

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

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Keywords: Mirror display, Art content, Effect of art content, Mental state, Psychological experiment

## ABSTRACT

*There are many opportunities for people to look into a mirror in daily life. What kind of effect it has when art content is displayed together? Using a mirror display that has both display and mirror functions, we carried out psychological experiments in which art content is displayed along with one's face and full-body images, and how it affects mental state was evaluated. Ten video artworks that are considered appropriate were selected as art contents. Thirty five subjects read scenarios prepared in advance to be inducted into a stressed state or a depressed state. Then, they watched the mirror display and the differences in their mental states between the art-display and the non-art-display conditions were compared. It was revealed that, when art content was displayed, the depressed and the stressed states were improved to a normal state.*

## 1 Introduction

It has been investigated that art has the power to heal and inspire human minds [1][2][3][4]. Art is an expression of artists' inner world and can be thought of as the ultimate VR. However, art appreciation is often done in museums and art galleries, and the power of art is not fully utilized in our daily lives.

We often look into a mirror in our daily lives. Washing our faces, putting on makeup, and checking our clothes are our daily normal routines. Isn't it possible to improve our stressed or depressed mental state by combining the daily act of looking into the mirror with the power of art?

Recently, a mirror display that has both mirror and display functions has been developed [5][6][7]. By using the function, it is possible to display art images/videos at the same time when we see our face and whole-body image. It is an interesting research theme to investigate, if art is displayed using such a mechanism, how it affects our mind. Since the combination of art and a mirror that reflects the real world is a typical AR (augmented reality), such research is an interesting application of VR/AR. In this paper, we will clarify the effect of art contents on mental states by carrying out psychological experiments.

## 2 Basic Concept

### 2.1 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 display [5] [6] [7]. Among these, we have decided to use a mirror display developed and commercialized by AGC Inc. [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.

### 2.2 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. To improve these, we spend time on entertainment such as watching movies and TV or playing games. On the other hand, in this research, the power of art will be used. An experiment is carried out based on an assumption that, if art content is displayed at the same time when our face or whole-body image is reflected in the mirror, it would have a positive effect on our mental state. Specifically, it is investigated whether the following two mental states can be improved or not.

- Stressed state: For this mental state whether art has a calming effect or not is investigated.
- Depressed state: For this mental state whether art has an inspiring effect or not is investigated.

As a method of evaluating changes in mental state, the methodology of psychological experiments using subjects is adopted.

## 3 Experimental Conditions

### 3.1 Subject

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

- Students: 20 males and 10 females (ages: 20s)
- Staff members: 5 females (ages: 30s-40s)

Since this is the first time for the subjects to experience a mirror display, we briefly explained to them the functions of the mirror display before starting the experiment.

### 3.2 Experimental environment

A small and a large mirror displays were used. The small mirror display was supposed to be used for grooming. Since the experiment was conducted in our

laboratory, the subjects were instructed to "look into the mirror while imagining you are washing your face or brushing your teeth." For the large mirror display, they were given an instruction to "imagine a scene when you see your whole body and check your clothes before going out."

### 3.3 Art content

As the video content to be used for the experiment, 10 types of video artworks, created by Naoko Tosa [8][9][10] one of the authors and are considered to have the capability to calm and inspire human mind, were selected. A preliminary experiment was conducted with a small number of subjects evaluating each content. Based on the results each content was allocated to either stressed state or depressed state to be used for the experiment.

### 3.4 Display of art content

In the case of a small mirror display, it is expected that a 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, 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 (Fig. 1).



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

Figure 2 shows how it looks like from the subject's point of view. The left side of Fig. 2 is a state where the face image overlaps with the video content, so it is difficult to use when washing faces or brushing teeth. The right side of Fig. 2 shows the face image 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.



Fig. 2. Video content and face seen from the subject's point of view. (Left: The face image overlaps with the video content, Right: The face image is on the masked part.)

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 in a mirror. The right side of Fig. 3 shows a state in which the video content and the whole-body image are superimposed.

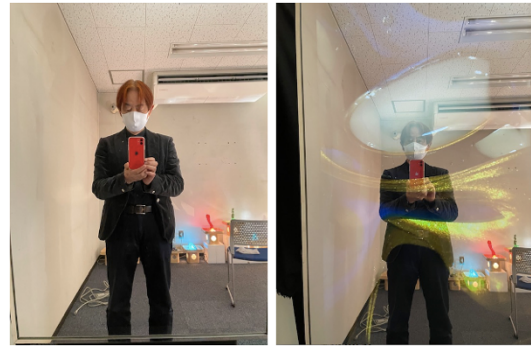


Fig. 3. Video content and face seen from the subject's point of view.

### 3.5 Setting of mental state

For the subjects to be in a stressed or depressed state, we prepared scenarios corresponding to each of 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

### 3.6 Procedure of the experiment and evaluation item

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

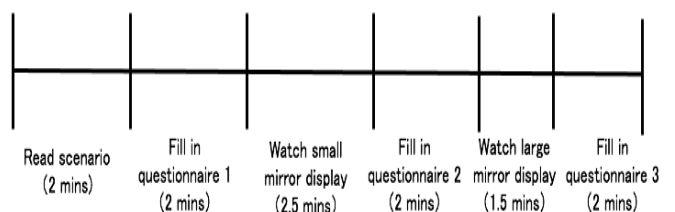


Fig. 4. Time flow of the experiment

The length of the small and large display gaze time was decided as appropriate by preliminary experiments with a small number of subjects.

The eight evaluation items were prepared to check whether or not the mind is stressed or depressed as

shown in Table. 1. Each item was evaluated on a 7-point scale.

**Table 1. Evaluation items.**

Question items to evaluate whether or not the mind is stressed (A)	Question items to evaluate whether or not the mind is depressed (B)
Can you get rid of tiredness? (A1)	Does energy come out? (B1)
Can you relax? (A2)	Are you motivated? (B2)
Can your stress be removed? (A3)	Can you be creative? (B3)
Can you forget bad things? (A4)	Can you face difficulties? (B4)

## 4 Experiment

A psychological experiment was conducted under the experimental conditions described in Chapter 3. 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.

### 4.1 Results

First, answers to the four types of questions regarding "whether or not the mind is stressed" and "whether or not the mind is depressed" were averaged for all subjects. The results are shown in Fig. 5 for the average scores and the standard deviations. Also, Figs. 6-13 show the results for each question item. (Figs. 6-13 are shown at the end of the paper.)

This experiment consists of two conditions; related to the content (with/without art) and the timing of evaluation (after reading the scenario/after watching the small mirror display/after watching the large mirror display). Therefore, two way analysis of variance (two way ANOVA) was performed. Figure 5 also shows the results of multiple comparisons using the Holm method (\*\* indicates the significance of  $p < .001$ ).

## 4.2 Discussion

### Average score (Fig. 5)

In both cases of "whether or not the mind is stressed" and "whether or not the mind is depressed", the mental state is improved by about 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 mind is stressed," the score of 2 is improved to the score of 4. In other words, the state of feeling stress is improved to a normal state. In the case of "whether or not the mind is depressed", the state of the score of less than 1.7 is improved to the score of about 3.7.

At the same time, there is not much improvement by looking at the large display after the small display. This should be an issue for future studies.

### Scores corresponding to each question (Figs. 6–13)

The results for individual questions are similar to those in Fig. 5. However, the result after using a large mirror display with art content is slightly different for some evaluation item. For the question "can your stress be removed?", looking at the large mirror display after the small display decreased the evaluation value. This may be based on the assumption that, as the question A3 asks if the mind is resting comfortably, probably the display of art content in such a case might have the opposite effect on their mental state.

### Results of multiple comparison (Fig. 5)

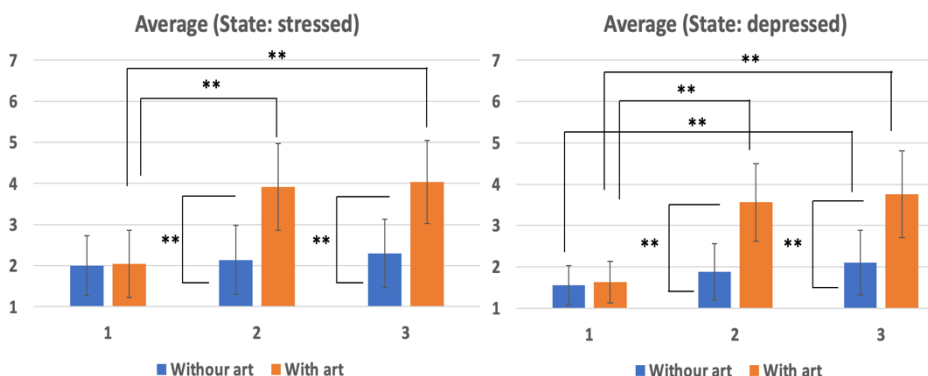
When art is displayed, in both the stressed state and the depressed states, there is a significant difference between timing 1 and timings 2, 3 under the 1% condition, and timings 2 and 3 are not significantly different. In addition, in comparison with the case without art, it was shown that there was a significant difference in timings 2 and 3 under the 1% condition.

## 5 Conclusion

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.

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. As a result, it was found that when the art content was displayed together, in both the stressed



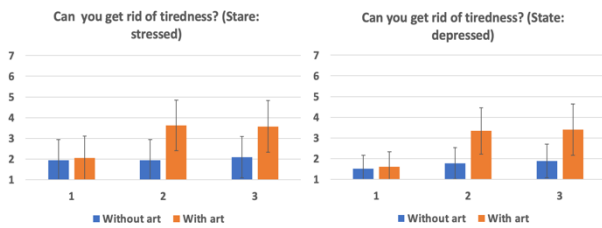
**Fig. 5. Result for average score (1: After reading the scenario, 2: After watching the small mirror display, 3: After watching the large display)**

case and the depressed case, the mental state of the subjects was improved by two levels as compared with the case where the art contents were not displayed together.

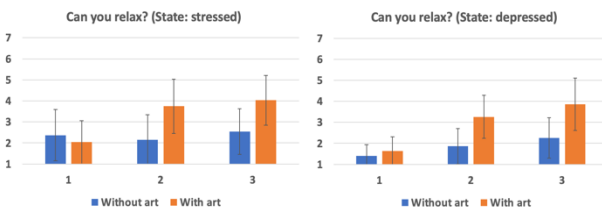
As future work, we plan to carry out similar experiments in a more realistic situation such as at homes or at hotels to clarify that art contents have the power to improve people's stressed and depressed states.

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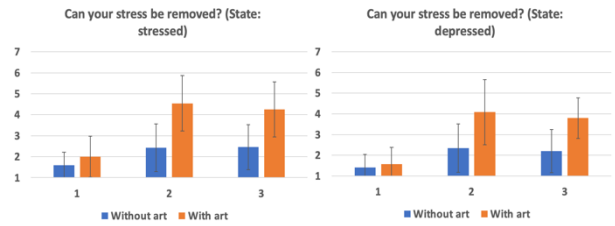
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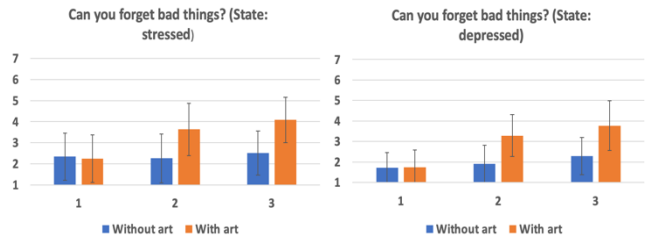
**Fig. 6. Results for the question A1**



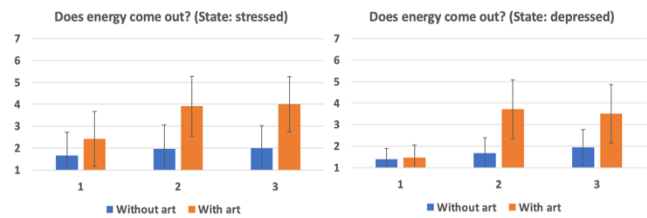
**Fig. 7. Results for the question A2**



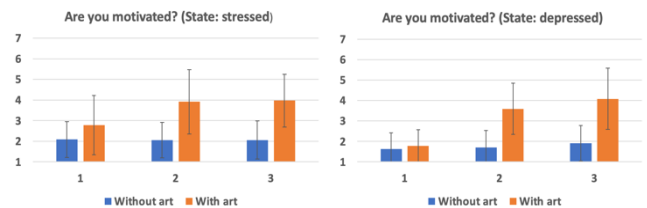
**Fig. 8. Results for the question A3**



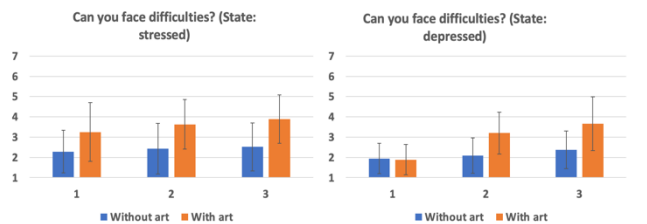
**Fig. 9. Results for the question A4**



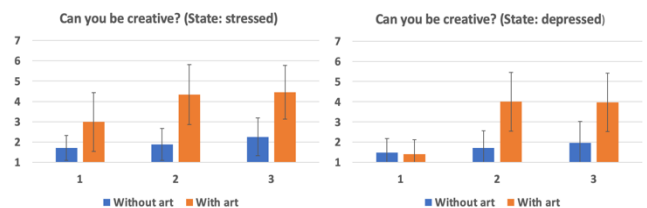
**Fig. 10. Results for the question B1**



**Fig. 11. Results for the question B2**



**Fig. 12. Results for the question B3**



**Fig. 13. Results for the question B4**