

# Experiment of Inclusive Quiet Room as a Chilling Out Space in a Media Art Exhibition

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## Abstract

Some people including those with autism and developmental disabilities have sensory hypersensitivity. To support them, the social diffusion of “Quiet rooms” where they can chill out is required. However, the significant cost of setting these rooms up is an issue. We introduced the “Inclusive Quiet Room,” a novel approach to a portable Quiet Room that merges an easy-to-construct Instant House with immersive videos and soothing sounds. This paper examines the impression and practicality of the Inclusive Quiet Room by analyzing questionnaire responses and heart rate data from people who tried it at a media art exhibition.

## Keywords

People with Mental disabilities, Autism, Developmental disabilities, Environmental engineering, Quiet Room, Hypersensitivity, Sensory stimulation, Accessibility, Diversity, Inclusive

## Introduction

### Background

Many people with mental disorders such as autism and developmental disorders have sensory hypersensitivity. Quiet Rooms are spaces that reduce stimuli and provide a calm environment to prevent such people from panicking due to external stimuli due to sensory hypersensitivity. There are three types of human senses: special senses (sight, hearing, smell, taste, and balance), somatic senses (touch, pressure, temperature, kinesthesia, and proprioception), and visceral senses (organ sensation and visceral pain). There are also combined effects such as temperature sensation affecting pain sensation. In this paper, we conducted a demonstration experiment focusing on the special senses of sight and hearing, and the somatic senses of touch, pressure, and temperature, with the aim of gaining knowledge that will contribute to the realization of a chilling out space utilizing Quiet Room.

### Related Works

**Flotation Tanks in Sweden** In a study on Flotation Tanks published by Kjellgren et al. [5], autistic patients who were alone in a water-filled flotation tank for 45 minutes and floated in the water in the tank were reported to be less tense and more sedated. The results of the experiment on 11 autistic

children showed that the tension level of all autistic children was eased and the panic subsided.

**Cozy room in Japan** Karita et al. set up Cozy room as a chilling out space for mentally retarded and autistic children in a rehabilitation facility [4] and measured the stress of 22 autistic children before and after using the room from  $\alpha$ -amylase activity (sAMY) in their saliva. The results showed that sAMY was significantly lower after use, confirming that the Cozy Room had a calming effect on children with autism and intellectual disabilities.

**Significance of this study** Previous studies have shown that environmental adjustments help people with autism, developmental disabilities, and other mental disorders to calm themselves and reduce tension [2, 9]. In this study, we propose a new method of environmental adjustment by using multisensory stimulation as well as conventional sensory deprivation such as soundproofing, and verify the effectiveness of this method.

### Research Objective

Based on the hypothesis that a chilling out space can be provided to those with sensory sensitivity by providing multisensory stimulation, we designed and produced a prototype of a Quiet Room that incorporates digital elements and constructed a system to measure the degree of relaxation to humans. In addition, a demonstration experiment was conducted to verify whether the Quiet Room was an effective facility for the general public. This paper reports the results of the experiment using the Quiet Room, which presents multisensory stimuli incorporating digital elements created by the authors, and the results of the analysis of the questionnaire survey, free descriptions, and heart rate. We aim to promote understanding of mental barrier-free to cope with invisible mental disorders including autism and developmental disabilities.

## Inclusive Quiet Room

### Overview

The Inclusive Quiet Room was created utilizing a space constructed using a simple structure and adding digital, tactile, and visual elements to the conventional Quiet Room, which is mainly designed for sensory deprivation (Figure 1, Figure 2).



Figure 1: Inclusive Quiet Room in a media art exhibition.

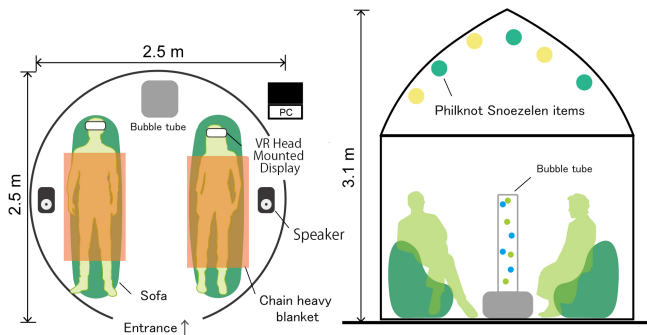


Figure 2: The layout of Inclusive Quiet Room.

This was developed based on a literature review on snoezelen and the experience of actual sensory sensitivity sufferers among the production team. It includes an instant house [6], a simple structure that can be easily transported and installed, bubble tubes and light sensory snoezelen, immersive virtual reality (VR) video with relaxing music, soft cushions, and heavy blankets (chain blankets) (Figure 3). The specifications were set up based on the idea of a person with autistic and developmental disabilities, combining psychedelic visual effects, a heavy chain blanket, and tactile stimulation by artificial turf, which are not provided in normal Quiet Rooms. The setting aimed to have people experience the process of feeling calm and regaining their composure, and to examine the situation. In addition, the Instant House, a space that can be easily constructed in a short time and soundproofed with thermal insulation, can be used to facilitate exhibitions at event venues. By exhibiting in a variety of locations, the need for and benefits of Quiet Rooms can be communicated to all people, regardless of sensory sensitivity, and is expected to promote understanding and acceptance for its widespread use in society. Furthermore, we believe that the easy and low-cost installation will be useful for the future implementation of Quiet Rooms for social diffusion.

### Equipment

In the Inclusive Quiet Room, Instant House was used to create a soundproofed space. Chain blankets and artificial turf

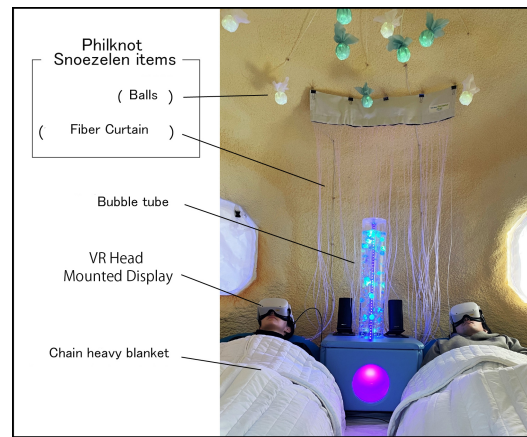


Figure 3: Inside of Inclusive Quiet Room.

were used to present tactile stimuli for relaxation. Snoezelen equipment such as bubble tubes and balls were used to create a visual space (Figure 2, Figure 3).

Instant houses are simple structures developed based on the concept that they can be installed in various locations in a short time [6]. The one used in this experiment has a floor diameter of 250 cm and a height of about 310 cm. The interior walls are created with urethane and are about 8 cm thick.

The chain blanket is developed in Sweden for “sleepless” or “fidgety and restless” people. The metal chains inside the blanket give it weight, and the properties of the chains allow the blanket to conform snugly to the body, providing the comfort of being wrapped. It has been reported that the use of chain blankets during sleep has improved insomnia symptoms in 78% of people with a diagnosis of mental illness or developmental disability [1].

International Snoezelen Association describes the snoezelen concept as follows [3]: “In a purposely designed room (mostly a white room) the use of light and sound elements, scents and music initiate sensual sensations. These have both relaxing and activating effects on the different perception areas.” The bubble tube is a typical snoezelen device. A clear acrylic cylinder is filled with water, and air is pumped into it from below, causing the bubbles to rise and the water to flow. By irradiating the water with light that changes to various colors, it provides gentle sensory stimulation to the senses of sight, sound, and touch.

### Video Content

To facilitate the experience of highly immersive audiovisual stimuli, the video and music were played using VR technology. A VR headset (Meta Quest 2) was used to play the VR video, and speakers were used to play the sound. The arrangement is shown in Figure 2. The VR videos used in the work were about 6 minutes long, and the contents shown in Figure 4 were presented in order from A to F, changing with the passage of time. The contents were as follows: an imitation of the sensory stimulus snoezelen used to relax people with sensory sensitivity (Figure 4 (A)), a relaxing video with images of the starry sky and the universe (Figure 4 (B, C, D)),

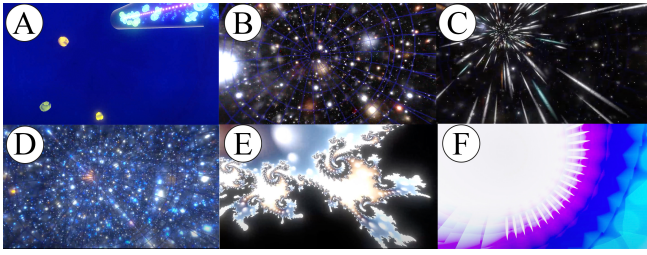


Figure 4: VR images during the experience. A: “snoezlen” sensory stimulation for relaxation. B, C, D: relaxing images of starry skies and universe. E, F: psychedelic images with geometric motifs.

and a psychedelic video (Figure 4 (E, F)). Psychedelic is a visual effect characterized by bright colors, geometric patterns, deformed shapes, and strange scenes, and was used to relax the viewer through visual stimulation.

### Sound Content

We created an original piece of music arranged with electronic music, mainly natural sounds and piano music, which is considered to have a highly relaxing effect [7]. The music was harmonized with the contents of the VR videos and changed over time while synchronizing with the videos. Specifically, quiet piano sounds and natural environmental sounds were presented for the relaxing images in the beginning, while electronic and other sound effects were added to the piano sounds for the psychedelic images at the end. Music was played using stereo speakers so that multiple people could listen simultaneously in the Quiet Room.

### Experiment in an Exhibition

In order to investigate each elemental technology of the proposed Inclusive Quiet Room and its overall effectiveness, a demonstration experiment was conducted using a media art exhibition space where many people, regardless of sensory sensitivity, could participate. This experiment was conducted after receiving approval from the ethical committee.

### Experiment Procedures

The experiment in this paper was conducted in a media art exhibition that took place over four days in November 2022. The Inclusive Quiet Room was set up in the atrium space which is connected to the outdoors. The roof protected the space from rain but allowed wind to enter the room. The outside temperature averaged 11-13°C during the fall season. In this experiment, the maximum number of people who could experience the room at the same time was two, and the entrance to the room was generally left open. The participants experienced the following procedures. The time required for steps (1) through (5) was about 4 minutes, and the overall duration of the experiment was about 12 minutes. Before and after the experiment, questionnaires were used to survey opinions and evaluate the experience. Participants who agreed to wear a smartwatch also had their heart rate measured during the experience.

- (1) Receive a brief explanation of the experiment and fill out the consent form and questionnaires regarding gender, age, and sensory characteristics.
- (2) Enter the Instant House and lie down on the sofa.
- (3) (if desired) Put on a smartwatch (Apple Inc. Apple Watch) for heart rate measurement.
- (4) Put on a chain blanket.
- (5) Wear a VR headset.
- (6) Have a VR visual and sound experience. (about 6 minutes)
- (7) After the experience is over, remove the headset and chain blanket and exit the Instant House.
- (8) Fill out a questionnaire about the impressions of the experience.

### Overview of the Questionnaires

The pre-experience questionnaire was prepared with reference to the previous study on sensory sensitivity and blindness [8] to conduct a survey on the sensory characteristics of the participants. The questionnaire consisted of 20 items as shown in the left column of Figure 5, and participants were asked to mark all applicable items. The questionnaire items added for this experiment were “I feel calm when I’m alone in a space,” “Dark spaces such as wardrobes are calming,” and “A bright space where I can feel sunlight is calming.”

The post-experience questionnaire surveyed impressions of each elemental technology in the Inclusive Quiet Room and overall impression of the experience. As shown in the left column of Figure 6, the participants rated their impressions on a 7-point Likert scale ranging from 1 (not at all applicable) to 7 (highly applicable) regarding the video, sound, tactile sensations from the cushions and chain blankets, the overall space of the work, and their mood after the experience. There were also two alternative questions: “Which do you feel calmer in total darkness or in colorful visual effects?” and “Which do you think is more relaxing, being hugged by someone or using a soft cushion?” In addition, a free-response box was provided to write impressions and opinions.

## Results

### Questionnaires

**Analysis subjects** The subjects for the quantitative questionnaire analysis were 128 people (79 males, 48 females, and 1 other, aged 15-76 except for those who did not respond) who were confirmed to have answered both questionnaires conducted before and after the experience. As for free responses, analysis was conducted on the 146 subjects who responded to the questionnaire conducted after the experience.

**Quantitative Results** The results of the pre-experience questionnaires are shown in Figure 5. With regard to the items “Having “own space” at home, at work or at school makes me feel calm and stable” and “I feel calm when I’m alone in a space”, more than 60% of the subjects answered that these items were applicable. In addition, less than 5%

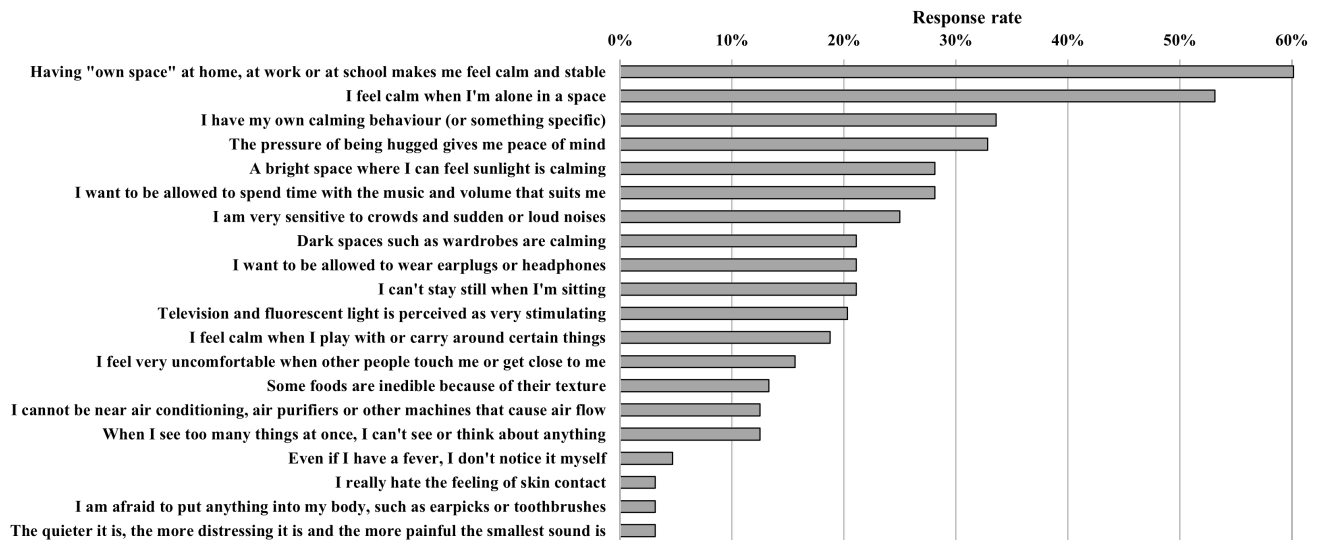


Figure 5: Results of the pre-experience questionnaires (n=128)

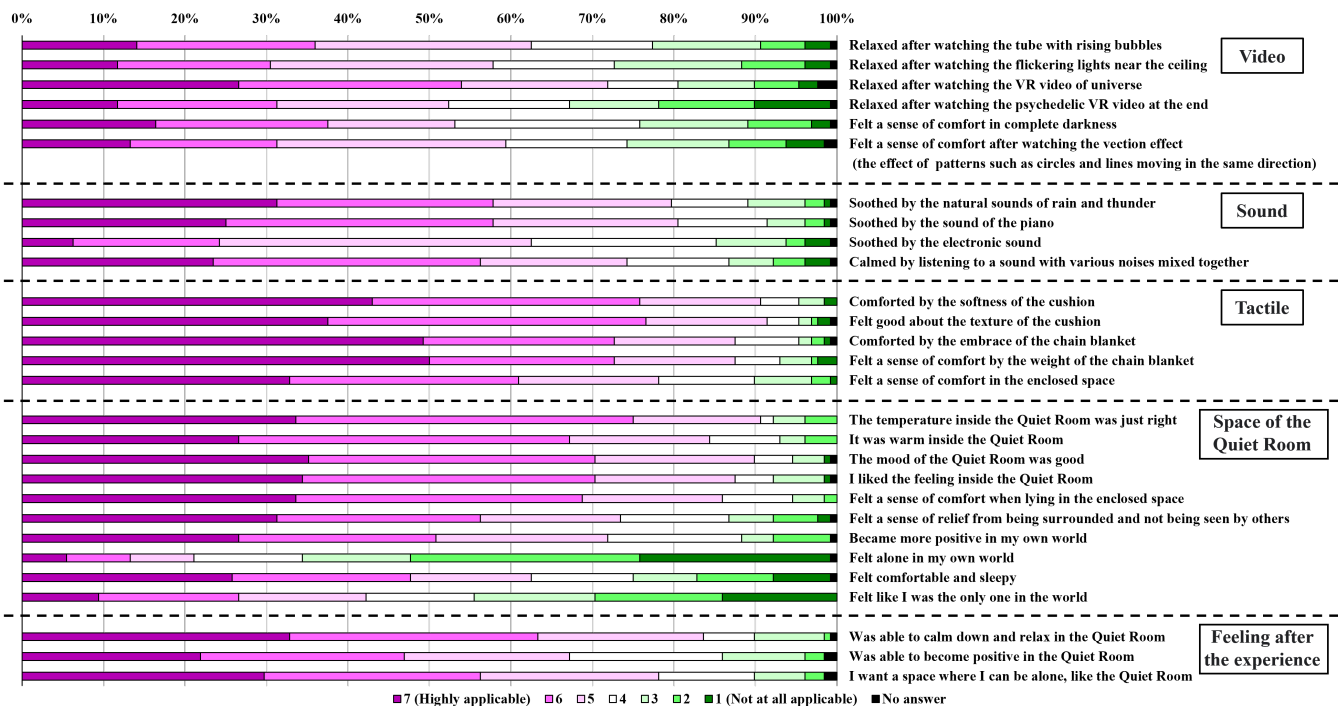


Figure 6: Results of the post-experience questionnaire on a 7-point scale (n=128)

of the subjects had negative opinions about the sensation of physical contact, such as “I really hate the feeling of skin contact”, indicating that people with sensory sensitivity to touch are in the minority.

The results of the questionnaire on a 7-point scale after the experience are shown in Figure 6. All items except two, “Felt alone in my own world” and “Felt like I was the only one in the world,” 55–85% of the subjects gave a positive response

of 5 or more out of 7. In the question “Which do you feel calmer in total darkness or in colorful visual effects?”, 45% of the subjects answered darkness and 55% answered colorful visual effects. The results by gender and age are shown in Figure 7. In the question “Which do you think is more relaxing, being hugged by someone or using a soft cushion?”, 55% of the subjects answered “human” and 45% answered “cushion”. The results by gender and age are shown in Figure 8.



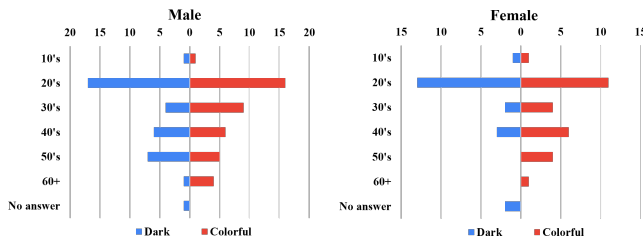


Figure 7: Results by gender and age of question “Which do you feel calmer in total darkness or in colorful visual effects?”

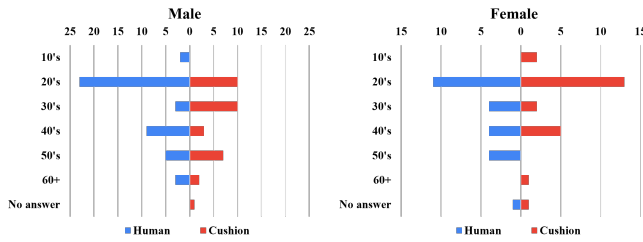


Figure 8: Results by gender and age of question “Which do you think is more relaxing, being hugged by someone or using a soft cushion?”

**Free Description Analysis** Of the 146 participants who responded to the post-experiment questionnaire, free-text responses were obtained from 64. 91% of these included positive opinions about the environment and other aspects of the Quiet Room, and 23% included negative opinions. The percentage of those that included both positive and negative opinions was 17%, and complete negativity was 6%. In order to gain insights toward the realization of the chilling out space utilizing the Quiet Room, in addition to the special senses of sight and hearing, and the somatic senses of tactile pressure and temperature, we focused on the “sense of space” which includes the comfort of the space and the impression of the space design and analyzed the words in the free responses.

As a result, the percentages of positive free-answers identified for each of the senses were: visual 40.6%, hearing 15.6%, tactile pressure 23.4%, temperature 9.4%, and spatial 34.3%. The results of the analysis and examples of the answers are shown in the Table 1. As for the examples, we focused on the most representative ones among the responses that described similar contents. In terms of visuals, there were comments about the feeling of drifting through the universe, the positive feeling of being in the beauty and brightness, and the feeling of a planetarium. Regarding hearing, there were descriptions of a calm feeling of being surrounded by music, music that made them feel cheerful, and a more inclusive feeling if there was more of a sense of spatial audio. In terms of tactile pressures, 12.5% of the respondents said that the chain blanket was comfortable, and others said that they felt wrapped up and that it was like the feeling of being hugged by someone while experiencing the room alone. In the area of temperature, some people said they felt warm and wrapped up, that it was a sensory exploration type of experience, and that it

Table 1: Categories and examples of free responses. Numbers in brackets indicate the number of respondents.

Positive comments (58)	
Visual (26)	Psychedelic but calm; I was drawn in by the fractal-like shapes and felt at ease; Good sense of drifting through universe
Space (22)	It was interesting to see so many innovations as a calm space; I was grateful and moved by the mystical space; The sensation was like when I got refreshed in a sauna
Tactile pressure (15)	The feeling of being wrapped in the blanket was very pleasant; The weight of the blanket made me feel comfortable as I gradually became one with the blanket
Hearing (10)	I could feel the story; It was comfortable
Temperature (6)	I felt warm and wrapped up
Negative comments (15)	
Visual (6)	The strong contrasts and flickers of color and light made me feel restless and suffocated; the scene with the multicolored sticks raining down on me felt stabbing and scary as I have tip and blade phobia
Space (3)	I wanted the door to be closed
Hearing (2)	I could hear voices around me and there was concern that I was being watched

would be nice if the blanket had heat like an electric blanket. Regarding the sense of space, they described a very unique spatial experience, a calm space that they would like to have in their laboratory, a room that is just the right size, a comfortable space, and a sensory experience as if they got refreshed in a sauna.

Furthermore, some respondents expressed the hope that the understanding of sensory hypersensitivity and people concerned would expand socially, stating that they had experienced problems on crowded trains and had friends with some sensory hypersensitivities, so many people would benefit if there were such a place. From the comment “I felt more inspired to get in the zone than relieved,” it can be inferred that a fusion of meditation and Quiet Room is expected. Although some opinions completely rejected the idea, such as that the light was too bright and did not calm them down, the opinion was generally positive, suggesting the demands for relaxation to the visual and hearing senses, comfort to the sense of tactile pressure, and calmness due to the sense of the enclosure in the space. In a society where there is so much stimulation, this could prove part of the need for spaces where people can be soothed and calmed by multisensory stimulation.

## Heart Rate

**Survey Methods** To evaluate the degree of relaxation during the experience based on biological information, we analyzed time-series changes in heart rate measured by a smart-watch. Since we used a setting that measured heart rate every 5 seconds, we recorded approximately 72 heart rate data for each 6-minute experience. After processing to exclude missing or duplicate data due to measurement errors, we analyzed the data for the 84 participants who were determined to be valid.

**Analysis Results** The heart rate decreased on average by approximately 2 bpm (beats per minute) within 30 seconds from the start of the experience. During the period from 30 to 260 seconds (during the playback of the relaxation video), there was no significant change in the average heart rate. On the other hand, from 260 to 345 seconds, when the psychedelic video was played, there was a tendency for the heart rate to increase.

Since the tendency of the increase or decrease in heart rate seemed to be different for each scene of the spatial experience with audiovisual images, a statistical test was conducted to compare the heart rates at representative time points. We set four points as the target: the beginning of the experience, the beginning of the relaxation video (Figure 4(A, B, C, D)), the beginning of the psychedelic video (Figure 4(E, F)), and the end of the experience. Since there were large individual differences in the heart rate values that could be obtained (maximum value of 128.0 bpm and minimum value of 44.0 bpm for all data), values normalized by the mean value of heart rate for each participant were used for the test.

Nonparametric tests were used because the Shapiro–Wilk test determined non-normality at the 5% level. The Friedman test, a nonparametric test for differences between groups, was used to test the difference between time points, and there was a significant difference at the 5% level ( $p = 1.45 \times 10^{-7}$ ). Therefore, multiple comparisons using Wilcoxon signed rank test were conducted. The Bonferroni method was used to correct for multiplicity. As shown in Figure 10, there was a significant reduction in heart rate at the 5% level for the beginning of the experience and each of the other three time points ( $p = 3.2 \times 10^{-7}$ , effect size  $r = 0.59$  with the beginning of the relaxation video,  $p = 4.8 \times 10^{-5}$ ,  $r = 0.48$  with the beginning of the psychedelic video, and  $p = 2.4 \times 10^{-3}$ ,  $r = 0.38$  with the end of the experience).

## Discussion

### Questionnaires

In the questionnaire, all aspects of the visual, sound, tactile, spatial design, and overall experience were generally well received. However, since the same stimuli were given to all the participants in this experiment, there were cases where the stimuli did not match the sensory characteristics of the participants and made them feel uncomfortable. In the future, it will be necessary to construct a mechanism to switch the stimuli according to the sensory characteristics and preferences of each individual.

We also found that many people said it would be better if there were places like Quiet Room where they could be

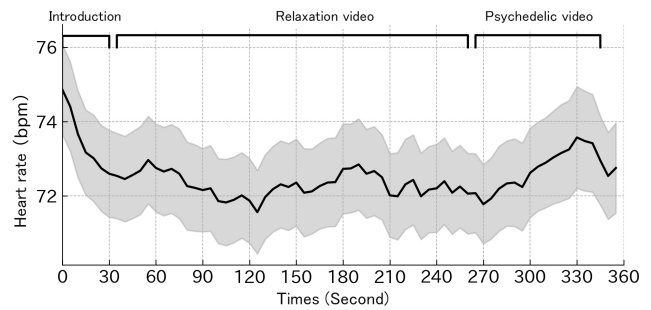


Figure 9: Mean heart rate during the experience. Gray areas indicate standard errors.

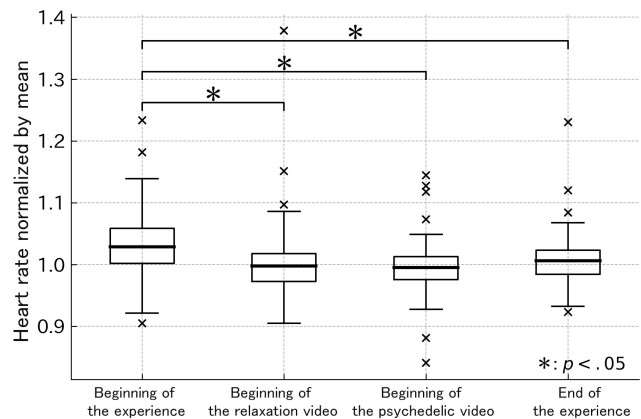


Figure 10: Results of non-parametric tests of normalised heart rate at four time points during the experience. The × sign indicates outliers.

alone in laboratories, workplaces, public transportation, and so on. It is suggested that there are positive opinions toward its widespread use in society. We believe that we were able to make the experiment through this exhibition the first step toward the social implementation of Quiet Room in our country.

## Heart Rate

Compared to the beginning of the experience, the heart rate significantly changed in the direction of relaxation at each time point during the experience, indicating the relaxing effect of the Quiet Room. In addition, since the heart rate decreased as early as 30 seconds after the start, it can be inferred that the relaxation effect was quickly obtained by entering the Quiet Room itself.

On the other hand, no significant difference was observed in the heart rate at each time during the experiment after the start of the relaxation video. There was no significant difference in the heart rate before and after the psychedelic video scene, in which the average heart rate tended to increase. Therefore, although this experiment suggested a relaxing effect of the combination of simple structures, VR images, and sound, further verification is needed to determine the differ-

ence in effect depending on the type of images.

## Conclusion

### Summary

In this paper, we developed the Inclusive Quiet Room, a digital rehabilitation experience that combines digital, tactile, and visual elements, that are not found in conventional Quiet Room, utilizing a space constructed using an easy-to-build Instant House. We verified the effectiveness of the experience for the general public. Both the results of the questionnaire and the measured heart rate indicated that the proposed Quiet Room and the combination of multisensory stimuli that work on the visual, auditory, and tactile senses produced a relaxing effect. In addition, there were approximately 5% of participants with sensory sensitivity in the screening of the questionnaire before the experience. Through the exhibition of the Quiet Room using a simple structure, it became clear that both people with and without disabilities can easily experience the relaxing effects of the space. Furthermore, it was found that more than 60% of people think that they need a space just for themselves, a result that proves the need for a place where people can relax alone in social life. The fact that there were many positive opinions toward the social diffusion of Quiet Rooms can be concluded that there is a necessity for places that function as temporary shelters where people can heal and calm down by regulating multisensory stimuli from the outside in a society where there are a lot of noise and human voices.

### Future Works

Although, in this experiment, many visitors to the exhibition were the participants, we hope to conduct the experiment with people with autism and developmental disabilities who are in need of Quiet Rooms, as mentioned at the beginning of this paper. We hope that in the future, as the number of places where people can chill out increases in society, the number of panic-stricken situations will decrease. By creating a calming environment, it is expected to promote the creation of a society in which people with sensory hypersensitivities can live together with their families and other people in society, maintaining a comfortable sense of distance and helping each other as needed. The next research project will be to conduct experiments on the people concerned, to improve the method of presenting space and sensory stimuli, and to raise issues for the diffusion of Quiet Rooms in society.

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