

Psychological Evaluation of the Effects of Exposure to Projector Light while Viewing Art

Ryohei Nakatsu¹, Shun Kanai¹, Go Kazawa¹, Kazuyoshi Kitabayashi², Hirotaka Kawata², Manae Miyata², Naoko Tosa¹

nakatsu.ryohei@gmail.com

¹Kyoto University, Sakyo, Kyoto, 606-8501 Japan

²Seiko Epson Corporation, Nagano, 399-8285 Japan

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ABSTRACT

When projecting art and other contents using a projector, entering the space where the contents are projected is considered adequate. The purpose of this study is to confirm the effectiveness of this method through a psychological experiment. We constructed a space in our laboratory where art can be projected and viewed and asked subjects to view art contents under three viewing conditions (Condition 1: Outside the projection space, sitting on a chair; Condition 2: Inside the space, sitting on a chair; Condition 3: Inside the space, sitting on a floor), and to evaluate the experience in terms of "Impression," "Relaxation," "Motivation," and "Creativity." As a result, Condition 2 was rated higher than the other conditions in "Relaxation," partially confirming the effect of entering the projection space to view the art. However, there was little difference between "Impression," "Motivation," and "Creativity." Therefore, further experiments need to be conducted to clarify the effects of entering the projection space and viewing art content.

1 Introduction

A form of art exhibition displaying art videos or images using a projector is becoming increasingly popular. Projection mapping, for example, is widely accepted because it can artistically transform an entire environment by projecting contents onto an existing three-dimensional object, such as a building [1][2].

Another exhibition format is one in which artwork is projected onto the entire space, including the floor and the viewer entering the space. This exhibition format was often avoided because it would result in a portion of the content being projected onto the viewer's body or the viewer's shadow being displayed.



Fig. 1. Exhibit in the Invisible World at the New York Museum of Natural History.

(<https://www.amnh.org/exhibitions/invisible-worlds>)

However, this form of viewing is becoming increasingly

popular because the viewer is exposed to the light from the projector. A portion of the content is projected onto his/her body, giving the viewer a sense of being one with the content. For example, exhibits at Invisible World at the NY Museum of Natural History [3] and the Teamlab exhibit [4] use an exhibition format in which the viewer is exposed to light from a projector, and a portion of the content is projected onto the viewer's body. Figure 1 shows a view of the exhibit at the NY Museum of Natural History.

However, experiments have yet to be conducted to confirm this. With the above background, this research evaluates, through a psychological experiment, how exposure to light and the projection of art content on the body psychologically impacts the viewer when viewing an artwork such as video art.

2 Method of Psychological Evaluation Experiment

2.1 Subjects

This experiment was conducted with 27 Kyoto University students.

2.2 Experimental environment

Art content is projected by a projector under the following two defined setting conditions, and subjects are asked to evaluate the art content subjectively. The concepts are shown in Fig. 2. On the right side of Fig. 2, art contents are projected onto a floor surface by a projector, viewed by a viewer from outside the projection space. On the left side, the viewer enters the projection space and is exposed to the projector's light while viewing a portion of the projected content onto his/her body.

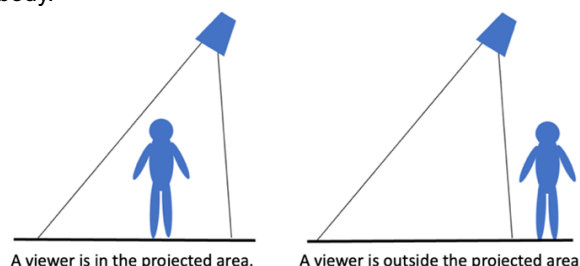


Fig. 2 Conceptual diagram of the experimental environment.

2.3 Actual experimental environment

For the projector model, an ultra-short-focus projector (EPSON EB-770F/4100lm) was used to obtain a sufficient projection area because the ceiling height was

not high enough. The actual experimental environment is shown in Fig.3.



Fig. 3 Actual experimental environment.

Preliminary experiments showed that the projector's installation height (approximately 2 m) was insufficient. Therefore, it was found that, to be sufficiently illuminated or projected the content onto one's body, the viewer must sit in a chair or on the floor to view the art. Based on this preliminary experiment, we decided to have the subjects view the art under the following three conditions, as shown in Fig. 4.

Condition 1 (Out/Chair): Subjects sit on a chair outside the projection space.

Condition 2 (In/Chair): Subjects sit in a chair in the projection space.

Condition 3 (In/Floor): Subjects sit on the floor in the projection space.

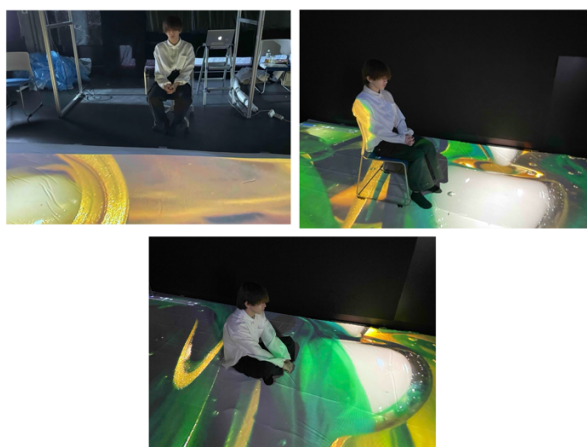


Fig. 4 Actual art viewing. Top left: Condition 1, Top right: Condition 2, Bottom middle: Condition 3.

2.4 Contents

The projected art content is the video artwork "Genesis [5]" created by Naoko Tosa, one of the authors. The reasons for using this artwork are as follows.

(1) Genesis is a work in which various color paints are injected into a liquid (viscous water) containing dry ice. The paint, which is trying to diffuse, interacts with the dry ice bubbles rising upward, photographed with a high-speed camera, creating various shapes. Compared to a painting created with a paintbrush, this is a natural phenomenon that does not involve human manipulation, thus eliminating arbitrariness on the artist's part.

(2) Genesis has various works depending on the paint color used. Since they have similar characteristics but give slightly different impressions, they can be used to eliminate the adverse effects of repeatedly using the same content

in psychological evaluation experiments. Repeating the experiment multiple times with the same content under different setting conditions is common in psychological experiments. If the same content is used in such experiments, the subject's degree of concentration may decrease due to familiarity with the content, which may affect the results. Using several different contents based on the same production method and with the same characteristics but using different colors, such as in Genesis, can eliminate such adverse effects.

2.5 Evaluation Items

Twenty-three evaluation items, grouped into "Impression factor," "Relaxation factor," "Motivation factor," and "Creativity factor," were used (Table 1). A psychology expert, one of the authors, determined and validated these evaluation items.

Table 1. Evaluation Items.

Impression factor		Motivation factor	
Comfortable	-	Enthusiastic	- Not
Uncomfortable		Enthusiastic	
Friendly - Unfriendly		Immersed	- Not
Beautiful - Not beautiful		immersed	
Calm - Restless		Curious - Not curious	
Interesting - Boring		Motivated	- Not
Warm - Cold		motivated	
Changeable - Not changeable		Aroused - Not aroused	
Luxury - Sober		Creativity Factor:	
Individual - Ordinary		Associate	- Do not
Relaxation factor		associate	
At ease - Not at ease		Immersive	- Not
Secure - Not secure		immersive	
Pleasant - Not pleasant		Activated - Not activated	
Relaxed - Not relaxed		Inspired - Not Inspired	
Healed - Not healed		In the zone - Not in the zone	

The evaluation was on a 7-point scale from 1 to 7, and the evaluation results were entered using Google Forms using each subject's smartphone.

2.6 Actual experimental conditions

As previously described, the subjects have three conditions: Condition 1 (Out/Chair), Condition 2 (In/Chair), and Condition 3 (In/Floor). The three types of art content to be used were as follows.

Content 1: Genesis Red

Content 2: Genesis Blue

Content 3: Genesis Green

The three conditions of the subjects and three types of art content were combined according to a design-of-experiment method, and three experiments were conducted for each subject.

2.7 Experimental process

Figure 5 shows the actual experimental process.

Explanation (5 mins)	Viewing 1 (5 mins)	Evaluation 1 (5 mins)	Viewing 2 (5 mins)	Evaluation 2 (5 mins)	Viewing 3 (5 mins)	Evaluation 3 (5 mins)

Fig. 5 Experimental process.

3 Results of the Psychological Evaluation Experiment

3.1 Comparison of the three experimental conditions

First, the evaluation values of 27 subjects were averaged for the three experimental conditions (Condition 1: Out/Chair, Condition 2: In/Chair, Condition 3: In/Floor) and compared for each evaluation item. Figures 6 (Impression factor), 7 (Relaxation factor), 8 (Motivation factor), and 9 (Creativity factor) show the results.

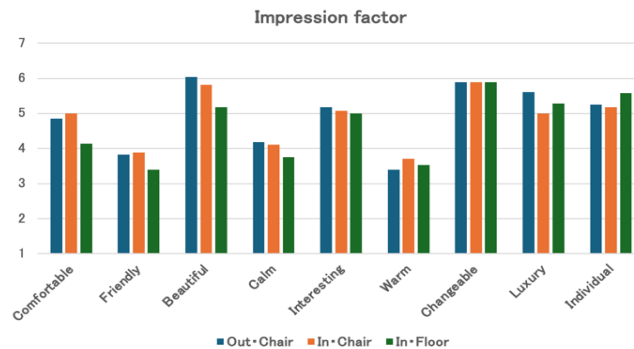


Fig. 6 Results for Impression factor.

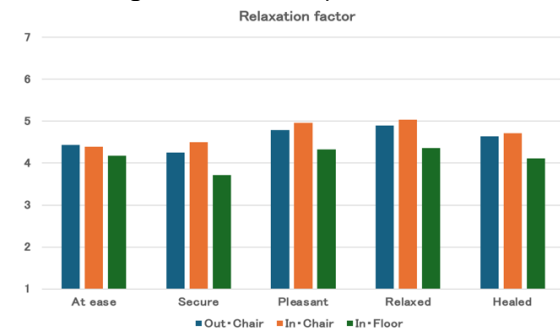


Fig. 7 Results for Relaxation factor.

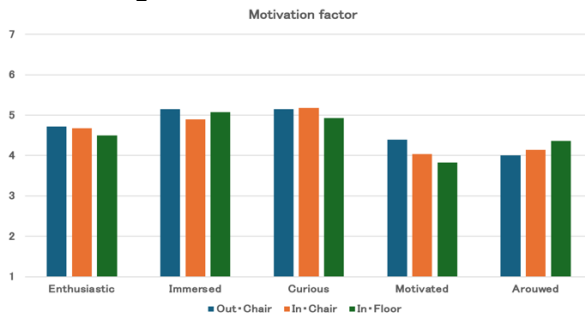


Fig. 8 Results for Motivation factor.

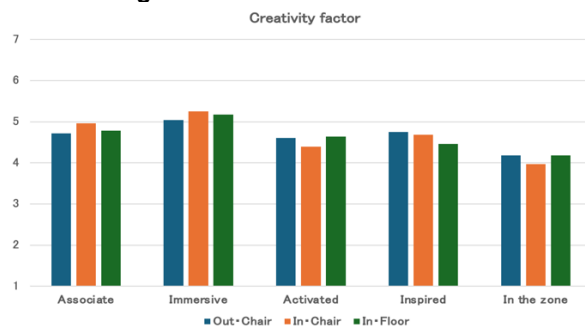


Fig. 9 Results for Creativity factor.

Impression Factor: The differences among the three conditions are not very clear. Looking across the evaluation items, "Beautiful," "Interesting," "Changeable," "Luxury," and "Individual" have high evaluation values of 5 or higher in almost all conditions. On the other hand, "Friendly" and "Warm" have evaluation values of 4 or less, indicating that the content used was not familiar to the subjects.

Relaxation factor: The evaluation values in almost all evaluation items are in the order of In/Chair > Out/Chair > In/Floor, with In/Chair having higher evaluation values than the other conditions. As for the evaluation values, "Relaxed" and "Pleasant" have relatively high values close to 5.

Motivation factor: There are some differences among the evaluation items regarding differences among experimental conditions, but almost all of the items showed little difference among experimental conditions. Regarding evaluation values, "Curious" and "Immersed" have high evaluation values near or above 5.

Creativity factor: There are some differences among experimental conditions regarding the evaluation items, but almost all of the items show little difference among experimental conditions. In terms of evaluation values, "Associate" and "Immersive" receive high values near or above 5, followed by "Activated" and "Inspired" at around 4.5 or above.

3.2 Analysis of variance (ANOVA) results

To confirm the discussion above, the results for each factor were analyzed using an analysis of variance (ANOVA). The results are shown in Fig. 10 (Impression factor), Fig. 11 (Relaxation factor), Fig. 12 (Motivation factor), and Fig. 13 (Creativity factor).

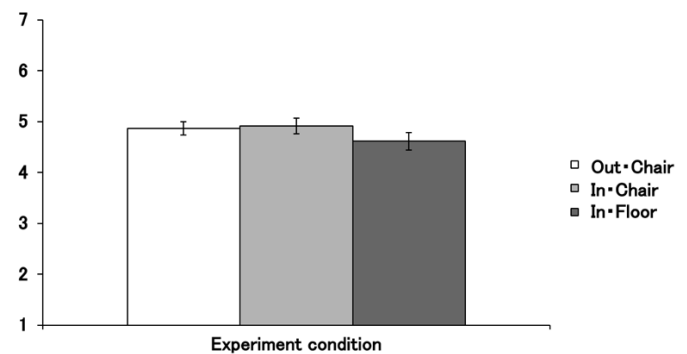


Fig. 10 ANOVA results for Impression factor.

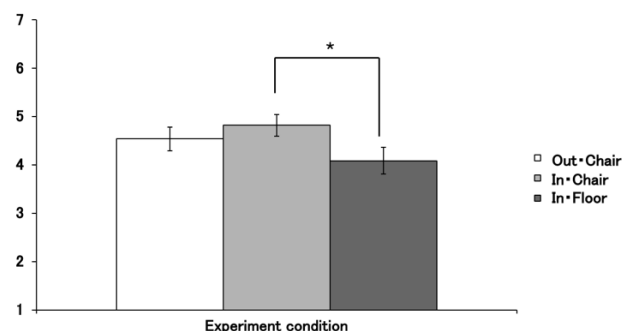


Fig. 11 ANOVA results for Relaxation factor.

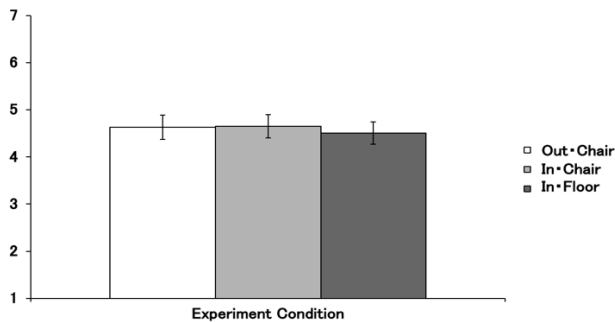


Fig. 12 ANOVA results for Motivation factor.

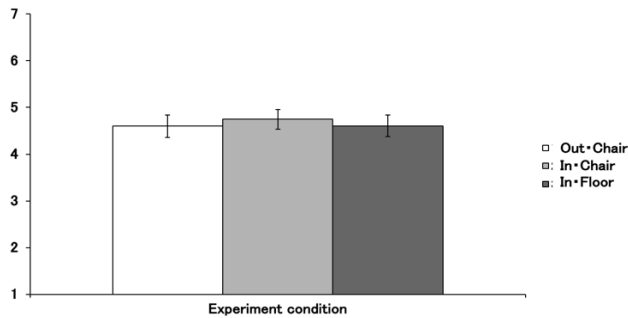


Fig. 13 ANOVA results for Creativity factor.

Impression Factor: The ratings by condition averaged by the evaluation items showed that the "In/Floor" condition had lower rating results than the other conditions. However, ANOVA results showed that the main effect on experimental conditions was insignificant ($p=.157$).

Relaxation Factor: In the ratings by condition averaged over the evaluation items, "In/Chair" was rated higher than the other conditions. Analysis of variance showed that the main effect related to the experimental condition was significant at the 5% level ($p=.022$). Multiple comparisons revealed that the difference between "In/Chair" and "In/Floor" was significant at the 5% level ($p=.040$).

Motivation Factor: The ratings by condition, averaged by the evaluation items, showed nearly identical scores for all conditions. The main effect on experimental conditions was not significant ($p=.866$).

Creativity Factor: The ratings by condition, averaged by the evaluation items, showed nearly identical scores for all conditions. The main effect on experimental conditions was not significant ($p=.753$).

3.3 Considerations

Relaxation factor results: "In/Chair" was rated higher than "Out/Chair" and "In/Floor" for the relaxation factor. Except for the low value for "In/Floor," the initial goal of "entering the projection space and viewing art under the projector's light" was confirmed to be effective. However, for other factors, there are few differences between the experimental conditions, and the results of the ANOVA show that the differences among conditions are insignificant. Some considerations on this point are discussed below.

Cause of the slight difference between the experimental conditions: In this regard, it is thought that there are advantages and disadvantages to viewing from outside the projection environment and viewing within the viewing environment, respectively. First, the condition of

viewing from outside the projection space (Out/Chair) is thought to provide the same sensation as entering the viewing space since the subject is viewing right next to the projection space. Another advantage is that by viewing from outside the viewing space, one can appreciate the entire space, or in other words, the entire content. On the other hand, viewing from inside the projection space has the advantage of allowing the subjects to experience the sensation of being inside the art space, or in other words, the sensation of being one with the art contents, by being exposed to the light from the projector and the art contents. On the other hand, the disadvantage is that by entering the projection space, the viewer cannot see the entire content from a bird's eye view and can only appreciate a portion. These advantages and disadvantages are thought to complement each other, so the difference between "Out/Chair" and "In/Chair" is not significant.

4 Conclusion

When using a projector to project art or other content in a space, there is a form of viewing in which the viewer enters the projection space and is exposed to the projector's light. This type of viewing gives the viewer a sense of being one with the art and the space and may improve the quality of the viewing experience.

The purpose of this research is to confirm this by a psychological experiment. An immersive environment was constructed in which art images were projected from the projector to the floor. Using this experimental environment, we conducted a psychological experiment to compare three types of viewing methods: sitting on a chair outside the projection space (Out/Chair), inside the projection space sitting on a chair (In/Chair), and inside the projection space sitting on the floor (In/Floor).

As a result, "In/Chair" received a higher evaluation result than the other conditions, and the effect of entering the projection space to view the images was partially confirmed. At the same time, however, the results for the "In/Floor" condition were lower than those for the "In/Chair" condition. This is likely because the young subjects are not accustomed to sitting on a floor and are uncomfortable with this condition. It would have been better to give the subjects instructions such as taking a relaxed position or lying on the floor.

In the future, we plan to analyze the results of this experiment further to clarify the effectiveness of entering the projection space to view the projector. We hope this will lead to the expansion of new use areas for projectors.

Reference

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