

# The Impression of an Artificial Skylight at the Hospital

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## ABSTRACT

*This study is to verify the psychological effect of an artificial skylight on visitors at the hospital. The results showed that people were livelier and they felt more connected to nature and the exterior in the hospital's waiting room with the artificial skylight than in a windowless space.*

### 1 Introduction

It is difficult to create openings connect to the exterior environment for spaces in the center of a large building or the basement. The problems that arise for those spaces include the impression of being stuck in a closed space, poor working performance, the inability to recover from fatigue, etc.<sup>1</sup> Various types of research have been done to remedy the issue. Monitor, paintings, fish tank and more were used to recreate the underground office space, but none had the same effect as an actual window.<sup>2</sup> The impression of a virtual window with a large display that projected a natural landscape was also previously studied. Although the favorable evaluation was obtained compared to the windowless condition, it still is not as effective as the real window.<sup>3</sup>

Recently, the development of artificial skylights in the lighting field is in progress with

a favorable outcome. Canazei et al.<sup>4</sup> did research on its psychological effect. However, few evaluation items made it insufficient. Conversely, using more specific evaluation items, Yamakawa et al.<sup>5</sup> showed that the artificial skylight gives a positive impression of the spaces and mood almost equal to an actual window. Nevertheless, only the psychological effects were verified. Contrarily, Sato et al. verified both the psychological as well as physiological effects of the artificial skylight. Compared to windowless condition, the central nervous fatigue can be easily recovered under the artificial skylight and real skylight condition. Moreover, heart rate at rest tends to decrease while cerebral flow tends to increase: it means that the active thinking is being performed even in a relaxed state. During the break time of the experiment, the artificial skylight was glazed as much as the real one. It shows that it can be a substitute for the real one when it comes to the effect of refreshment.

The results above show that artificial skylight plays an important part in closed interior spaces. However, only small-scale experiments (in a simulation room or less than 25 participants) were done in the past. It is necessary to confirm the effect of the artificial

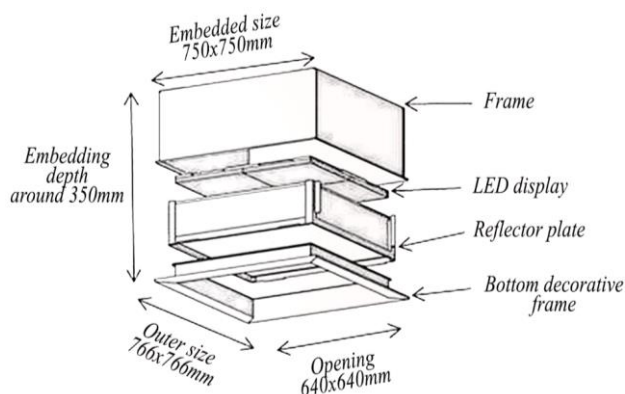
skylight in a real environment. Therefore, in this experiment, we investigated the psychological effect of the artificial skylight in a local university hospital.

## 2 Experiment

The experiment took place at the University of Fukui Hospital's waiting area.



**Fig. 1** Waiting area adjacent to a reception desk  
The experimental setup consisted of an artificial skylight, a projector that projected the image on the floor and a speaker.











**Fig. 2** Structure of the artificial skylight

We compared four conditions, including blue sky, blue sky/tree shadow, ocean, ocean with sharks with the windowless control condition to evaluate the effect of the artificial skylight on people who sit at the waiting area and their impression on the space (Table 1). POMS2 short form (Profile of Mood State 2nd Edition), a psychological questionnaire used to rate an individual's mood disturbance and an original items questionnaire based on a semantic

differential and a rating scale method were used. A total of 379 people participated in the experiment.

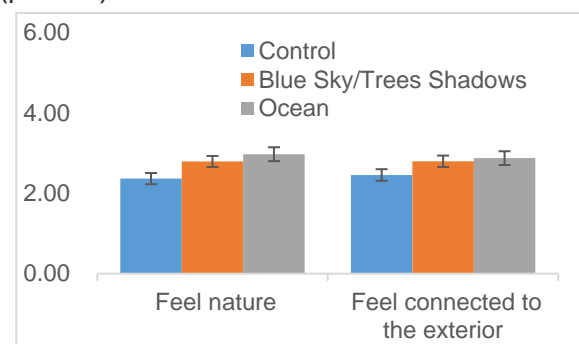
**Table 1** Experimental conditions

	<i>Artificial skylight</i>	<i>Image projected on the floor from the projector</i>	<i>Speaker</i>
<b>Control</b>	Off	Off	Off
<b>Blue sky</b>			Off
<b>Blue sky/ Tree shadow</b>			Birds twittering
<b>Ocean</b>			Waves
<b>Sharks</b>			Waves

## 3 Results and Discussion

### 3.1. The Impression on the Space

Based on the results, compared to the control condition, the participants felt more connected to the exterior and nature in Blue Sky/Tree shadow and Ocean conditions ( $p < 0.05$ ).



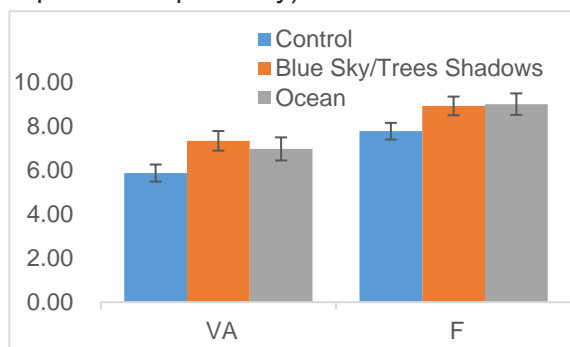
**Fig. 3** Results of 'Feel connected to the exterior' comparing the control, blue sky/tree shadow condition, and ocean condition

The results are somehow expectable because people tend to have a positive

connection to nature and daylight. That being said, surprisingly, the blue sky condition did not reach the level of difference compared to the control condition. It might be because, in the blue sky condition, the rays of light projected on the floor were subtle so it was not noticeable enough to the participants. From this, we could deduct that the participants tended first to notice the projected image on the floor before started to search for the opening on the ceiling. We could then conclude that an artificial skylight alone might be less effective than the one with a projected shadow. For this visually noticeable reason, the ocean condition is more perceivable than the blue sky/tree shadow condition.

### 3.2. The Influence on Participants' Mood

Among the seven subscales, compared to the control condition, the participants felt a little more vigorous and friendlier under Blue Sky/Tree shadow and Ocean condition ( $p < 0.01$  and  $p < 0.05$  respectively).



**Fig. 4** Average of POMS2 short form subscales VA, F of control, blue sky/tree shadow and ocean conditions

It shows that compared to a space without an opening connected to the exterior, the presence of an artificial skylight helps people who were initially tired to be more lively and active. Additionally, people tend to enjoy gazing at both the artificial skylight and the projected shadow on the floor, which somehow elevate

their mood.

## 4 Conclusion

This study proved that an artificial skylight could improve the hospital's spatial impression and the people who visit the hospital. However, compared to Sato et al.'s results, the difference between the tested conditions with the control one is quite small. During the questionnaire survey, we asked the participants whether they noticed the devices. We found that several of them did not notice it, especially those who sit far from the skylight. Hence, the waiting area's layout and the device's position are key in a better result.

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