

Research on the Effects of Art Lighting on Creative Work

Ryohei Nakatsu¹, Shun Kanai¹, Akihiro Yamada², Seiro Yuge², Takashi Kusumi¹, Naoko Tosa¹

nakatsu.ryohei@gmail.com

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

²Mitsubishi Electric Corp, Amagasaki, Hyogo, 661-8661 Japan

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ABSTRACT

An important question is how artistic lighting in offices affects work that requires creativity. This study first constructed an experimental environment to simulate an office with glass lighting as the primary lighting source. Next, we evaluated such an environment from the perspective of how subjects feel about such an environment and from the perspective of whether it enhances their creativity. The results showed that art lighting was rated significantly higher in the psychological evaluation than LED lighting. On the other hand, no significant differences were found in the results of creativity tests using J. P. Guilford's test method, which means further study is needed on the evaluation from the viewpoint of creativity.

1 Introduction

Traditional lighting in offices has focused primarily on increasing work efficiency and productivity. Therefore, lighting has been designed and manufactured to ensure uniform illumination using white light source in the office space. However, such an office space tends to be inorganic space, which, combined with office work aimed at increasing efficiency and productivity, tends to cause stress to the people working there.

With AI about to replace much of the simple office work, office work should be focused on more than just efficiency and productivity. Instead, it should be more accessible for the people working there to generate ideas and exercise their creativity. For this reason, artistic lighting is to be used for lighting. However, there have been few attempts to apply artistic lighting to office spaces.

This study aims to evaluate the effect of placing artistic lighting with glass art created by one of the authors in a simulated office space. As for the evaluation, we used a psychological evaluation method to assess how subjects perceive an office space with artistic lighting. As another method, we evaluated the subjects' creativity using the creativity test proposed by J. P. Guilford [1].

2 Related Research

There have been few attempts to apply artistic lighting to offices. As mentioned in the introduction, this is probably due to the prevailing view that office lighting should be white and uniform in illuminance, with the primary goal of increasing work efficiency. One attempt to incorporate natural lighting into offices is research that developed lighting that simulates the light of a blue sky [2]. Brain wave measurements have reported that some people may be able to work with calmer and more focused minds than with general lighting.

3 Psychological Evaluation of Art Lighting on Creative Work

3.1 Subjects

Thirty Kyoto University students were used as subjects.

3.2 Experimental environment

Art lighting

An experimental environment was constructed using glass art created by one of the authors. The art lighting arrangement is as follows.

Art lighting, which combines glass art and lighting, is placed along the room's walls (Figs. 1 and 2). Glass art is also placed on the ceiling, which is illuminated from above, making it the primary light source in the room (Fig. 3). On the floor, a "Light table" developed in a joint research project with Mitsubishi Electric Corp. is installed (Fig. 4).



Fig. 1 Examples of art lighting.

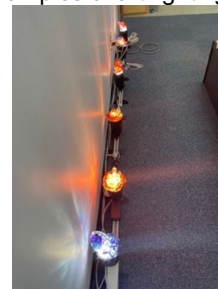


Fig. 2 Art lighting arranged along a wall.



Fig. 3 Glass art placed on the ceiling.

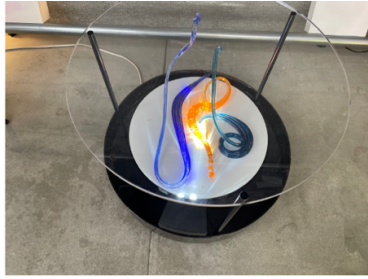


Fig. 4 Light table on the floor

Experimental environment

An experimental environment simulating an office was prepared by setting up several chairs, the light table, and the above-mentioned art lighting. Fig. 5 shows a side view of the environment.

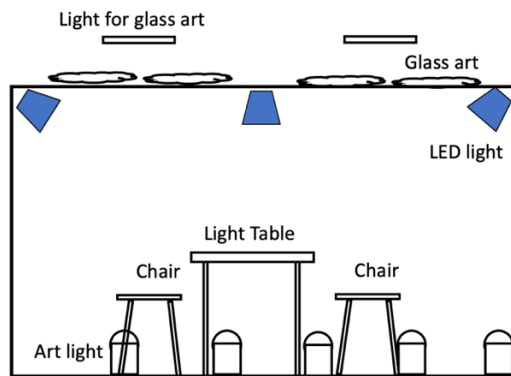


Fig. 5 Side view of the experimental environment (LED lights are used for comparison experiments with art lighting).

3.3 Lighting conditions

Lighting is under the following two conditions.

Lighting Condition 1: Art lighting on, LED lighting off

Lighting Condition 2: LED lighting on, art lighting off

LED lighting simulates a typical office environment. The average illumination level of the room was set at 400 lx on the desk (light table) to create an artistic effect and ensure that the room was bright enough to work.

3.4 Evaluation by subjects

The following two methods were used to evaluate the above experimental environment.

(1) Based on the method proposed by J. P. Guilford on creativity, the so-called "test method [1]" was used. The "test method" is a method in which subjects think and describe as many ideas as possible within a time limit in response to a question such as "Think of a new way to use everyday items (such as newspapers)." The time limit was set at 10 minutes. The number of ideas and their quality are used to evaluate how creative the subject is. As actual test items, "tennis ball" and "spoon" were given to subjects. (2) After the evaluation using the test method was completed, the subjects were asked to fill out questionnaires for the evaluation items at the end of each experiment, and the results were analyzed. Each subject made responses using Google Forms on his or her smartphone.

3.5 Experimental procedure

The two lighting conditions were presented to each subject in different lighting conditions, either Lighting Condition 1 or Lighting Condition 2. They were controlled so that the overall number between condition 1 first and condition 2 first was the same.

3.6 Evaluation items

Along with the evaluation using the test method, the subjects were asked to respond to several evaluation items (questions) at the end of each experiment, and the results were analyzed. Each subject made responses using his/her smartphone and Google Forms. Question items were determined using the following procedure.

Previous research on lighting evaluations has used evaluation items regarding "how do you feel about the lighting itself (impression factor)" [4][5]. On the other hand, another study conducted a psychological evaluation of the relationship between art and creativity. In this study, questions regarding creativity and motivation were prepared and tested [6]. While using the evaluation items used in [4] [5] as a base, we modified and added the items related to creativity in [6], taking into account the purpose of this experiment (Table 1).

Table 1. Evaluation Items

How do you feel about the lighting? : Impression factor (9 items)	What effect does the lighting have on you? : Effect factor (12 items) (Motivation)
Comfortable – Not comfortable	I can work efficiently – I cannot work efficiently
Familiar – Not familiar	I can concentrate – I cannot concentrate
Beautiful – Not beautiful	I make fewer mistakes – I make more mistakes
Calm – Not calm	I feel energized – I do not feel energized
Interesting – Boring	I can be positive – I cannot be positive
Warm – Cold	(Creativity)
With change – Without change	Ideas come up – Ideas do not come up
Fancy – Sober	Ideas expand – Ideas do not expand
Individual – Ordinary	Associations come to mind – Associations do not come to mind
	(Relax)
	I do not feel stressed – I feel stressed
	I do not get tired – I get tired
	I can relax – I cannot relax
	I can forget bad things – I cannot forget bad things

4 Analysis of Psychological Experiment Results

4.1 Results of the psychological evaluation of the environments

First, the psychological evaluation of the lighting environment was analyzed. Figure 6 compares the psychological evaluation experiments between art and LED lighting regarding the "Impression factor." Also, Fig. 8 compares the psychological evaluation experiments

between art and LED lighting regarding the "Effect factor." At the same time, the analysis of variance (ANOVA) results are overlapped in Figs 6 and 7, which will be described later.

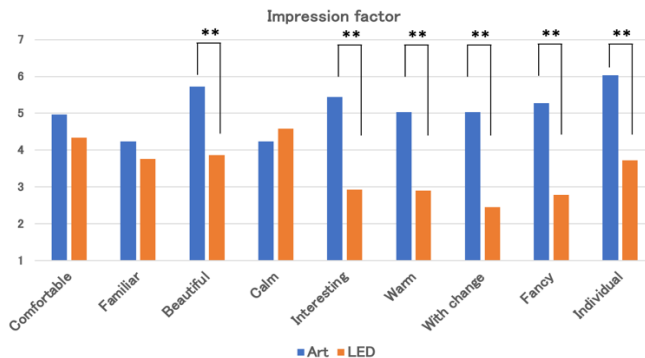


Fig. 6 Results of psychological evaluation experiment between art and LED lighting (Impression factor).

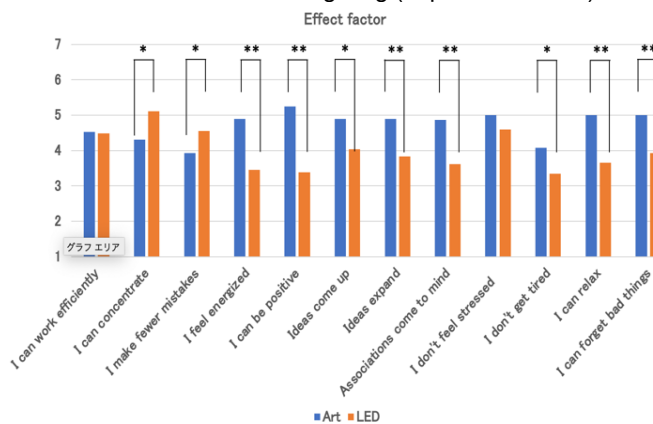


Fig. 7 Results of psychological evaluation experiment between art and LED lighting (Effect factor).

Impression factor: Regarding the "Impression factor," art lighting received higher evaluation results than LED lighting, except for the results related to "Calm." In particular, "Beautiful," "Interesting," "Warm," "With change," "Fancy," and "Individual" were rated higher for art lighting than for LED lighting, indicating that art lighting gives a good impression to the evaluators. The "Calm" rating for LED lighting is considered high because the subjects are accustomed to the conventional lighting used in offices.

Effect factor: As for the "Effect factor," three items related to the "Creativity factor" and four items related to "Relaxation" were rated higher for art lighting than for LED lighting, indicating that subjects rated art lighting as more effective in enhancing creativity and relaxing them compared to LED lighting. This indicates that subjects rated art lighting as more effective in enhancing creativity and relaxation than LED lighting. In contrast, the five items related to the "Motivation factor" showed different trends depending on the evaluation items. Art lighting was rated higher than LED lighting for "I feel energized" and "I can be positive," but LED lighting was rated higher for "I can concentrate" and "I make fewer mistakes." Art and LED lighting received almost equal scores for "I can work efficiently." Since "I can concentrate" and "I make fewer mistakes" are considered evaluation items for

conventional office work that require high efficiency, the conventional lighting in the office is more familiar to the subjects, leading to the higher evaluation of LED lighting.

4.2 Analysis of variance (ANOVA) results

For a more detailed analysis, an analysis of variance (ANOVA) was conducted to check whether the difference in results between art lighting and LED lighting was significant. The results of the ANOVA for the "Impression factor" are overlapped in Fig. 6. The results for the "Effect factor" are overlapped in Fig. 7. A "****" indicates a significant difference at the 1% level, and a "***" indicates a significant difference at the 5% level.

Impression factor: First, regarding the "Impression factor," art lighting was rated significantly higher than LED lighting at the 1% level for six items: "Beautiful," "Interesting," "Warm," "With change," "Fancy," and "Individual." On the other hand, there was no significant difference between the three items: "Comfortable," "Familiar," and "Calm." The results for the three items of "Comfortable," "Familiar," and "Calm" may reflect the fact that many people are accustomed to conventional LED lighting. These confirm what was stated in 4.1.

Effect factor: As for the "Effect factor," the three items related to "Creativity" and the four items related to "Relaxation" were significantly higher for art lighting than for LED lighting at either the 1% or 5% level, except "I do not feel stressed," indicating that subjects rated art lighting as more effective than LED lighting in enhancing creativity and relaxing them. Specifically, art lighting was significantly more effective than LED lighting at the 5% level in "Ideas come up" and "I do not get tired." In comparison, art lighting was significantly more effective than LED lighting at the 1% level in "Ideas expand," "Associations come to mind," "I can relax," and "I can forget bad things." The results also indicate that the difference between art and LED lighting is insignificant for "I do not feel stressed." These results confirm what was stated in 4.1.

In contrast, the five items related to "Motivation" showed different trends depending on the evaluation items. Art lighting was significantly higher than LED lighting at 1% for "I feel energized" and "I can be positive." At the same time, LED lighting was rated 5% higher than art lighting for "I can concentrate" and "I make fewer mistakes." As for "I can work efficiently," there was no significant difference between art and LED lighting. These also provide further details of what was discussed in 4.1. The fact that LED lighting was rated significantly higher than art lighting in the evaluation items "I can concentrate," "I make fewer mistakes," or that there was no significant difference between the two for "I can work efficiently" indicates that people still have a strong appreciation for conventional work that aims for high efficiency.

5 Creativity Test Results and Their Analysis

In addition to psychological evaluation, whether people's creativity is enhanced is an exciting issue. Assessing creativity is difficult, but one method is the "test method" proposed by J. P. Guilford on creativity [1]. This method evaluates creativity by asking subjects to

develop as many ideas as possible within a time limit. The results are evaluated based on the number of ideas that came up and the quality of the ideas.

Guilford's testing method was employed in our study to determine how the art environment affects the work. Each subject was given one of two tasks, "Consider different uses for a tennis ball other than its original use" and "Consider different uses for a spoon other than its original use," and the overall number of subjects who responded to the two tasks was controlled to be equal. Six raters evaluated the ideas obtained in terms of "Originality," "Practicality," "Imagination," "Exciting," and "Applicability."

Figure 8 compares art lighting and LED lighting regarding the number of ideas. Fig. 9 compares art and LED lighting regarding the quality of ideas based on the average value among the six raters.

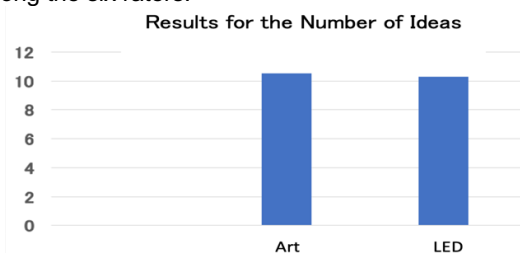


Fig. 8 Comparison results of art and LED lighting regarding the number of ideas.

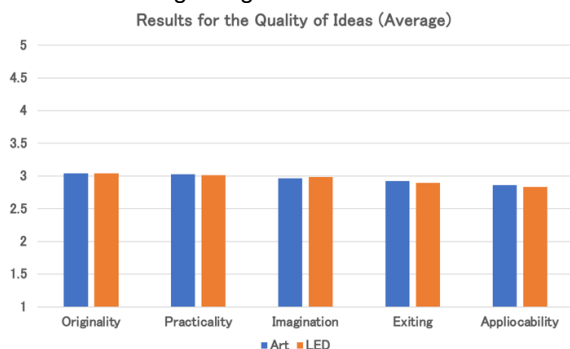


Fig. 9 Comparison results between art lighting and LED lighting on the quality of ideas (averaged for six raters).

Figures 8 and 9 show little difference between art and LED lighting concerning J. P. Guilford's creativity test. To be sure, an analysis of variance (ANOVA) was performed on the number of ideas shown in Fig. 8, and the result showed that there was no significant difference between art lighting and LED lighting. Also, ANOVA was performed on the quality of ideas for the average of the six people shown in Fig. 9, and the results showed that there was no significant difference between art lighting and LED lighting.

As shown in Figs 6 and 7, in the subjective evaluation of the lighting environment, art lighting was rated higher in almost all evaluation items for the "Impression factor," and art lighting was rated higher in most evaluation items for the "Effect factor." The ANOVA results also showed that the difference between art and LED lighting was significant at 1% or 5% for most evaluation items.

The results of J. P. Guilford's creativity test shown in Figs. 8 and 9 are inconsistent compared to these results. A more detailed analysis of these results is required. At the same

time, the creativity test proposed by J. P. Guilford may not be suitable for the present experiment. This means further investigation is required.

6 Conclusion

Offices have traditionally used white, uniform lighting with the primary goal of improving office work efficiency. However, now that AI is replacing human workers to perform routine tasks, office workers are expected to be more creative. Based on the assumption that artistic lighting, rather than conventional lighting, is appropriate for such an office, we constructed a simulated office environment with artistic lighting that combines glass art and a light source. Furthermore, we evaluated how subjects perceive such an environment compared to conventional LED lighting by a psychological experiment. In addition, we evaluated whether creativity is improved using the creativity test proposed by J. P. Guilford.

The results of the psychological experiment showed that such an environment stimulates people's minds and gives them feelings such as "Beautiful," "Interesting," and "Individual," as well as significantly higher evaluation values compared to LED lighting in evaluation items such as "I can relax," "Ideas expand," and "I do not get tired," etc. This suggests that an office environment with art lighting is consistent with creative work. On the other hand, the results of the creativity test proposed by J. P. Guilford, which asks subjects to generate as many ideas as possible within a time limit, showed no significant difference between art lighting and LED lighting.

However, creativity is a difficult concept. Based on this experiment alone, it cannot be said that there was no difference between art lighting and LED lighting in terms of creativity. Further analysis of the results of this study will be conducted, and further examination of what constitutes creative office work and what office lighting is best suited for it is an issue for our future study.

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