

A Study on the Visual Features of Bathroom Chairs That Look Comfortable to Sit on

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Abstract: A wide variety of bathroom chairs are available in the market, which makes it difficult to choose which to buy. It is impossible to reproduce the actual condition of use in the selling space because we cannot be naked when we try sitting on the chairs. An image of the appearance seems to be an important factor in the buying decision process. However, no indicator is currently available for such an image. This study aims to define the visual features of bathroom chairs that look comfortable to sit on. First, a survey was conducted on the actual use and purchase of bathroom chairs to ascertain that a wide variety of products are used. Based on the survey result, a hypothesis was established that the features suggesting good sitting comfort may vary depending on the bathing style. Using POSA to divide the subjects were divided into four bathing style groups, a questionnaire survey was conducted. In the survey, images of bathroom chairs were shown to the subjects of each group and each group was asked if the chairs looked comfortable to sit on. The responses were analyzed based on the rough set theory to extract the features. The study revealed that the features suggesting good sitting comfort were different from one group to another. Designs representing the features given by each group were created by computer graphics.

Key words: Bathroom chairs, visual sensation, sitting comfort, POSA, rough set.

1. Background and Purpose of the Study

Washing one's body seated on a bathroom chair in taking a bath is a unique custom of the Japanese. This is one of the traditional customs retained by the Japanese even today when globalization is underway. As such, bathroom chairs are essential to their life. As the household goods market is getting matured in recent years, the variety of bathrooms chairs on the market has widened so much that it is difficult to choose which to buy. While it is possible to try sitting on a living room chair in the selling space, it is impossible to try sitting naked on a bathroom chair. Users need to make a buying decision from the image of the appearance, but no indicator has been identified as to what appearance suggests good sitting comfort. This study aims to reveal the appearance features of bathroom chairs that people would consider comfortable to sit on. The indicators defined by this study can be utilized in designing bathroom chairs and selecting which to purchase. It should be noted that the target of this study is limited to bathroom chairs used by people without disabilities.

2. Method of the Study

This study aims to clarify the conditions of bathroom chairs that visually appear comfortable to sit on without having the subjects actually sit on the chairs. With respect to the preceding studies on bathroom chairs, there is one on the indicators of bathroom chairs that are comfortable to sit on and suited to the act of bathing [Note 1] and

this study has determined physical features. However, a wide variety of chairs are marketed and purchased in actuality. In view of this, a hypothesis was established that features of chairs that visually appear comfortable to sit on may vary in accordance with the bathing style. First, background of the actual purchase and use of bathroom chairs was ascertained. Next, a questionnaire survey on the bathing style was conducted and the subjects were grouped using the Partial Order Scalogram Analysis (POSA). Then, another questionnaire survey was carried out by asking the subjects of each group if the bathroom chairs in the images shown to them looked comfortable to sit on. The result was analyzed based the rough set theory to identify the features of each group. Lastly, designs of bathroom chairs with the combination of these features were presented in images.

3. Survey on the Actual Use and Purchase of Bathroom Chairs

First, background of the actual purchase and use of bathroom chairs was ascertained by conducting a web-based questionnaire survey on 700 men and women across the country [Note 2]. As a result, the following matters were observed with respect to the actual purchase and use of bathroom chairs. The ownership rate of bathroom chairs was 81.6%, which means that many people use bathroom chairs. An oval shape was the most common seat shape, but it was found that bathroom chairs of various other shapes were also used (Figure 1). “Low price” was ranked first (chosen by 46.2% of the respondents) as the most important matter to be considered in buying a bathroom chair [Note 3], followed by “Looks comfortable to sit on” (21.7%) and “Looks easy to stand up and sit down” (13.0%). The percentages for the items concerning sitting comfort were 54.2% in total [Figure 2]. These figures show that, in addition to the price, the appearance (that makes the chair look comfortable to sit on) is an important factor to be taken into consideration in making a buying decision. With respect to the actual situation of purchase, “Purchased at a home center/supermarket/mass merchandise store” was the most common response and merely 2.3% of the respondents said that they “purchased after comparing multiple chairs by actually sitting on them (wearing clothes)”. These results imply that buying decisions are made based on visual judgment rather than the actual sitting comfort (Figure 3).

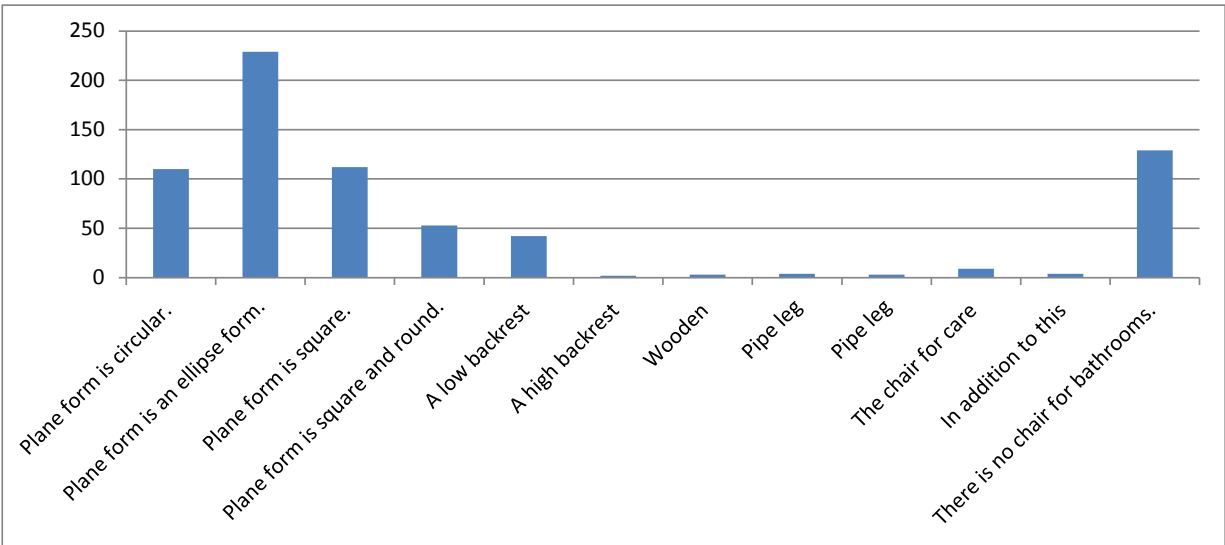


Figure 1. Bathroom chair ownership (number of valid responses: 700)

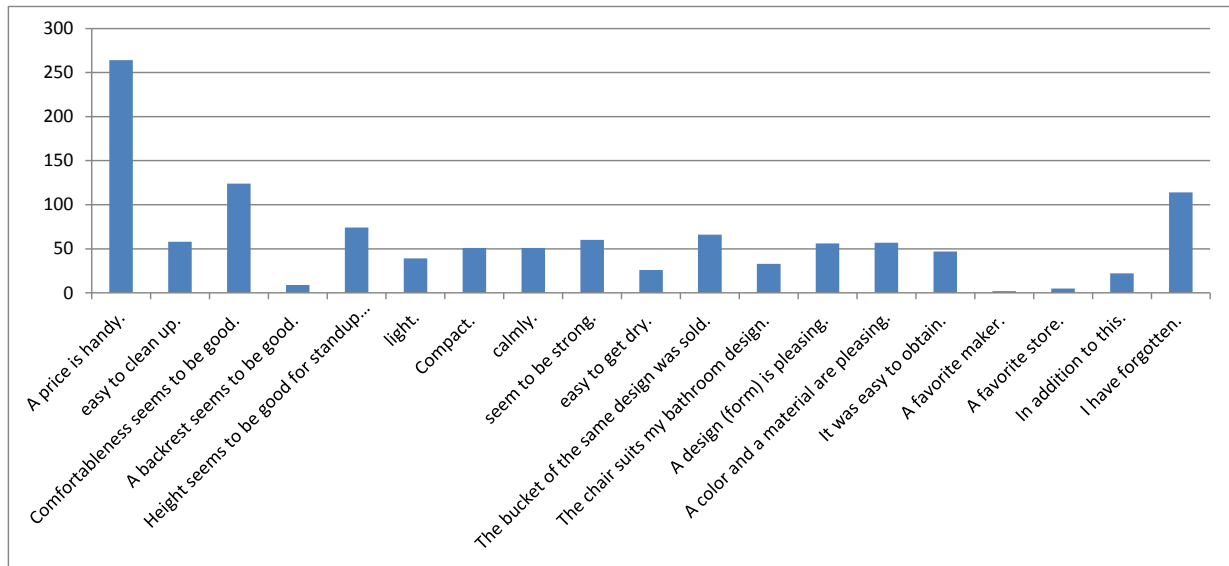


Figure 2. Matters that are considered important in purchasing a bathroom chair (number of valid responses: 571)

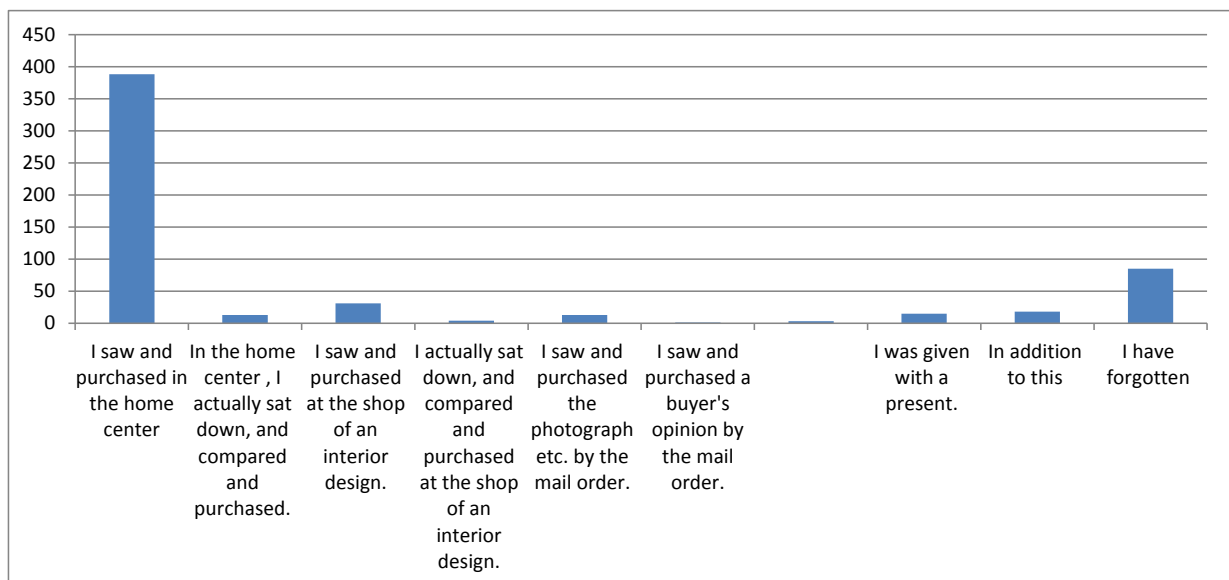


Figure 3. Actual situation of purchase for bathroom chairs (number of valid responses: 571)

4. Grouping by POSA (Partial Order Scalogram Analysis)

To extract the features of bathroom chairs that look comfortable to sit on for each bathing style, the subjects were grouped by using POSA. POSA stands for Partial Order Scalogram Analysis. It is a method to determine sequential scales of multiple dimensions by expressing two-dimensional data on a network. Arrangement of responses to multiple independent questions on a network in accordance with the response pattern clarifies the sequential (evolutionary) relationship hidden behind the responses [Note 4].

4.1 Web-Based Questionnaire on Bathing

A survey on the bathing style was conducted on 421 men and women across the country [Note 5]. Table 1 shows the question items in the questionnaire. These items were determined through brainstorming by designers with an experience of developing bathroom chairs. Since individual interests and preferences would greatly

influence the purpose of bathing, considerations solely based on the questionnaire results would have limitations. Therefore, it was decided to form networks based on the questionnaire results using POSA to examine the bathing style. On the other hand, the following results were obtained from the questionnaire alone. With respect to the survey items on the bathing style, 43.7% of the respondents chose “Bathe at a fixed time”, 66.7% for “Want to bathe in a short time”, 60.8% for “Often soak in a bathtub”, 62.9% for “Bathe for the purpose of recovering from fatigue” and 35.2% for “Bathe also for the purpose of beauty care”.

Table 1. Question Items on the Bathing Style

| | | |
|---|--------------------------------------------------------------|--------|
| 1 | Bathe at a fixed time (= fixed time) | 43.70% |
| 2 | Want to bathe in a short time (= short time) | 66.70% |
| 3 | Often soak in a bathtub (= soak) | 60.80% |
| 4 | Bathe for the purpose of recovering from fatigue (= fatigue) | 62.90% |
| 5 | Bathe also for the purpose of beauty care (= beauty) | 35.20% |

4.2 Hypotheses for Grouping

Prior to the formation of the network, it was presumed that the subjects may be divided into a “group that bathes only for the purpose of washing”, a “group that bathes for the purpose of beauty care” and a “group that bathes for the purpose of recovery from fatigue”. Also, it was considered that responses to the item “for the purpose of beauty care” are likely to be different between the genders. Therefore, it was decided to form a network for men and women respectively aside from the overall POSA network.

4.3 Considerations on the POSA Networks

Figure 4. Overall POSA Network

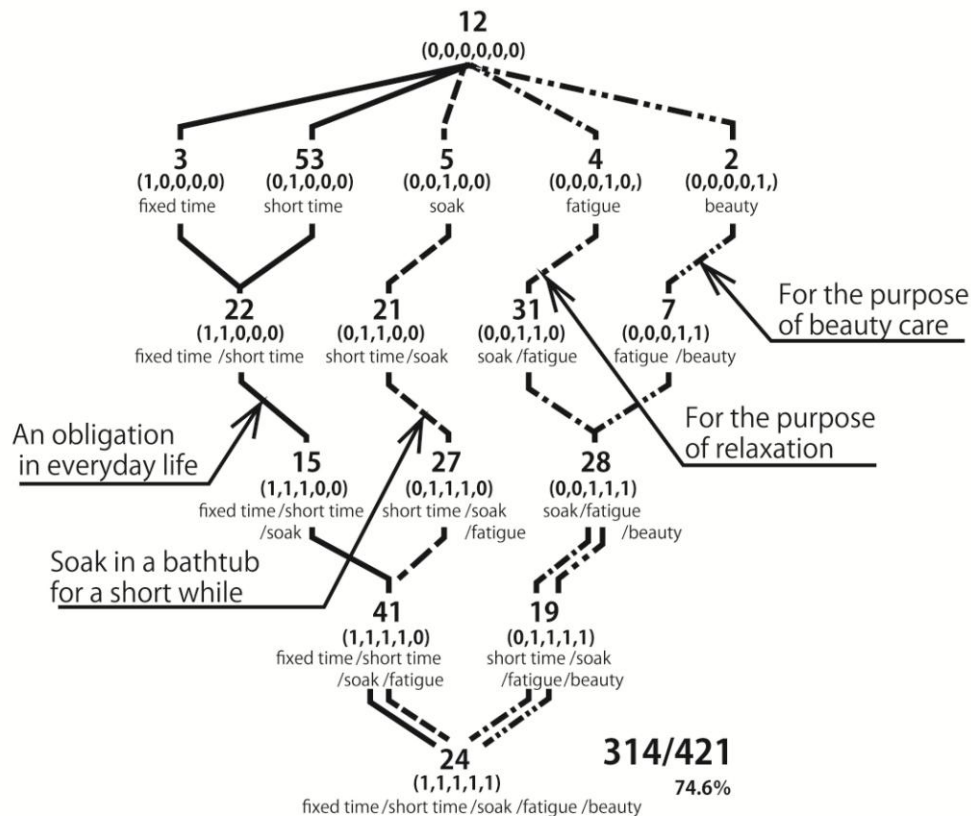


Figure 5. POSA Network for Women

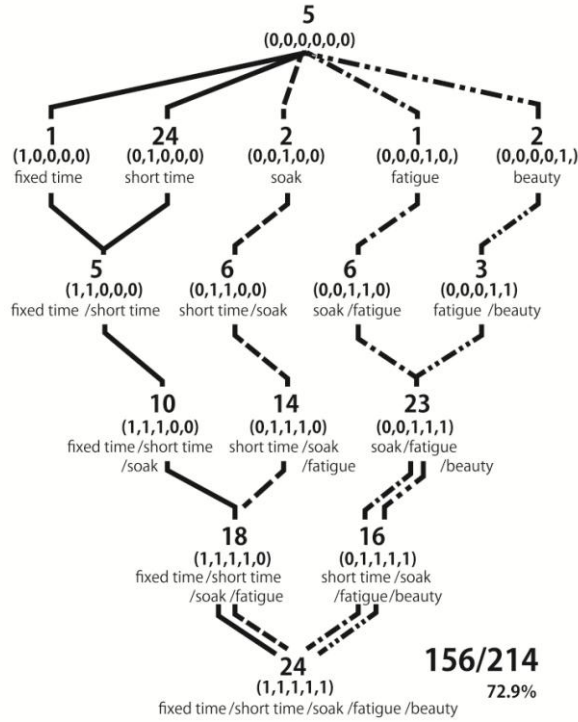
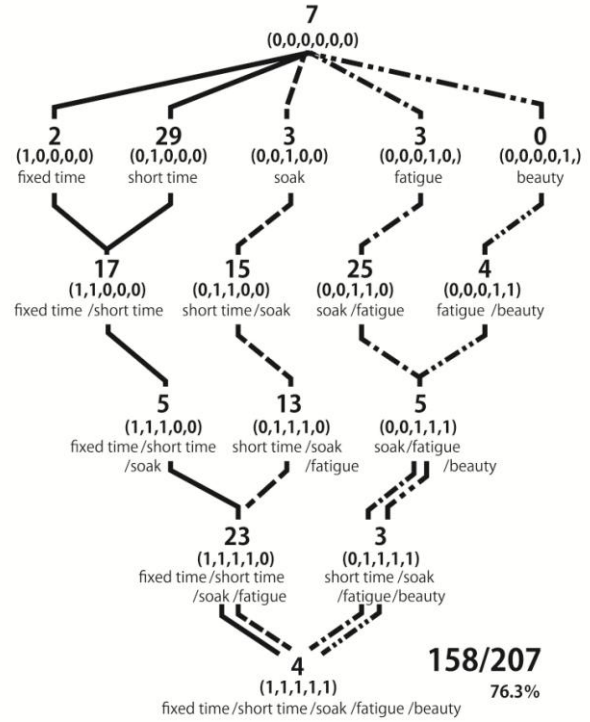


Figure 6. POSA Network for Men



4.4 Considerations on each network group

Next, group names were given according to the lines in the network diagram and considerations were made on each group. The solid line located in the far left of Figure 5 should correspond to the “an obligation in everyday life” group. This group has many people who want to “bathe in a short time” or often “bathe at a fixed time”. The dashed line located second from the left should correspond to the “soak in a bathtub for a short while” group. The number of people in this group increases in accordance with the increase in the number of items. It is considered that “Soak in a bathtub” does not constitute a purpose by itself but it makes up a purpose being combined with other items. The dash dot line located third from the left should correspond to the “For the purpose of relaxation” group. In this group, the combination of “Soak in a bathtub” and “Recovery from fatigue” has the greatest number of people. In view of this, it is possible to consider that many of the subjects wanted to soak in a bathtub to recover from fatigue. The dash dot dot line located in the far right should correspond to the “For the purpose of beauty care” group. The fact that the number of people who chose only “beauty care” was very small suggests that “beauty care” hardly constitutes a purpose by itself but it comprises an element of purpose by being combined with fatigue relief and soaking in a bathtub.

4.5 Considerations on the Respective Networks for Men and Women













Network diagrams were created for men and women respectively as in Figures 5 and 6 to examine the gender-based difference between the networks. As the number of purposes increases towards the bottom of the diagram, it shows that most men had fewer purposes than women. The figures in third level from the top of the network for men are greater than those for women. For example, the numbers of men who prefer bathing at a fixed time for a short time and who often soak in a bathtub and want to recover from fatigue are greater than women. On the other

hand, the figures in the fourth level of the network for women are greater than those for men. Therefore, it is considered that the percentage of women having many purposes of bathing is greater than men. The figure at the bottom of the network, which corresponds to the number of people who responded yes to all the question items, is five times as large as that for men, which also indicates that women tend to have many purposes of bathing. Also, as was presumed before the study, the percentage of women who bathe for the purpose of beauty care turned out to be much greater than men. Hence, it was ascertained that there is a difference between men and women with respect to the purpose of bathing.

5. Features of Bathroom Chairs Preferred by Each Bathing Style Group

As described in the previous section, based on the networks formed by using POSA, the subjects were grouped according to the bathing style. Applying the rough set theory, features of bathroom chairs that look comfortable to sit on were explored for each group.

Table 2. Table of Attributes

| Attributes | | Attributes value | Sign | Diagram |
|------------|-------------|------------------|------|-------------------------------------------------------------------------------------|
| Plan view | Hole | with a hole | a1 |  |
| | | With no hole | a2 |  |
| | Dent | with a dent | b1 |  |
| | | With no dent | b2 |  |
| | Front angle | with R | c1 |  |
| | | With no R | c2 |  |
| | Plan Form | Circle | d1 |  |
| | | Ellipse | d2 |  |
| | | Square | d3 |  |
| | | Rectangle | d4 |  |
| | | Quonset | d5 |  |
| | | Other | d6 |  |















| Attributes | | Attributes value | Sign | Diagram |
|------------|--------------------|-----------------------------|------|---------------------------------------------------------------------------------------|
| Form | Height | high | e1 |  |
| | | low | e2 |  |
| | Ratio | Longwise | f1 |  |
| | | Oblong | f2 |  |
| | | Other | f3 |  |
| | The style of a leg | With no hole | g1 |  |
| | | with a hole to four sides. | g2 |  |
| | | with a hole to three sides. | g3 |  |
| | | with a hole to two sides. | g4 |  |
| | | Stick-like leg | g5 |  |
| Backrest | Height | Nothing | h1 |  |
| | | low | h2 |  |
| | | high | h3 |  |
| | | the same as the usual chair | h4 |  |

Table 3. Sample Images

| | | a | b | c | d | e | f | g | h |
|----|--|---|---|---|---|---|---|---|---|
| 01 | | 1 | 1 | 2 | 4 | 1 | 2 | 4 | 1 |
| 02 | | 1 | 1 | 2 | 4 | 1 | 2 | 4 | 3 |
| 03 | | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 |
| 04 | | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 |
| 05 | | 1 | 1 | 1 | 6 | 1 | 1 | 2 | 1 |
| 06 | | 1 | 1 | 1 | 4 | 1 | 2 | 2 | 1 |
| 07 | | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 08 | | 2 | 2 | 2 | 4 | 2 | 2 | 4 | 1 |
| 09 | | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| 10 | | 1 | 1 | 1 | 5 | 2 | 2 | 2 | 2 |
| 11 | | 1 | 1 | 1 | 3 | 1 | 1 | 5 | 1 |
| 12 | | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 1 |
| 13 | | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 2 |
| 14 | | 1 | 1 | 1 | 3 | 1 | 2 | 2 | 3 |
| 15 | | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 3 |
| 16 | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 |
| 17 | | 1 | 1 | 1 | 4 | 2 | 2 | 2 | 2 |
| 18 | | 2 | 1 | 1 | 4 | 2 | 2 | 4 | 1 |
| 19 | | 1 | 2 | 1 | 4 | 2 | 2 | 4 | 1 |
| 20 | | 1 | 2 | 2 | 6 | 1 | 1 | 5 | 1 |
| 21 | | 1 | 1 | 1 | 4 | 1 | 3 | 5 | 4 |

Table 4. Rough Set Study Result

| An obligation in everyday life | | | | | Soak in a bathtub for a short while | | | | |
|--------------------------------|----------|-------------------|----------------------------|----------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------|
| a2c1h2 | 1.000000 | With no hole | Front angle with R | Backrest low | f1h2 | 1.000000 | Longwise | Backrest low | |
| a2c1d5 | 1.000000 | With no hole | Front angle with R | Plan Form Quonset | d2h2 | 1.000000 | Plan Form Ellipse | Backrest low | |
| d5g2h1 | 1.000000 | Plan Form Quonset | With a hole to four sides. | Backrest low | e1g2h2 | 1.000000 | Form high | With a hole to four sides. | Backrest low |
| a2c1d6 | 1.000000 | With no hole | Front angle with R | Plan Form Other | d2f1g2 | 1.000000 | Plan Form Ellipse | Longwise | With a hole to four sides. |
| a2b1d6 | 1.000000 | With no hole | With a dent | Plan Form Other | | | | | |
| a2b1d5 | 1.000000 | With no hole | With a dent | Plan Form Quonset | | | | | |
| d5f1g2 | 1.000000 | Plan Form Quonset | Longwise | With a hole to four sides. | | | | | |
| a2b1h2 | 1.000000 | With no hole | With a dent | Backrest low | | | | | |

| For the purpose of relaxation | | | | |
|-------------------------------|----------|------------------------|-------------------------------|-------------------------------|
| d6g2 | 1.000000 | Plan Form Other | With a hole to four sides. | |
| b1d0 | 1.000000 | With a dent | Plan Form Other | |
| c1d6 | 1.000000 | Front angle with R | Plan Form Other | |
| d4h2 | 1.000000 | Plan Form Rectangle | Backrest low | |
| d4e2g2 | 1.000000 | Plan Form Rectangle | Form low | With a hole to four sides. |
| f1g2h1 | 1.000000 | Longwise | With a hole to four sides. | Backrest Nothing |

| For the purpose of beauty care | | | | |
|--------------------------------|----------|---------------------------|-------------------------------|------------------|
| f1h3 | 1.000000 | Longwise | Backrest high | |
| e2g2 | 1.000000 | Form low | With a hole to four sides. | |
| g1h3 | 1.000000 | Leg style With no hole | Backrest high | |
| d6g2 | 1.000000 | Plan Form Other | Backrest low | |
| d4h2 | 1.000000 | Plan Form Rectangle | Backrest low | |
| d4g1 | 1.000000 | Plan Form Rectangle | Leg style With no hole | |
| f2h2 | 1.000000 | Oblong | Backrest low | |
| b1d6 | 1.000000 | With a dent | Plan Form Other | |
| c1d6 | 1.000000 | Front angle with R | Plan Form Other | |
| e2h2 | 1.000000 | Form low | Backrest low | |
| d4f1 | 1.000000 | Plan Form Rectangle | Longwise | |
| d1f1h2 | 1.000000 | Plan Form Circle | Longwise | Backrest low |
| c1d4h3 | 1.000000 | Front angle with R | Plan Form Rectangle | Backrest high |

5.1 Experiment on Shape Elements Using the Rough Set Approach

First, the questionnaire for the formation of the POSA network was given to 20 university students to find respondents who may be positioned on the network diagram of Figure 4. Twelve of them were reproduced on the POSA network. Then, as a follow-up survey, a questionnaire for the rough set study was given to these 12 subjects. This enables a rough set study for each group on the POSA network. The questionnaire for the rough set was given by showing the sample images (Table 3) to the subjects and asking them to choose yes or no as to whether or not the chairs in the images look comfortable to sit on. The shape elements covered by this study were decided based on the elements extracted from the bathroom chairs on the market (Table 2). Color and material, which are also visual elements, were excluded from the appearance element classifications [Note 6]. The images used in this survey were created by computer graphics. Images of 21 kinds, which were of the same color, material texture and angles were used. The shape elements of each sample is listed to the right of each computer graphics image in Table 3 and the symbols represent the attribute values in Table 2.

5.2 Remarks on the Rough Set Study Result

Table 4 shows the rough set study results. The alphabets and numerals in the left column correspond to the features and the description is given in the far right column. The figure at the center, 1.0000, is the S.C.I value. After determining the decision rule condition for each subject, the conditions of the subjects in each group on the POSA network were merged to obtain the result for each group. Only the results with a high S. C. I. value [Note 7] are shown on the table. Those with a low S.C. I. value were omitted. Some of the results after the merger were combinations of four or more elements, but such results were excluded as it was considered that because of its simple configuration, a bathroom chair with a combination of four of more features would not be recognized as having outstanding features. In addition, contradicting combinations, such as “longitudinal” and “low in height”, that may be physically possible but not feasible on product, were also excluded.

5.3 Considerations on Each Rough Set Group

As a result of the analysis based on the rough set theory, features of bathroom chairs that look comfortable to sit on were obtained for each bathing style.

The following considerations were made based on the rough set theory for each group classified according to the bathing style. The group that “Bathe as an obligation in everyday life” pointed out such features as “with a rounded front edge”, “with no hole”, “semicircular seat”, “low backrest” and “with a depression in the seat surface”. These features may be necessary if a bathroom chair should be a simple and easy-to-clean tool for daily use. The group that “Soak in a bathtub for a short while” often pointed out “longitudinal”, “high”, “low backrest”, “oval seat” and “plate-shaped legs on four sides with gap”. When interviewed, one of the subjects in this group made a remark that he/she preferred a high chair that makes it easy to stand up and sit down because he/she wants to soak in a bathtub in his/her short bathing time. This group did not point out “with a depression in the seat surface”, which was pointed out by most other groups. “Low backrest” was preferred by this group. It is considered that people in this group may not spend much time sitting on a bathroom chair because they also soak in a bathtub in their short bathing time. The group that “Bathe for the purpose of relaxation” preferred “rectangular seat”, which was hardly preferred by other groups. This maybe because a rectangular seat is wide and therefore, makes one feel relaxed when seated on it. One subject made a remark that he/she feels most relaxed in the bathtub while bathing. The group that “Bathe for the purpose of beauty care” preferred a bathroom chair with a “high backrest” feature that was not preferred by other groups. The hypothesis turned out to be true for this point. When bathing for the purpose of beauty care, activities relating to beauty care are often carried out while one is seated on a bathroom chair. People in this group may have preferred a high backrest based on the assumption that they are seated on the bathroom chair for a long time. Similar remarks were obtained in the interview survey. This group also pointed out “rectangular seat”, which was also preferred by the group who bathe for the purpose of relaxation.

Based on the above-described results, proposals were made on the design of bathroom chairs that look comfortable to sit on for each group. Figures 7, 8, 9 and 10 show a list of extracted attributes in the left and a representative example of the design with the combination of these attributes in the right.

Figure 7. Features preferred by the group that “bathes as an obligation in everyday life” and a representative example of the combination thereof

Figure 8. Features preferred by the group that “soaks in a bathtub for a short while” and a representative example of the combination thereof

Figure 9. Features preferred by the group that “bathes for relaxation” and a representative example of the combination thereof

Figure 10. Features preferred by the group that “bathes for the purpose of beauty care” and a representative example of the combination thereof

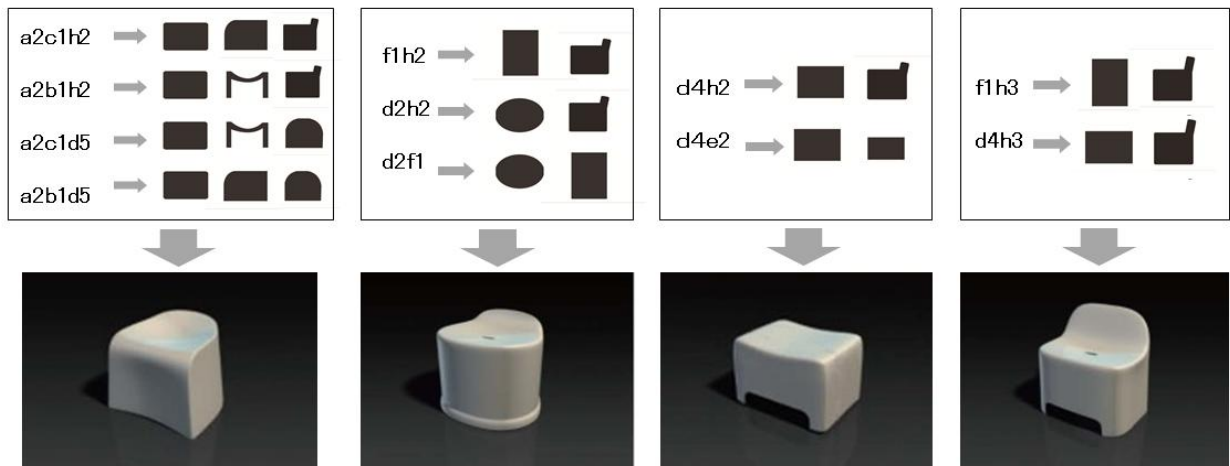


Figure 7.

Figure 8.

Figure 9.

Figure 10.

6. Conclusion

As described above, this study revealed that people of different bathing styles find different bathroom chairs look comfortable to sit on and visual features suggesting good sitting comfort were identified for each group.

In the preceding study on physical indicators, different chairs were compared by having the subjects sit on them. The chairs had different dimensions of seat height, width, depression in the seat surface and backrest, but they all had a rectangular seat. Since the features extracted in this study involve different seat shapes, for the purpose of verification, it would be necessary to create prototypes of the chairs for each group and check the sitting comfort by sitting on them. The author would like to study how the color and the material influence the sitting comfort in the future.

Notes and References:

- [1] Hashida, N., Aoki Y., & Akazawa, C.(2012), “*Indicators of Bathroom Chairs that are Comfortable to Sit on and Suitable for the Act of Bathing*”, Transactions of Japan Society for Interior Studies No. 22,
- [2] This survey was carried out by Interwired Co., Ltd. (DIMSDRIVE) for a week in March 2010. Registration system Internet questionnaire, 350 men, 350 women, 20-29 years old, 30-39 years old, 40-49 years old, 50-59 years old 60 years old - 69 years old 140 persons each $140 \times 5 = 700$ persons
- [3] Most bathroom chairs are sold at 1,000 to 5,000 yen. However, in recent years, it is not uncommon to find a bathroom chair that costs more than 10,000 yen and users tend to buy one as long as he/she likes it without giving much regard to the price.
- [4] An example of a study by using POSA: Y. Nakano, “*A Study on Unidimensionality in Social Distances*”, *School of Sociology and Social Work Journal*, 83, 213-225, 1999-11, Kwansei Gakuin University
- [5] This survey was carried out by Interwired Co., Ltd. (DIMSDRIVE) for a week in August 2011.
- [6] In product development, decisions on color are made in deciding the lineup after the shape has been decided. Therefore, it was decided to focus on the shape first to identify the shape of the chair that looks comfortable to sit on. As white is the most common color of the bathroom chairs on the market, the color of the sample images used in the survey was unified as white.
- [7] S.C.I. stands for Subject Covering Index, which refers to the ratio of the number of subjects whose preference fulfills the merged preference rule condition over the total number of subjects. Mori. N, Watanabe. H., & Inoue. K (2004) *Rough Sets and Kansei*, KIABUNDO