COMPATIBILITY OF VISIBILITY AND HARMONY OF PICTOGRAM -FOCUS ON RESTROOM MARK-

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ABSTRACT

In recent years, there are various design signs to guide people. In the signature "pictogram" which enables guidance without using words is often used. However, when looking into the building, the signature using the pictogram is given its own design to match with the indoor space, and signs which are difficult for the user to understand are distributed. It can be thought that these pictograms are being redesigned to adapt to architecture. Therefore, the research aimed for a sign plan which is easy for users to understand, and thought that standard pictograms harmonizing with various buildings are necessary. Visibility is important for pictograms, and in this research, the objective is to study the conditions of pictograms that compatibility of visibility and harmony.For reference to the research conducted for each generation, The author conducted an experiment using the pictogram of the Japanese Industrial Standard toilet mark, which had high recognition among all generations. The author divide the pictograms into pictograms for men and women whereby the existing designs filled with color and new designs with only contour lines are more harmonious using textures of concrete, brick, white wall, wood pictograms were synthesized.

The author compared with that pictograms . As a result, The author received responses that the design of only the outline of the pictogram for men and the pictogram for women is more harmonious in all scenes. Among them, both male pictograms and female pictograms showed significant differences in the two scenes, and a significant trend was observed in the remaining two scenes. The author conducted experiments on the width of the contour line using 4 scenes images same as comparison and study the pictograms of the line widths with the greatest thickness. As a result, there was not much difference in the width of the width of the contour line of the pictogram in all scenes of male pictograms and female pictograms. The author discussed the effect on visibility and harmony by shape and color as future prospect.

Keywords: *Pictograms, Compatibility, Harmony*

INTRODUCTION

Background and Purpose of Research

In recent years, sign has been positively designed in Japan. For example, the 2020 Tokyo Olympic Games, Paralympic Games have been devised to make it easier for foreigners and tourists as well as Japanese. One of them is changing 7 kinds of pictograms so as to match the pictogram of the Japanese Industrial Standard (hereinafter referred to as JIS) and the pictogram of the International Organization for Standardization (hereinafter referred to as ISO), and 15 new pictograms and help marks are added. From this change, it can be seen that pictogram, which is a figure that provides information on objects, concepts or states regardless of letters and languages [Traffic Ecology Mobility Foundation (2017)] plays an important role in communication. Although the number of foreign tourists visiting Japan has declined after the Great East Japan Earthquake, due to the visit Japan project, which is a visit to Japan promotion business [Japan Tourism Agency] aiming to increase the number of foreign tourists visiting Japan. Since foreign tourists visiting Japan are expected to increase in the future, the necessity of graphic symbols for guidance using pictograms is considered to be increasing. In Japan, the standards are JIS Z 8210 "Public Information Symbols" for the pictograms guide. Public Information Symbols is "Everyone can understand even without professional or occupational training [JIS Z 8210]" and is "a figure symbolised for guiding for unspecified large number of people [JIS Z 8210] ". However, since JIS is an arbitrary standard, various other redesigned pictograms are often used. For example, you may see only contour line pictograms, angular designs, designs like illustration and so forth. From these facts, it can be thought that the pictogram of the signature has been redesigned to harmonize with the architecture. Although it is easier for users to unify figure symbols. It is possible to recognize quickly if the pictogram in any place is the same, because everyone can understand as common recognition if signs are unified even if race and age are different. Therefore, the author thought that a harmonized and unified pictogram is necessary in modern times where globalization advances. In this paper, the research aimed to study the design of pictogram in harmony with various architectures. So many people can understand easily Public Information Symbols.

Current Situation of Pictogram

One research on the current situation of pictograms is [Papers of the Kitakami 2002]. In order to clarify the present condition and problems of the pictogram and aim for a better pictogram in an easy-to-understand manner, we clarified issues to be considered from the five viewpoints of representation, visibility, object, aesthetics and standardization. In addition, [Torii 2008] conducted a survey on awareness of pictograms by generation. Both generations have high awareness of what is seen in public and general facilities such as handwashing and telephone, that women are less aware of the word pictogram than men and pictograms about elementary school transportation. A study by [Ohno 2011] which clarified the difference of the present state of pictogram by culture and customs. Regarding the pictogram of the toilet, we are clarifying the difference in color and shape between Osaka, San Francisco and Seoul.

Understandability of Pictogram

Understandability of pictogram [Shiraishi 2009] is studying the influence on visibility, comprehension degree, favorability by coloring pictogram. In addition to colored pictograms, research on pictograms of still images and moving pictures is undertaken by [Ono 2016], and proposals and usefulness of visual languages constituting still pictograms, moving pictograms, and colorized pictograms expressing the meaning of verbs from the verification of the methodology to create a new pictogram is summarized. In addition, [Kudo 2013] investigated children and students with intellectual impairment, studied the conditions of pictograms that were easy to understand and considered in an easy-to-understand manner, such as adding graphics representing movement to the pictograms or making illustrations. It was revealed that there are effective ones that added graphics should not be added depending on the installation rate, frequency of eye observation, daily frequency of action at the place, and so forth.

Balance of Visibility and Harmony

Not only research on pictograms but also studies on balance between visibility and harmony for landscapes were consulted. Studies on what kind of design and evaluation will be done by considering landscapes with respect to things where visibility is important, such as snow pole and signboard

pointing to the lane width. [Homma 2013] conducted a study on the visibility and the landscape of the signboard in the shopping street. By comparing the shape of the signboard and the type of the wall surface, it is shown that the shape of the signboard has a greater influence than the type of the wall surface, by comparing the degree of conspicuity, the degree of harmony, and the appearance. In addition, [Hirasawa 1994] mentioned about snow pole, because it is installed for the full year unnecessary at the unnecessary time, that it is damaging the road scenery such as nature, suggesting a new type snow pole, with weather, day and night and so forth. A comparative study was conducted. As a result, it was revealed that the new type of snow pole is more visually recognizable and is embedded in the landscape.

COMPARATIVE EXPERIMENT OF PICTOGRAM

Outline of Experiment

The author conducted comparative experiments for 10 male students and 10 female students with the indoor space from December 28, 2017 to January 10, 2018. The author used the filled with color pictograms and only contour line pictograms(FIG. 1) and asked which pictograms are in harmony. In this research, The author used the pictogram of JIS which is widely used in Japan, and The author let test subject answer "which is more assimilated to the background texture filled with color pictograms or only contour line pictograms".

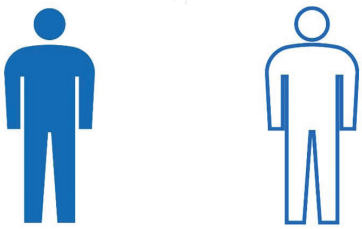

Figure 1: Filled with Color Pictogram (left) only Contour Line Pictogram (right)

Comparative Experiment Method

The author created indoor space Computer Graphics ,which only the wall texture was different and the other elements are all the same. The author synthesized two kinds of pictograms for men's design and women's design which devide filled with color pictograms and only contour line pictograms for Computer Graphics of four scenes "concrete", "brick", "white wall" and "wood". (Fig. 2) We arranged these images on one display and experimented which of the two pictograms harmonized with the texture of the wall of the indoor space.

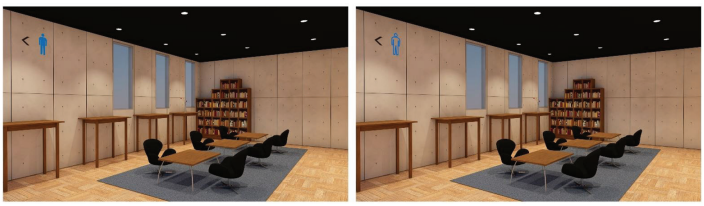

Figure 2: A Comparative Image (Filled with color Pictogram and only Contour Line Pictogram)

Comparative Experimental Results

The experimental results are shown in Table 1 and Table 2. The numbers in the table are the numbers of people who answered that they are more harmonious compared the two pictograms.

There were more responses that the only contour line pictograms are more harmonious than filled with color pictograms except for the female pictogram on which wall texture is "brick".

Table 1: Experimental Result of Male Pictogram

Male	Concrete	Brick	White wall	Wood
Filled with color(people)	5	6	8	3
Only contour lines(people)	15	14	12	17

Table 2: Experimental Result of Male Pictogram

Female	Concrete	Brick	White wall	Wood
Filled with color(people)	3	11	6	5

Only contour lines(people)	17	9	14	15

Analysis of Experimental Results

The author conducted Chi-squared test with the statistically significant result obtained in the experiment or with a significance level of 5%. As a result, there was a significant difference in "concrete" and "wood" in the pictogram for men, and a significant tendency was seen in "bricks". Then, in order to correspond to all scenes, The author conducted chi-square test on data of experiments of pictograms for all men, and a significant difference was observed. In female pictograms, there was a significant difference in "concrete" and "wood", and a significant tendency was seen in "white wall". Significant differences were also seen in all pictograms for women when all the scenes were integrated. From these results it can be said that the only contour line pictograms are more harmonically than the pictograms filled with color.Therefore, as a next step, we conducted experiments on the width of the optimal contour line for only contour line pictograms.

EXPERIMENT ON LINE WIDTH OF ONLY CONTOUR LINE PICTOGRAMS

Outline of Experiment

In order to investigate the influence on visibility and harmony by changing the width of the line width of the only contour line pictogram, The author conducted experiments using the magnitude estimation method (hereinafter referred to as ME method). The author made test subjects answer about how easy it is to recognize compared to the standard image and how harmonized it is with compared to the standard image.

Magnitude Estimation Method

Magnitude estimation method (ME method) was used as a method for finding psychological quantity. "The strength of the physical stimulus and the intensity of the sensation caused by it are not necessarily proportional. For example, when weighing 100 g and 200 g respectively into two boxes of the same appearance, 200 g is physically 100 g. However, the feeling of weight

when you have it is generally felt more than twice as heavy. [Okamoto (2014)] Thus, the ME method is "a physical quantity of stimulation and a person against it It is possible to quantify the sensory psychology of [Fukuda (2009)] ". This method presents standard stimuli to subjects and reports on the extent to which the randomly arranged comparative stimulus presented afterwards felt to the standard stimulus, numerically. For example, R = kSn (R: psychological quantity, S: physical quantity, k: constant, n: exponential exponent) and R = kSn (R: psychological quantity, S: physical quantity, and k: constant, n: exponent) and the data obtained from the data are aggregated and analyzed to calculate the stimulus physical quantity as S and the psychological quantity as R it can express and it can clarify how people feel, [Fukuda (2009)], [Okamoto (2014)].

By this method we derive the stimulus and the expression of psychological quantity for it, "function on visibility and line width" and "function on harmonicity and line width". We consider that the maximum sum of these functions represents compatibility between visibility and harmony in this study. However, this study aims to clarify the conditions that compatibility of visibility and harmony are compatible. It is a pictogram which is easy to understand, but it is not assimilated to the texture of architecture, when visibility strongly acts on a certain pictogram and shows high numerical value and low numerical value in harmony. In this research, it is assumed that both pictograms showing high numerical values for both visibility and harmony are compatible. As a specific method, a difference between visibility and harmony is obtained at each point on the function, an average value is taken, and a value smaller than that is adopted. The applicable range of the function is that the line width used as a stimulus value is 0.2 mm to 1.2 mm, and the maximum value among them is said to be compatible with both visibility and harmony.

Experiment Method

The author used the 5 kinds only contour lines male pictograms and female pictograms whose line width are all different. The author synthesized them into 4 scene images of "concrete", "brick", "white wall", "wood. Fig. 3). These images are all the same without pictograms. In this experiment the author covered 20 people in total, 10 men and 10 women.The author showed each image randomly every 5 seconds and the author inserted white

image between each image to avoid the influence of the previous image. The author had test subjects see an image of the standard stimulus, and asked how much visibility and harmony when compared to the standard image.

Figure 3: An example of a Scene Image

Experimental Results

Function of R=kSn (R: psychological quantity, S: physical quantity, k: constant, n: exponential exponent) was found for the physical quantity and the psychological quantity using the ME method. The author obtained result of the function in each scene regarding line width and visibility, line width and harmony of male and female pictograms. In this experiment, the line width is a physical quantity, and visibility and harmony are psychological quantities. Experimental results on visibility and harmony are shown in Tables 3 and 4.

Table 3: Experimental Results on Visibility of Pictogram

	Male pictogram	Female pictogram
concrete	R=159.7350S0.7312	R=160.8052S0.735
brick	R=166.1116S0.9063	R=163.0797S0.6706
white wall	R=164.3993S0.7365	R=164.7404S0.7201
wood	R=172.3058S0.8551	R=157.7611S0.8742

Table 4: Experimental Results on Harmony of Pictogram

	Male pictogram	Female pictogram
concrete	R=55.0174S-0.6966	R=64.5952S-0.5893
brick	R=64.1800S-0.6259	R=64.4614S-0.5717
white wall	R=60.7016S-0.6238	R=62.7191S-0.6752

wood	R=60.9256S-0.6517	R=64.4614S-0.5717

Analysis of Results

The purpose of this research is to clarify the design which visibility and harmony are compatible. Therefore, the author excluded cases which only visibility or harmony of the values strongly works. Specifically, the difference between visibility and harmony on the function was found, and the author adopted numerical values smaller than the average numerical value. The numerical value that takes the maximum numerical value in the function of the sum of visibility and harmony within the range below the average numerical value is the numerical value of this research. The results are shown in Table 5.

Table 5: Result of Line Width of Pictogram with Integrated Scene

Line width	Male pictogram(mm)	Female pictogram(mm)	Male pictogram(%)	Female pictogram(%)
concrete	0.75	0.8	2.14	2.29
brick	0.8	0.75	2.29	2.14
white wall	0.8	0.8	2.29	2.29
wood	0.8	0.85	2.29	2.43

In order to obtain the general-purpose numerical value of the line width, The author calculated as a percentage with respect to the length of the reference frame line of the pictogram (Fig. 4). As a result, the pictogram for men has a line width of 2.14% in "concrete", the line width of 2.29% in the other three scenes with respect to the length of the reference frame line of the pictogram, In the pictogram for women, the line width of 2.29% in "concrete", "white wall", the line width of 2.14% in "brick", the line width of 2.43% in "wood" . Fig. 4 shows the pictogram of line width that is easiest to see and match with architecture obtained in this research.

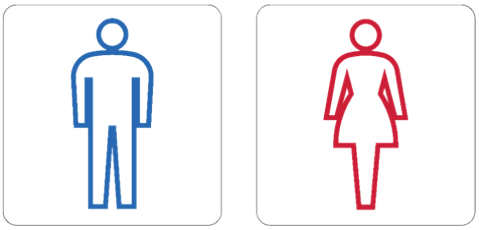

Figure 4: Pictogram with Line Width of 2.29% Obtained from Research

CONCLUSION

The author compared and analyzed the pictograms filled with color and the only contour lines pictograms, we found that in this study the only contour line pictograms are more harmonic with the texture of the architecture than the pictograms filled with color. Pictograms that were compatible with visibility and harmony was 2.29% of the line width compared to the reference frame of the pictogram Fig 4). Furthermore, analysis of the experimental results suggests that there is little possibility that colors and shapes have an influence on visibility and harmony because the results show little difference in the results between male pictograms and female pictograms. Likewise, because the results for each scene were similar, in this experiment, the possibility that the visibility and harmony may not be influenced by the architectural texture may be considered.

FUTURE PERSPECTIVE

The author got some issues from this research. The author used four scenes in this experiment, but it cannot be said that it corresponds to the texture of various other architectures. Therefore, it is necessary to conduct experiments with various textures and standardize pictograms. Also, the author used the toilet mark which is the male pictogram or the female pictogram in this experiment, they are relatively similar. Therefore, it is necessary to confirm to what extent, shape and color of the pictogram influences visibility and harmony strongly, conducting experiments with a pictogram showing an airport representing an airport, a pictogram showing a railroad representing a train station, a pictogram "P" representing a parking lot and a pictogram "i" representing an information corner which is completely different from

a pictogram of a human type. Finally, there are color hue, saturation, and brightness as elements that improve the compatibility of visibility and harmony further. The author think that by changing these color elements, we can obtain a pictogram suitable for further research purpose. According to the research of [Kishimoto et al. (2011)], since it is indicated that saturation has the most influence on attractiveness among hue, lightness, and saturation, the author would like to recommend that future research on saturation be conducted.

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REFERENCES

Kitagami Shinji (2002). Present Situation of Utilization of Pictograms and Future Prospects-What is a Good Pictogram and What is an Intelligible Pictogram?

Torii Koji, Tanaka Naoto (2008). Comparison of Recognition of Pictograms between Different Generations - Study of Easy to Understand Signature - Architectural Institute of Japan Journal of Academic Lecture.

Ohno Haruyo (2011). Color of the Pictogram of the Toilet. - 3 cities comparison.

Shiraishi Mamiko (2009). Influence of Coloring of Pictogram on Visibility.

Ono Shintaro (2016). Analyses of the Comprehensibility of Pictograms-Using Dynamic and Color Expression.

Kudo Mao, Yamamoto Sari (2014). Study on Conditions of Universally Considered Pictogram.

Homma Masashige, SatoHiroki (2013). Study on Landscape and Visibility of the Outdoor Advertising in All-lid Shopping Arcade.

Hirasawa Kyousuke, Takagi Hideki, NagaI Tomonori (1994). Evaluation of Visibility of New Type Snow Pole Considering Landscape.

Okamoto Yasuharu (2014).Psychology Data Analysis and Measurement:Keiso Shobo.

Human Performance Laboratory (2009).Ergonomic guide - How to science sensitivity -: Scientist Press.

Kishimoto Wataru, Murakami Kazuhito (2011). A Method to Generate Attractive Design based on Gaze Analysis and Image.

The Foundation for Promoting Personal Mobility and Ecological Transportation (2001) Guidelines for standard guidance symbols.