A Study of the Color Effect on the Changes in Emotion and Behavior

Testing the Efficiency of Creative Activities by Color in a Working Space

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Abstract: As offices increasingly move into the center of large cities, office workers are short of time to focus on their tasks and unable to improve their efficiency due to commuting time, transportation cost and reduced working space. As a measure to solve such complex issues, 'smart office' is drawing attention in recent years. It is also needed to correctly understand the psychological effect of color and which color can improve efficiency. This study aims to investigate how color has an effect on emotional change to improve the efficiency of creative activities in smart office, using an experiment. The experiment was conducted using the Profile of Mood States (POMS) test: a portable form of color paper was placed on the table of office and a creative activity was performed using LEGO blocks. The colors used for the experiment were changed from white and blue to white, blue, green and grey. This study proposed a portable folding color pad to improve the work efficiency of smart office based on 2 experiments.

Key words: Smart Office, Color Effect, Creative Activities

1. Introduction

As offices increasingly move into the center of large cities, office workers are short of time to focus on their tasks and unable to improve their efficiency due to commuting time, transportation cost and reduced working space. As a measure to solve such complex issues, 'smart office' is drawing attention in recent years. Smart office has advantages that can enhance the concentration and efficiency of works compared to Tele-working, as it has a number of bases in several areas besides the office in the city center. On the other hand, however, it is low in work concentration and is difficult to create an environment to maintain privacy, as it has extremely high flexibility of space because only the basic furniture is provided. This study, accordingly, attempted first to identify the changes in emotion by color, and then present a design of pad in a portable form that can be used in smart office. It was believed from the previous studies that humans are psychologically affected by color in their unconsciousness, which in turn affects the improvement of efficiency[1,2]. It is also needed to correctly understand the psychological effect of color and which color can improve efficiency[3]. This study aims to investigate how color has an effect on emotional change to improve the efficiency of creative activities in smart office, using an experiment. The experiment was conducted using the Profile of Mood States (POMS) test: a portable form of color paper was placed on the table of office and a creative activity was performed using LEGO blocks. Carried out to examine emotional change, this experiment revealed the effect of color on humans in smart office.
2. Smart Office

Smart office refers to renting parts of buildings that are located near central subway stations, and establishing them as workspace and implementing a pre-address system for office workers with long commutes. Creating an environment where workers can freely move around and work can reduce commuting time, improve productivity, make work efficient, enhance comfort in an indoor environment, increase productivity of work and promote power saving activities. In 「Slim Office」, NEC efficiently used the floor by realizing an office that thoroughly eliminates wastes without losing comfort and functionality, opening up the floor to eliminate wasted space, excluding all the partitions and furnishings that block the floor space, and removing dead space that is generated by partitions[4]. Also, file cabinets were reduced by re-evaluating the rules of storing paper documents and electronization, and by implementing a pre-address that does not limit one’s workspace with the usage of wireless LAN environments, new clients and smartphones, layouts that can freely change depending on the content of work or scale of teamwork was considered, and all places were made to be used efficiently.

![Open floor with a reduced cabinet](image1)  ![Freely choose a place to work](image2)  ![Diversified multi-function office](image3)

Figure 1 Realization of a slim office

『Smart Work』 materialized smart work that flexibly enhances the knowledge creativity by using ICT. By transmitting diverse information, sharing information or knowledge across an organization and stimulating thinking and by working on the spot at necessary times, an acceleration of teamwork was promoted. Also, a reform of working method was pursued, which included checking the data and documents prior to the meeting and immediately discussing matters in the meeting in order not to use paper documents and to quicken the speed of decision, and strengthening communication by removing the information gap in a video conference that connects two bases that are apart from each other.

![Ideas and sharing information and expertise originating](image4)  ![Team working](image5)  ![Working not using paper](image6)

Zero distance office

Figure 2 Realization of a smart work
However, that does not mean that the Smart Office is full of advantages only. It only contains simple desks and partitions, and the colors are monotonous. In other words, the degree of freedom is excessively high and it is difficult to utilize the office proficiently, and it becomes hard to focus on work. Also, workers are actually getting stressed out even during free time because it is challenging to obtain feedbacks from superiors or control tasks[5].

3. Research Method

A preparatory experiment was conducted by targeting 4 subjects (2 males and 2 females, average age of 21), in order to estimate the effect of the existence of colors.

![Figure 3 Process of experiment](image)

3.1 Preparatory Experiment

- A space with a Smart Office image was prepared by installing a white table (length: 1000 mm, width: 600 mm, height: 750 mm) next to a white wall of a general office.
- Experimental works were recorded with a video camera, and hand movements and time were recorded.
- LEGO blocks were presented on the table, and the purpose of the experiment was explained.

LEGO blocks were used in this experiment because they are used in many experiments in the field of sensibility research, appropriate for creative and active experiments, and anyone can assemble them together easily. Since diverse colors of LEGO blocks can cause inconvenience, 90 white pieces and 51 black pieces (2 colors only) that were associated with the LEGO block 6177 were used to reduce their effects on emotions or behaviors[6]. A completed chair was shot with a digital camera.

![Figure 4 LEGO block6177](image)
As for measuring emotions, a Profile of Mood States - Brief Form Japanese Version was used to investigate.

POMS refers to a Profile of Mood States-Brief Form Japanese Version, which is Yokoyama et al’s translated and shortened version of the index developed by McNair el, which evaluates states of temporary feelings and emotions. Questions are made up of 6 sub-criteria of T-A 「nervous-anxious」, D 「resentment-hesitant」, A-H 「anger-hostility」, V 「vitality」, F 「tiredness」 and C 「confusion」, and consist of 30 items and 5 methods. Scores of 5 sub-criteria are added up (base score), and higher scores indicate particular tendencies.

POMS is mostly used in the field of medical science, and can diagnose depression and measure the patient’s feelings. On the other hand, base score of 6-criteria of shortened POMS version was used after transforming it into standardized scoring (T-scoring: 50+10×[base score - average score] ÷ standard deviation) [7]

Figure 5 Form of POMS

• Fill-in sheets were collected, and subjects were made to produce 「an ideal chair that you want to sit on」 by using the LEGO block 6177.

• The mood was investigated by using POMS, and 5 minutes of rest were given after collecting fill-in sheets.

• After putting an A2-size colored paper on the table, the same experiment was then repeated.

Figure 6 The scenery of an experiment, and the completed work
1) Preparatory Experiment Results

Results from researching 4 subjects were extracted by using a T-score and calculating the average for each of 6 criteria, which were T-A ‘nervous-anxious’, D ‘resentment-hesitant’, A-H ‘anger-hostility’, V ‘vitality’, F ‘tiredness’ and C ‘confusion’, and significance differences were examined with the bivariate analysis. (Table.1, 2)

Table.1 Average and significant difference of color-less POMS

|       | Average before an experiment | Average after an experiment | Significant difference (p<0.05) |
|-------|-----------------------------|-----------------------------|---------------------------------|
| T-A   | 55.25                       | 44.75                       | 0.0609                          |
| D     | 50.5                        | 44.5                        | 0.0545                          |
| A-H   | 46.5                        | 38.25                       | 0.0332                          |
| V     | 43.25                       | 50                           | 0.2760                          |
| F     | 54                          | 38.5                        | 0.0002                          |
| C     | 61                          | 51.75                       | 0.2269                          |

Table.2 Average and significant difference of POMS with a color

|       | Average before an experiment | Average after an experiment | Significant difference (p<0.05) |
|-------|-----------------------------|-----------------------------|---------------------------------|
| T-A   | 40.5                        | 38.5                        | 0.2383                          |
| D     | 41.5                        | 42.75                       | 0.2148                          |
| A-H   | 37.75                       | 37.75                       | 1.0000                          |
| V     | 45.75                       | 47.5                        | 0.7156                          |
| F     | 41                          | 38.5                        | 0.4714                          |
| C     | 47.25                       | 46.25                       | 0.8404                          |

The average before and after using a colorless paper was compared with the average before and after using a colored paper, and numerical values before and after using a colorless paper showed lots of errors as well as significant differences. Therefore, it is believed that subjects could not focus due to heavy mood swings. However, significant differences were not observed when working on top of a colored paper, and as evident from low scores in 6-criteria and low errors in numerical values, it is believed that subjects were able to continue to focus.

2) Contemplation of the Preparatory Experiment

The preparatory experiment confirmed the possibility of measuring emotional changes due to colors. However, manufacturing time was not limited, and there were individual differences in regard to the subjects’ manufacturing time. In other words, even though well-made products were created, some subjects took too much time. Therefore, it is believed that comparable experimental results can be obtained by limiting manufacturing time. Also, 5 minutes of rest were administered during a preparatory experiment in order to refresh the eyes, but the duration was too long and that led to adverse effects. Also, since the overall experiment takes long if the number of subjects increases, it was attempted to reduce the time consumed for each subject. Consequentially, it was believed that lots of reliable experiment results could be obtained by limiting manufacturing time, reducing break time and increasing the number of overall subjects.
3.2 Main Experiment

The experiment sequence was identical to the preparatory experiment, but the number of subjects was increased to 10 (7 males and 7 females, average age: 21.4), LEGO block manufacturing time was limited to 5 minutes, and break time was reduced from 5 minutes to 1 minute. 4 colors, which were white, blue, green and gray, were used in the experiment.

![Figure.7 Process of Main experiment](image)

![Figure.8 The scenery of an experiment, and the manufactured chair](image)

1) Results

By using T-score, findings upon inquiry were extracted by averaging each of 6 criteria of nervous-anxious, resentment-hesitant, anger-hostility, vitality, tiredness and confusion, and significance differences were examined by using the bivariate analysis. (Table.3, 4, 5, 6)

![Table.3 Average and significant difference experiment before and after an experiment(White)](image)
When the averages of 4 tasks were compared, numerical values before and after using a white color showed lots of errors and it is believed that subjects were not able to concentrate that much. As for the remaining 3 colors, numerical values and errors for 6 criteria were low, meaning that subjects were concentrating prior to the experiment. Also, among 4 numerical values, the margin of error was the smallest for the blue color, and it is believed that this proves the fact that the blue color makes a person focused and stable.

2) Contemplation

This experiment showed that working with a blue color leads to very minor differences in T-A, D, A-H, V, F and C compared to other colors, and that it has an effect of improving concentration. In other words, it was
revealed that working with a blue color can lead to efficient creative activities. However, results that combined many factors, such as time limitations causing inconveniences in regard to working, conducting the next experiment without taking sufficient rest, colors having low depths and psychological effects not being fully reflected were shown in numerical values, and it can be claimed that it did not have major impact on the subject’s psychology. In future studies, I wish to add colors such as brown and pink, which could confuse the subject’s emotions, in order to confirm if significant differences or averages values are correct. It was also thought that using methods other than POMS for investigating one’s emotions while working could assist with obtaining more detailed information about colors.

4. Proposal of Design

In regard to suggesting a desktop product that improves work efficiency, a work desk mat was chosen as one of application samples after considering the best utilization of color effects, convenience and relocation. First, an image map was produced for the positioning of the product, and the direction of the design was set through idea sketches[8]. After considering portable convenience when moving from home to a smart office and storage in a general business bag, the size of a desk mat was set as an A2 size and designed to be partitioned. Making it in an A4 size is more portable, but the area is insufficient for working. Therefore, it was thought that dividing an A2 sized mat into four A4 sizes makes it easy to carry and use[9]. Also, the partitioned method makes it possible to combine the mats in diverse ways and many different shapes can be made. The color of the desk mat was set as gray to eliminate the stimulation of colors, and the color was emphasized to make the psychological effect stronger.
5. Conclusion

This study attempted to suggest methods so that subjects like designers, who move around frequently and conduct creative activities, can focus within a smart office. In detail, POMS, LEGO blocks and colored papers were used to conduct experiments that checked emotional effects through the effects of colors. It is believed that applying more colors and producing more diverse psychological effect products are important. Therefore, confirming psychological effects of more colors through experiments, suggesting and designing products that can maximize work efficiency, and supporting the environment where designers can focus on work become important. Based on such, a desk mat that considers psychological effects of colors and efficiency of creative activities was manufactured. By suggesting a desk mat that emphasizes a color effect, making it easy to carry a mat to a smart office or workplace, and combining desk mats on the spot, efficiency of creative activities is desired. By verifying emotional effects through more colors and verifying effects in the office, there is a need to apply such effects in diverse products other than desktop products. Also, I wish to verify the effects of shapes, texture and colors on emotional changes and design products that the users can instantly become pleased with.

6. Citations

[1] Masato Nagahashi (2010) *Influence that color of place mat gives to impression of meal*: It pays attention to neutral tints

[2] Nodoka Ohmori, Yumiko Wada (2009) *Gender differences in color preference and the psychological effect of color*

[3] Miki Takasaka (2000) *COLOR 「WEARING ・ PAINTING ・ WATCHING」*, Total Color Healing

[4] NEC Networks & System Integration Corporation, http://www.nesic.co.jp/topics/office.html

[5] Yutaka Matsuda (1995) *The design of color*

[6] *Possibility of a LEGO block*, http://www.legoeducation.jp/1ec/possibility.html

[7] Kazuhito Yokoyama (2005) *Profile of Mood States-Brief Form Japanese Version*

[8] *About an Image Map*, http://www.dear.or.jp/activity/menu09.html

[9] *Knowledge about a bag*, http://businessbag.yi103.com/bag-wisdom/bag_info01_size.html