

Evaluation of the Effect of Art Content on Mental States Using Mirror Display with AR Function

Ryohei Nakatsu
Design School
Kyoto University
Kyoto, Japan
ryohei.nakatsu@design.kyoto-u.ac.jp

Naoko Tosa
Graduate School of Advanced
Integrated Studies in Human
Survivability
Kyoto University
Kyoto, Japan
tosa.naoko.5c@kyoto-u.ac.jp

Satoshi Niiyama
AGC Inc.
Tokyo, Japan
satoshi.niiyama@agc.com

Takashi Kusumi
Graduate School of Education
Kyoto University
Kyoto, Japan
kusumi.takashi.7u@kyoto-u.ac.jp

Abstract—As there are many opportunities to look in a mirror in daily life, an interesting theme is to investigate what kind of effect it has when art content is displayed together at that time. A mirror display that has a display function, as well as a mirror function, has been put into practical use. Using the AR function of the mirror display, we carried out psychological experiments in which art content is displayed along with one's face and full-body images and it was evaluated how it affects mental state. By preliminary experiments, ten video artworks that are considered appropriate were selected as art content. Next, 35 subjects were asked to read aloud the scenarios prepared in advance to induct the stressed state and the depressed state. Then they watched the mirror display where the art content is displayed together with their face and whole-body images. The difference in the mental state between the art-display and the non-art-display conditions was compared and evaluated. As a result, it was revealed that without art content there was not much change in mental state, but when art content was displayed, the depressed or stressed state was improved to a normal state.

Keywords—*mirror display, art content, effect of art content, mental state, psychological experiment*

I. INTRODUCTION

It has been investigated that art has the power to enrich people's minds, sometimes to heal their minds, and to inspire their minds [1][2][3][4]. Art is an expression of the real world and artists' inner world that the artist perceived through his mind and can be thought of as the ultimate VR. However, art appreciation is often done in museums and art galleries, and it cannot be said that the power of art is fully utilized in people's daily lives. In order to enrich our daily lives, it is necessary to make more use of art in our daily lives.

On the other hand, we often look in the mirror in our daily lives. Getting up in the morning, washing our face, putting on makeup, and checking our clothes before going out is our daily normal routine. Isn't it possible to combine such actions with the power of art? We are often stressed and depressed in our busy daily lives. Isn't it possible to improve the stressed or depressed state by combining the daily act of looking in the mirror with the power of art?

Recently, a mirror display that has both mirror and display functions has been developed and is about to be introduced into

our lives [5][6][7]. By using the function of the mirror display, it is possible to display art images/videos at the same time when we see our face and whole-body image with the mirror. It is a very interesting research theme to investigate, if art is displayed at the same time when one's face or whole body image is reflected in the mirror using such a mechanism, how it affects our mind. Since the combination of art, the ultimate VR, and a mirror that reflects the real world is a typical AR (augmented reality), such research can be considered as an interesting application of AR.

In this paper, based on the above idea, we clarified the effect of art images on mental states by carrying out psychological experiments in which a face or whole-body image is displayed on a mirror and at the same time art images are displayed. The details of the experiment and its results will be described.

II. BASIC CONCEPT

A. Mirror display

Recently, several companies have put into practical use a mirror display that has both mirror and display functions. These are a combination of half mirrors, that have both mirror and glass functions, and computer displays and have been commercialized under names such as "mirror signage" or "magic mirror display" [6] [7]. In addition, half mirror film has been commercialized, and a simplified version of the mirror display can be completed simply by pasting the film on the display. Among these we have decided to use a mirror display developed by AGC Inc. and commercialized under the name of "Miralia" [5]. Its feature is that it utilizes the company's glass manufacturing technology to achieve a reflectance of about 65% for half mirrors, which is the same level as ordinary mirrors.

B. Mental state to be improved

We face various problems in our daily lives such as miscommunications with other people or delays in business progress, which affect our mental states. In order to improve these, we spend time by entertainment such as watching movies and TV or playing games, and we also take actions such as drinking alcohol. On the other hand, in this research, we will utilize the power of art. Specifically, we carried out our

experiment based on the assumption that if art content is displayed at the same time when one's face or whole-body image is reflected in the mirror, it may have a positive effect on mental state. Specifically, we have decided to verify whether the following two mental states can be improved or not by displaying art contents at the same time.

1) Stressed state: For this mental state we investigated whether art has a calming effect or not.

2) Depressed state: For this mental state we investigated whether art has an inspiring effect or not.

As a method of evaluating changes in mental state, we decided to use the methodology of psychological experiments, and evaluated the mental state of subjects by having them answer the questionnaire.

III. EXPERIMENTAL CONDITIONS

A. Subject

35 voluntary students and staffs from Kyoto University were used as subjects. The configuration is as follows.

30 students: 20 males, 10 females (ages 20s)

5 staff members: 5 women (ages 30-40 years old)

Since there are 20 males and 15 females, it is considered that the male-female ratio is well-balanced. Since this is the first time for the subjects to experience a mirror display, we briefly explained them the functions of the mirror display before starting the experiment.

B. Experimental environment

A small and a large mirror displays were used. The small mirror display is supposed to be used for grooming. However, since this experiment was conducted in our laboratory, the subjects did not actually wash their faces or brush their teeth, and they were instructed to "look in the mirror while imagining such a situation." In addition, for the large mirror display we gave the subjects an instruction to "imagine a scene where you see your whole-body and check your clothes before going out."

C. Art content

As the video content to be used for the experiment, 10 types of video artworks, that have been created by Naoko Tosa [8][9][10], one of the authors, and that are considered to have the capability to calm and inspire the mind, were selected based on our experience. As will be described later, a preliminary experiment was conducted with a small number of subjects, and it was decided to use them for the main experiment after verifying that these contents actually have a calming and/or inspiring function.



D. Display of art content

When displaying art content, different methods were used for the small mirror display and the large mirror display.

In the case of a small mirror display, it is expected that the person who uses it will mainly see his/her face. So, we decided to make it easier to see the face by masking a part of the video content to be displayed. As for which part to mask, if the face is considered as the center, it is conceivable to mask in a circle near the center. However, at the same time, since the area near the center of the art video content is important, we decided to mask about 30% of the right side of the video content in our experiment.

Figure 1 shows an example of the masked video content. In addition, Fig. 2 shows how it actually looks like from the subject's point of view. The left side of Fig. 2 is a state where the face overlaps with the video content, and the face is obstructed by the video content and cannot be seen well, so it is difficult to use when getting dressed or brushing teeth. The right side of Fig. 2 shows the face on the masked portion. In this case, it is possible to shift attention to the video content at any time while looking at one's face. During the experiment, the subjects were given an instruction, "If you want to see your face firmly, use the right part with the mask."



Fig. 1. Example of video art content with a mask

Fig. 2. Video content and face seen from the subject's point of view

In the case of a large mirror display, it is difficult to mask a part of the video content because the mirror shows the whole-body. Therefore, by changing the transparency of the video content, we decided to make the video content visible while looking at one's whole-body image. The transparency ratio was set to 50% based on preliminary experiments. The left side of Fig. 3 shows a state in which the whole-body is reflected as a mirror. The right side of Fig. 3 shows a state in which the video content and the whole-body image are superimposed.



Fig. 3. Example of using a big mirror display (Left: The state without the art content, Right: The state with the art content overlapped with human image)

E. Setting of mental state

In order for the subjects to be in a stressed or depressed state, we decided to prepare scenarios corresponding to these situations and have the subjects read them out before each experiment.

- Scenarios corresponding to the stressed state: 4 types
- Scenarios corresponding to the depressed state: 4 types

F. Procedure of the experiment

For each subject, mental state of two conditions, stressed/depressed, and two display conditions, human figure only/human figure + art content, make 4 conditions, which was arranged in random order for each subject. The experiment was conducted according to the following time flow for each condition (Fig. 4).

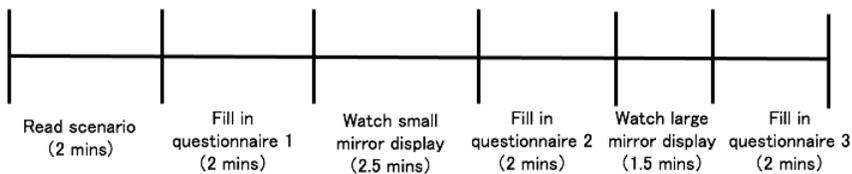


Fig. 4. Time flow of the experiment

The length of the small display gaze time of 2 minutes and 30 seconds and the length of the large display gaze time of 1 minute and 30 seconds were set as appropriate by preliminary experiments with a small number of subjects. Since the total time required for the experiment under one condition was 12 minutes, it took about 50 minutes for each subject, including the instruction time.

G. Evaluation items

The following eight evaluation items were prepared to check whether or not the mind is stressed and whether or not the mind is depressed. Each item was evaluated on a 7-point scale.

1) Question items regarding whether or not the mind is stressed (A)

- Can you get rid of tiredness? (A1)
- Can you relax? (A2)
- Can your stress be removed? (A3)
- Can you forget bad things? (A4)

2) Question items regarding whether or not the mind is depressed (B)

- Does energy come out? (B1)
- Are you motivated? (B2)
- Can you be creative? (B3)

- Can you face difficulties? (B4)

IV. PRELIMINARY EXPERIMENT

A. Purpose

The preliminary experiment was conducted to select the content to be used in the main experiment.

B. Video content

As was described before, out of the video art produced by one of the authors, Naoko Tosa, we selected 10 types of video content (Content 1 to Content 10) that are considered appropriate based on our experience.

C. Procedure

We asked 10 subjects to watch each of the above contents for 3 minutes and asked them to evaluate it according to the evaluation items described in Section III.G.

D. Results

Figures 5 and 6 show typical results of the experiment. The correspondence between the content numbers in the figures and the evaluation items is same as described in Section III.G.

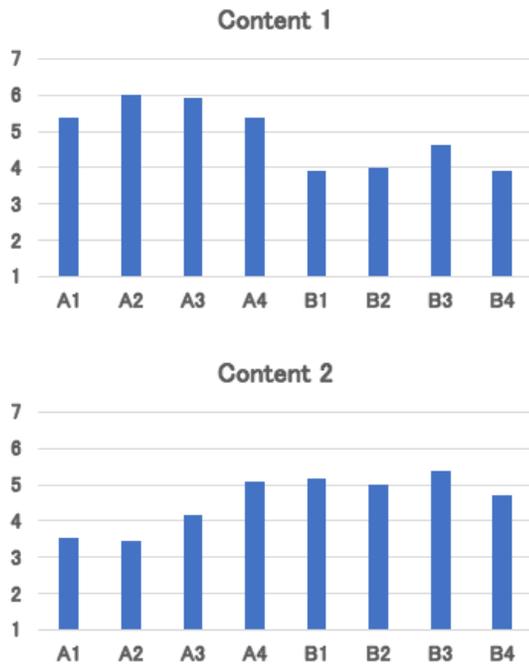


Fig. 5. Typical preliminary experiment results 1

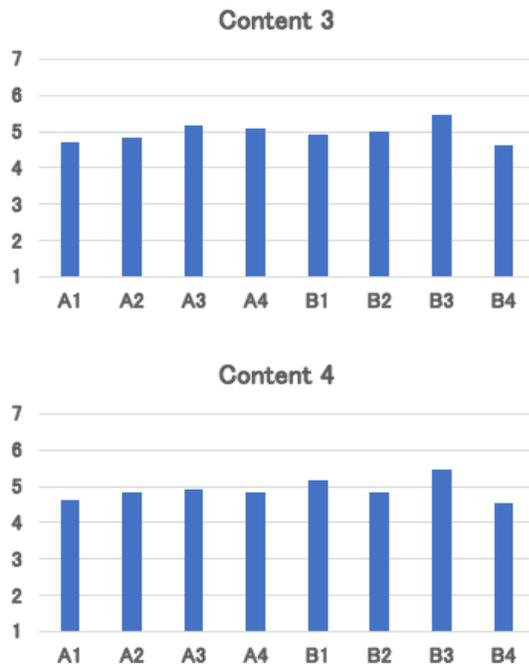


Fig. 6. Typical preliminary experimental results 2

E. Discussion

The followings are the results of the preliminary experiment.

- Each content were rated at midpoint score of 4 or higher for almost all items, so it is suitable to use these contents in the main experiment.
- Several types of content have obtained evaluation results that are biased toward "whether or not the stressed state is improved" and "whether or not the depressed state is improved" (Fig. 5).
- Several other types of content have been highly evaluated for both "whether or not the the stressed state is improved" and "whether or not the depressed stare is improved" (Fig. 6).

Based on these results, it was decided to classify 10 types of content into one of "content corresponding to stressed state" and "content corresponding to depressed state."

V. MAIN EXPERIMENT

A. Procedure

A psychological experiment was conducted under the experimental conditions described in Section III. For each experiment, depending on the stressed state or the depressed state, an art content corresponding to the state was randomly selected and was displayed on the mirror display.

B. Results

First, answers to the four types of questions regarding "whether or not the stressed state is improved" and "whether or not the depressed state is improved" were averaged for each subject, and the averaged results were obtained for all the question items. The results are shown in Figs. 7 and 8 for the average scores. Also, Figures 9 – 18 show the results for each question item.

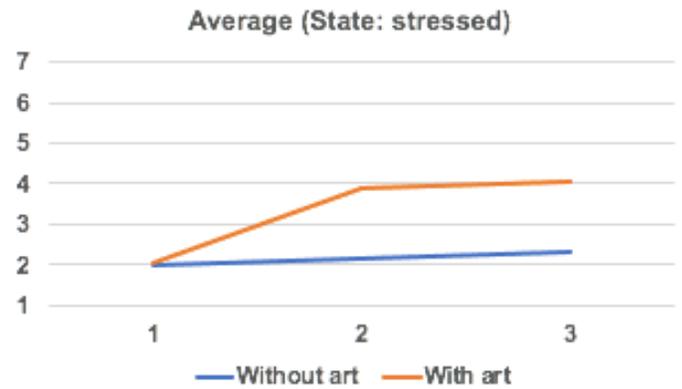


Fig. 7. Result for whether stressed state is improved or not (1: After reading the scenario, 2: After watching the small mirror display, 3: After watching the large display)

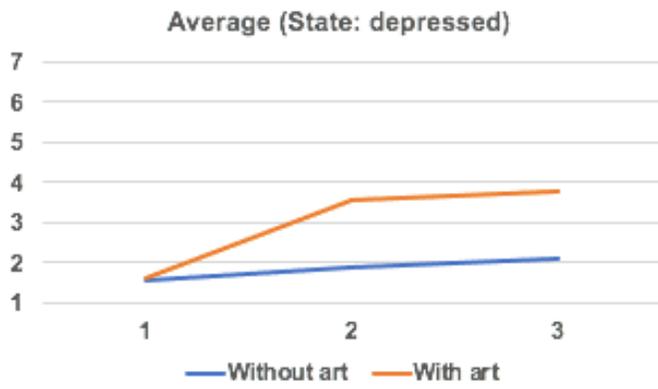


Fig. 8. Result for whether or not depressed statet is improved"

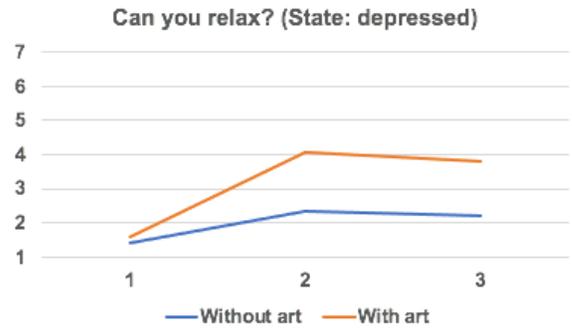
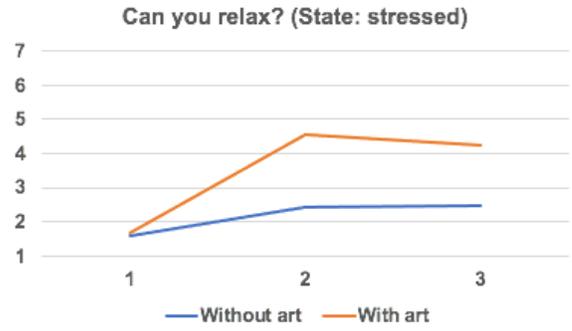


Fig. 10. Results for the question "Can you relax?"

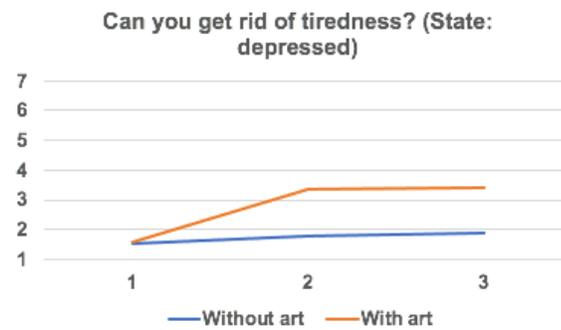
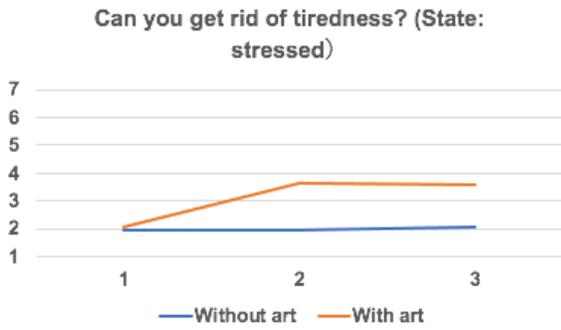


Fig. 9. Results for the question "Can you get rid of tiredness?"

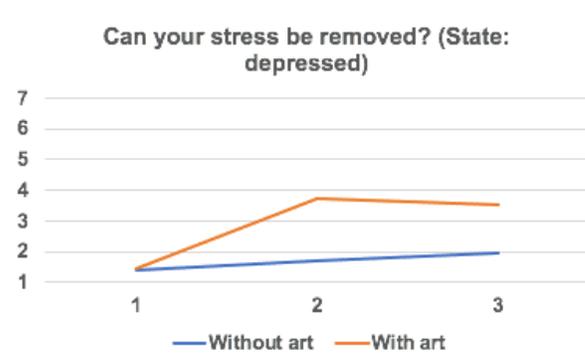
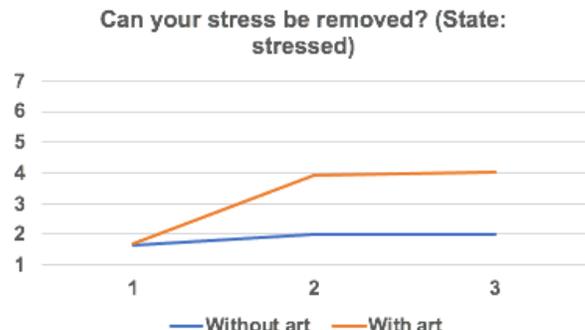


Fig. 11. Results for the question "Can your stress be removed?"

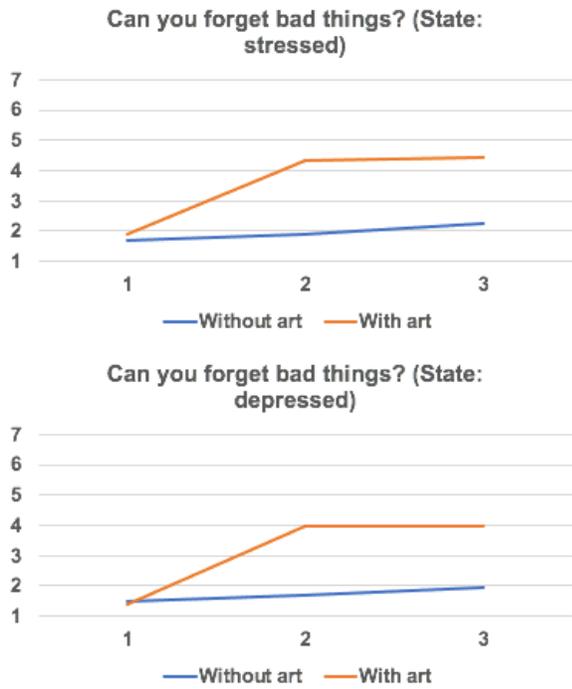


Fig. 12. Results for the question "Can you forget bad things?"

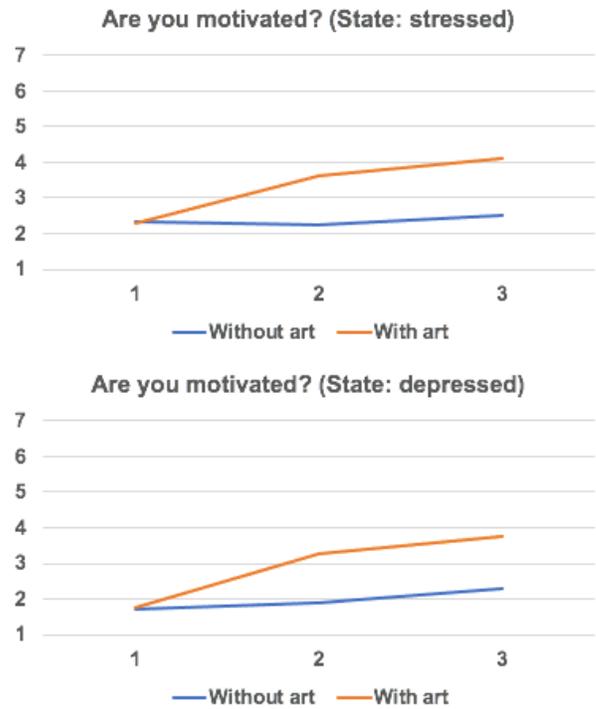


Fig. 14. Results for the question "Are you motivated?"

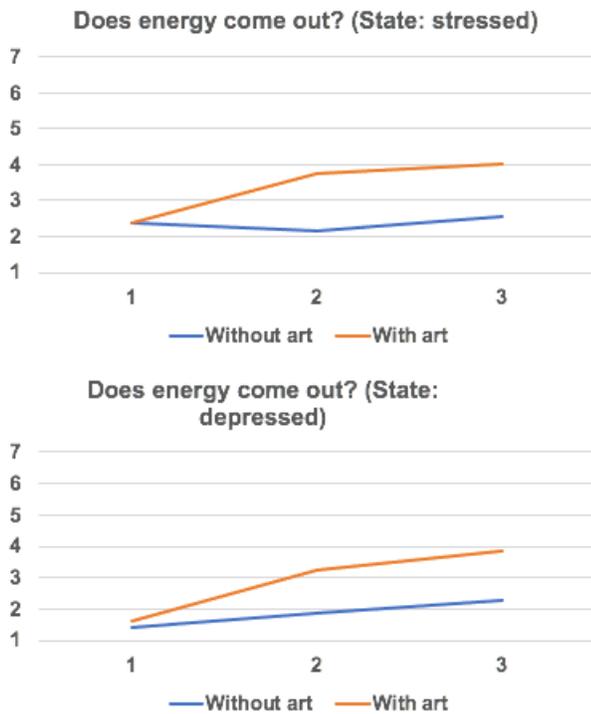


Fig. 13. Results for the question "Does energy come out?"

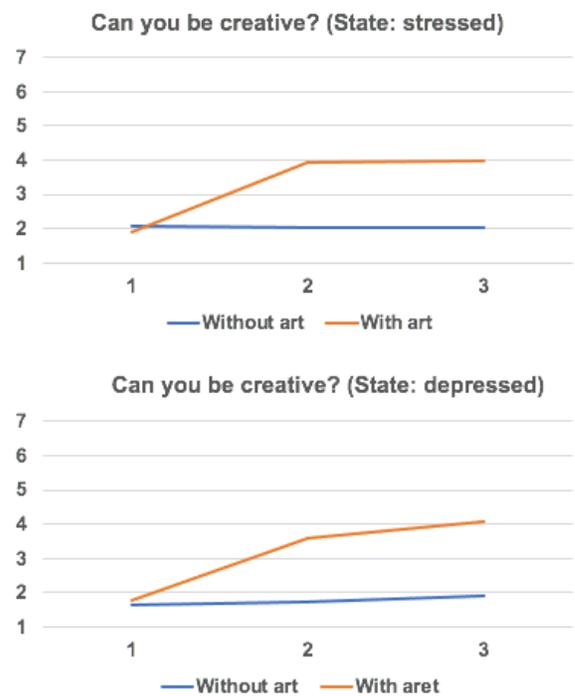


Fig. 15. Results for the question "Can you be creative?"

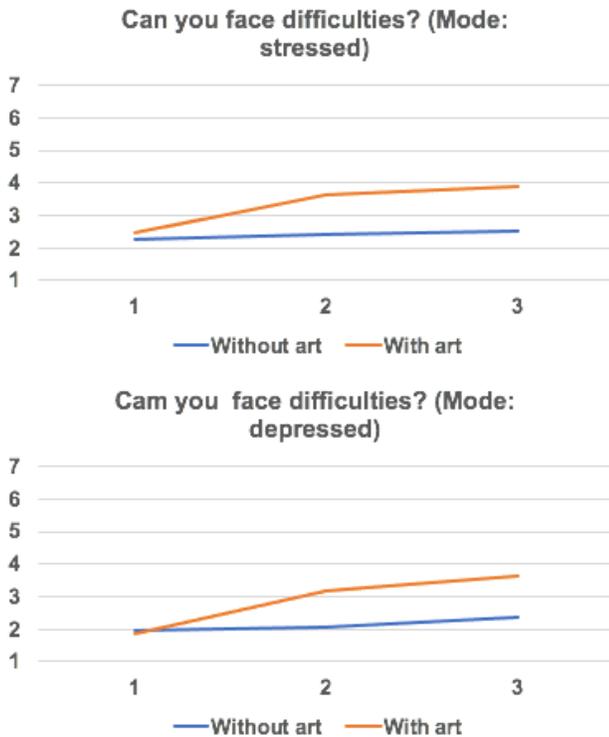


Fig. 16. Results for the question "Can you face difficulties?"

C. Discussion

1) The averaged scores (Figs. 7–8)

- In both cases of "whether or not the stressed state is improved" and "whether or not the depressed state is improved", the mental state is improved by two levels when the art content is displayed. On the other hand, when there is no art content, the improvement was limited to about 0.5 level.
- In the case of "whether or not the stressed state is improved", the score of 2 is improved to the score of 4. In other words, the state of feeling strong stress is improved to almost normal state.
- In the case of "whether or not the depressed state is improved", the state of score of 2 or less is improved to the score of about 3.5.
- There is not much improvement by looking at the large display after the small display. This should be considered to be an issue for future study.

2) The scores corresponding to each question (Figs. 9–16)

- The results for individual questions are basically the same as those in Figs. 7 and 8. When the art content is not displayed, the improvement of the mental state is less than 0.5 before and after looking at the mirror, but when the art content is displayed, the score is improved by about 2.

- The results after using a large mirror display with art content are slightly different between the question group A ("Is the stressed state improved?") and B ("Is the depressed state improved?"). For the latter question, by looking at the small mirror display followed by the large mirror display, the results continue to improve. On the other hand, for the former question, looking at the large mirror display after looking at the small mirror display did not improve the result. Rather, for some questions, there are some cases where the results are a bit worse after looking at the large mirror display.
- This is based on the assumption that the scene of looking at a large mirror display means going out for work, etc. The question group of B asks whether the mind is positive or not. So the subject tends to have the feeling that "I can do it." It is thought that displaying art in such a case tends to have a positive effect on the mind.
- On the other hand, the question group of A asks if the mind is resting comfortably. It is easy to make the subject feel like "I want to relax without working." At the same time, looking at the large mirror display would request the subjects to be ready for work. Therefore, it is thought that the display of art content in such cases would have the opposite effect on their mental state.

VI. CONCLUSION AND FUTURE RESEARCH

Various studies have been conducted regarding the influence of art on mental states, but most of them are for art appreciation in museums, etc. There are still few studies on how to utilize the power of art in daily life. We conducted experiments to evaluate the effect of art on mental states in an AR environment with the aim of utilizing art to improve a person's mental state in daily life. Specifically, we evaluated the effect of displaying art content on mental states together with displaying a human face or whole-body image using a mirror display that has both mirror and display functions by carrying out psychological experiments.

First, ten art contents were selected from the video artworks created by one of the authors, Naoko Tosa, based on our experience expecting that these have the effect of improving the state of being stressed or depressed. By preliminary experiments it was confirmed that all of the art contents have the effect of improving mental states. Next, as a main experiment, we constructed an environment where situations such as watching our face or whole-body image in a mirror using small and large mirror displays are simulated and tested the effect of displaying the ten art contents selected in the preliminary experiment along with human face or whole-body image. A psychological experiment was conducted in which 35 subjects were asked to comparatively evaluate between the case where the art content was displayed together with their face/body images and the case where the art content was not displayed on a 7-point scale. As a result, it was found that when the art content is displayed together, in both the stressed case and the depressed case, the mental state of the subjects is improved by two levels as compared with the case where the art contents is not displayed together.

In the future, by conducting a more detailed analysis, the relationship between art content and improvement of human

mental state and also the gender difference will be clarified. In addition, since most of the subjects of this experiment are relatively young people, it is necessary to examine how art changes the mental state in the case of people of other ages.

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