal in parts 1–3. The GAS was used to measure mood after the AUT in parts 2 and 3. The AVSM was used to measure what type of affective values the music had. All three questionnaires are scored on a five-point Likert scale ranging from 1 (not at all) to 5 (very much). The GACL is composed of the following eight subscales for the item "Rank each subscale in regard to your current mood": Energetic, Vigorous, Sleepy, Nervous, Distracted, Relaxed, Sluggish, and Calm. The GAS is composed of the following six subscales for the item "Rank each subscale in regard to your mood during the experiment": Fun, Energetic, Depressed, Distracted, Calm, and Relaxed. The AVSM is composed of the following eight subscales for the item "Rank each subscale in regard to the affective value of the music you listened to": Cheery, Fun, Happy, Sad, Calm, Gentle, Quiet, and Magnificent.

To assess the participants' study environment in daily life, we asked them about the frequency that they usually listen to music during activities such as writing a report or doing homework using a five-point Likert scale ranging from 1 (never) to 5 (always). If the answer was 4 or 5, they had to answer what type of music they listen to. Next, they were asked to indicate the frequency that they engaged in a creative activity in daily life using a five-point Likert scale ranging from 1 (never) to 5 (always). If the answer was 4 or 5, they had to answer what their creative activity is and whether they

engage in it regularly. In the part of evaluation regarding music, we asked whether ascending and descending melodic lines influenced their concentration using a five-point Likert scale ranging from 1 (not at all) to 5 (very much).

2.5 Experimental Procedure

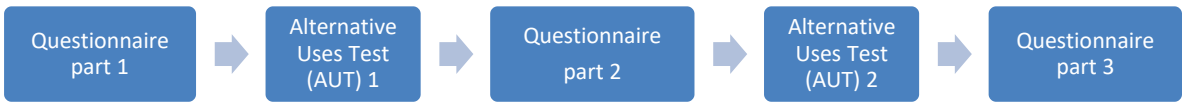

Figure 1. Experimental procedure

The participants were tested one by one in the order shown in Figure 1. In AUT 1 and AUT 2, the participants were randomly assigned to one of the music conditions or the silence condition. They were then tested for 15 minutes each during AUT 1 and AUT 2. We asked them to answer questionnaires 1–3 before and after AUT 1 and AUT 2. A break was provided between AUT 1 and AUT 2. All music stimuli were played on two loudspeakers (GENELEC 6010A) through an audio interface (TASCAM US 144mkII) on a Windows PC in a soundproof room, and the maximum sound pressure level was 50 dB, as measured by a sound level meter (RION, NL-31). Under the silence condition, a notification sound was played to indicate the start and end of the test. Under the music condition, a notification sound was played at the end of the test only.

3. RESULTS

We used the Statistical Package for the Social Sciences (SPSS) for all data analyses. A paired t-test was conducted to compare the total scores of the wood pencil and paper cup tests. No significant difference was found between the two tests, which suggests that the two tests had the same level of difficulty, in line with our previous result [16].

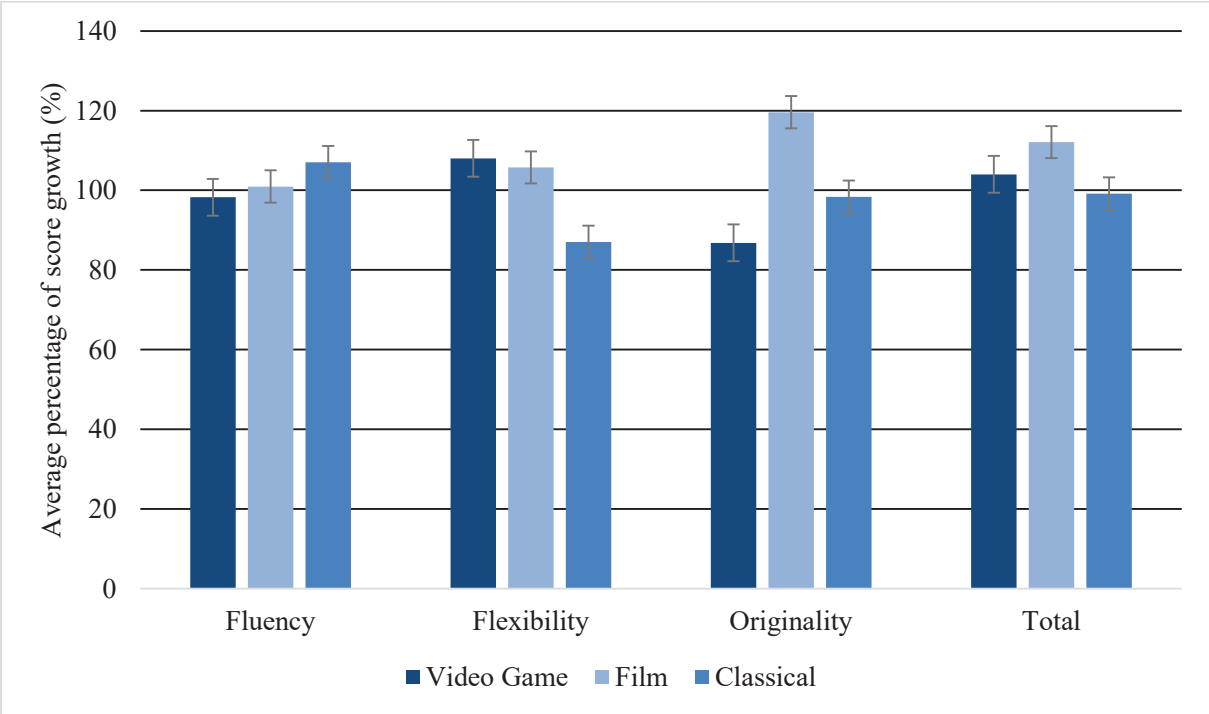

Figure 2. Average test scores under the music condition relative to that under the silence condition. Error bars represent standard errors.

Figure 2 shows the average test scores under the music condition relative to that under the silence condition. To assess whether listening to music enhanced creativity, we conducted Wilcoxon rank sum tests to compare the music and silence conditions for each test score. No significant difference was

found between the test scores under the music and silence conditions. This result did not agree with that from a previous study [10], which reported that listening to classical music enhanced creativity compared with silence. However, a trend was seen in which all creativity test scores were higher under the film music than under the silence condition.

The average score regarding the mood after the AUT in the film music group is shown in Figure 3. The horizontal axis is the GAS subscales. Wilcoxon signed-rank tests were conducted to compare the music condition and the silence condition after the AUT for GAS. No significant difference was found between silence and classical music or video game soundtracks. A significant difference was observed between silence and film music on only the Relaxed subscale. In addition, the two subscales of Fun and Energetic tended to be higher under the film music than under the silence condition. Ritter and Ferguson reported that participants under the music condition assigned music a significantly higher valence score than did participants under the calm, anxious, and sad music conditions [10]. In other words, music that reduced the participants' anxiety and boosted their mood positively had the effect of improving creativity. The mood induction of the film music was similar to that of music that reduces anxiety and boosts the participants' mood positively. We concluded that there might be a relationship between the trend of test score in the film music and the mood induction of the film music.

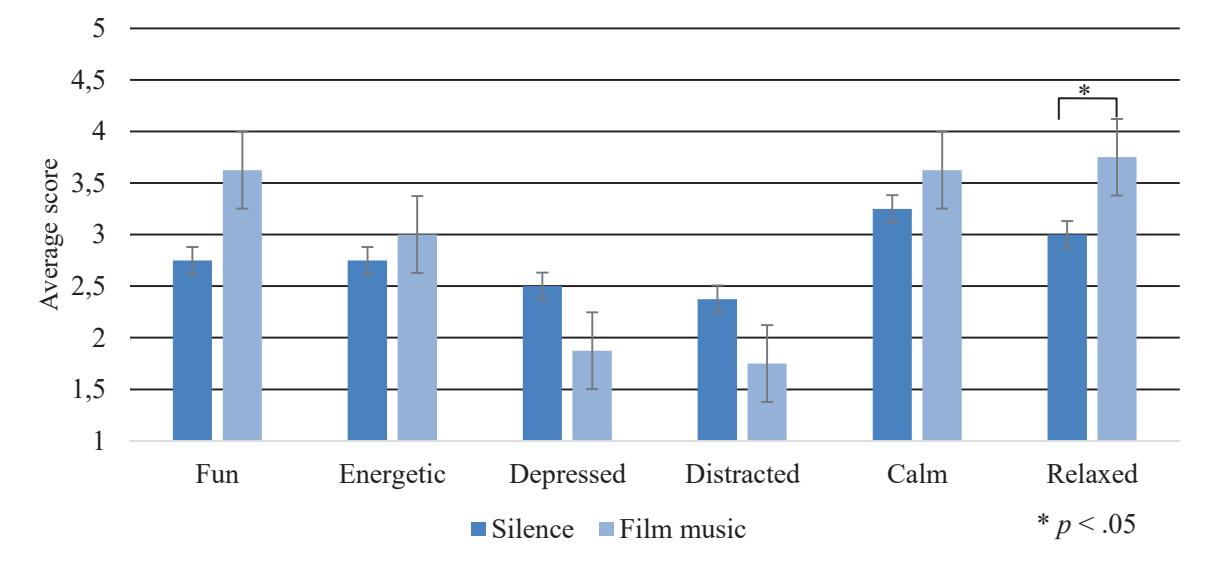

Figure 3. Average scores on a five-point Likert scale for the GAS in film music. Error bars represent standard errors.

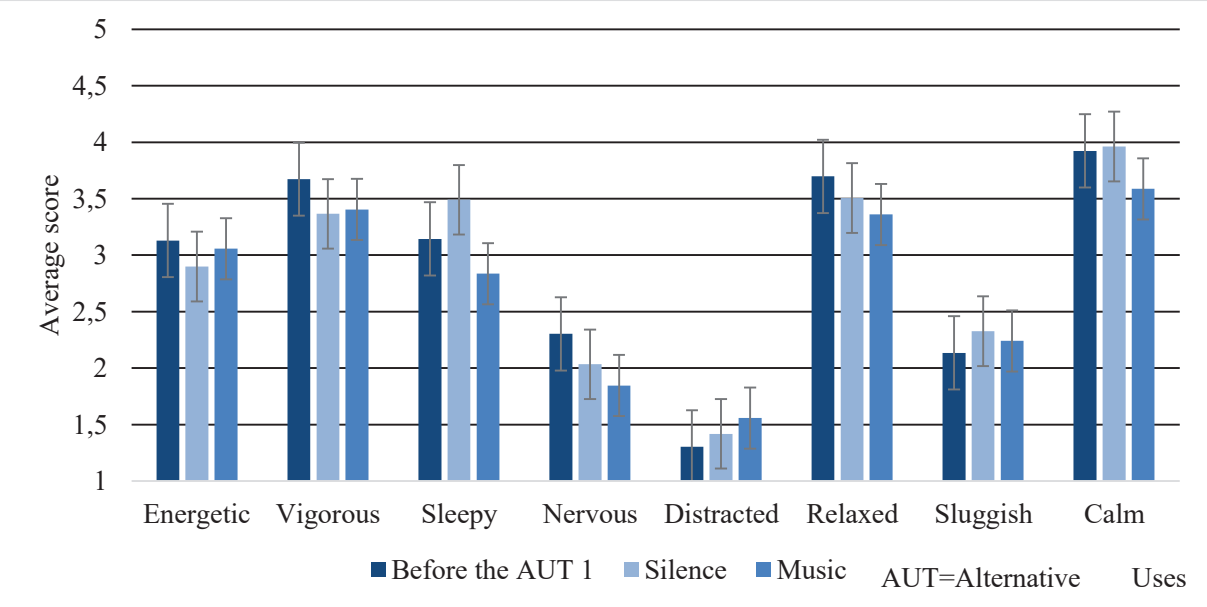

Figure 4. Average scores on a five-point Likert scale for the GACL. Error bars represent standard errors.

We used the GACL to measure the effects of music on arousal, and the AVSM to measure the characteristics of the music. Figure 4 shows the average scores on a five-point Likert scale for the GACL. We conducted Friedman tests to compare before AUT 1 with the music condition, before AUT 1 with the silence condition, and the music condition with the silence condition for each subscale. No significant differences were found for any of these comparisons.

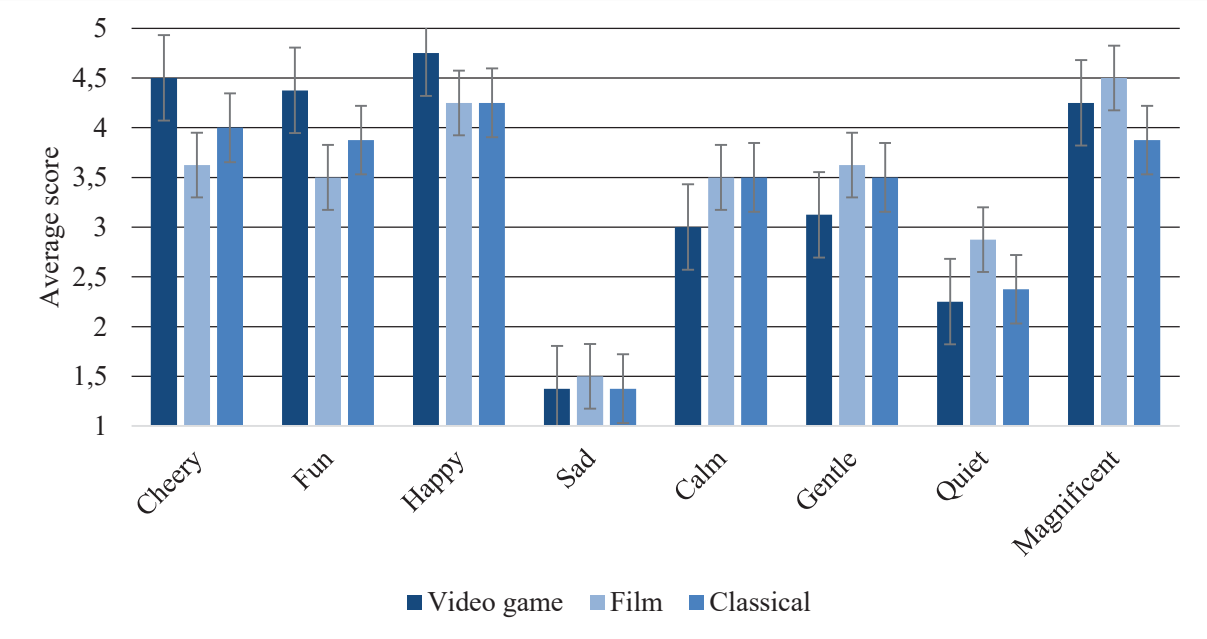

Figure 5. Average scores on a five-point Likert scale for the AVSM. Error bars represent standard errors.

Figure 5 shows the average scores on a five-point Likert scale for the AVSM. We found that all subscales under all music conditions were similar. The results of the AVSM can be used to determine what kinds of music features are suitable for enhancing creativity and to investigate relationships with mood induction. According to the previous study [10], it has been considered that the score of the subscales of Cheery, Fun, and Happy should be high as a characteristic of music for improving creativity. However, the results of this study showed that three subscales of Cheery, Fun, and Happy in the film music were lower than the other two genres, and three subscales of Sad, Gentle, Quiet in the film music were higher than the other two genres. These results may contribute to a research on music enhancing creativity.

The results suggest that it was difficult to support the hypothesis that listening to music can enhance creativity compared with the silence condition. According to the results of the GAS and GACL, no significant difference was found between the music condition and the silence condition, except for a significant difference for the Relaxed subscale under the film music condition, as shown in Figure 3. Further, we could not identify the effect of music on positive mood induction. These results were not in agreement with those from a previous study [10]. This was likely because music with lyrics was the most common answer for the question regarding what type music the participants listened to in part 3 of the questionnaire. This result was similar to that in our previous study [16]. The participants often listened to their favorite song to enhance her or his mood positively. Therefore, the music used in the present experiment did not sufficiently enhance the participants' mood positively.

4. CONCLUSIONS

In the present study, we measured the effects of classical music and movie and video game soundtracks on creativity using the AUT. We used the GAS, GACL, and AVSM as questionnaire surveys. Regarding the mood and arousal investigations of the GAS and GACL, no significant

difference was found between the music and silence conditions. However, a significant difference was observed for the Relaxed subscale under the film music condition. Mood induction by listening to film music tended to be positive. Moreover, we investigated the average test scores under the music condition relative to that under the silence condition. As a result, the average percentage was higher than 100% in the film music. According to the previous study [10], it is considered that the condition of the subscales of Cheery, Fun, and Happy is higher than that of other songs as a characteristic of music that promotes creativity. However, the film music had the features of being sadder, gentler, quieter, and more magnificent than the other two genres as shown in Figure 5. The previous study has not been demonstrated concretely the characteristic of music [10]. Hence, the characteristic of the film music may be associated with enhancing creativity.

Based on these findings, the hypothesis that listening to music can enhance creativity compared with silence was not supported. However, further studies are needed because the size of the sample was insufficient for statistical analysis.

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