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DEVELOPMENT OF EVALUATION SAMPLE MODEL FOR COSMETIC PUFF IN CONSIDERATION OF SENSE WIDTH

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Abstract: The purpose of this study is to produce an effective sample model for evaluation in the selection process of cosmetics puffs. Hardness and cell size were adopted as physical-properties data which replaces sensuous data. We made the evaluation model using real samples in a matrix using two properties on vertical and horizontal axis. In order to examine the interval of the physical-properties value of the puff used for each sample, sensory evaluation of the differential limen to the hardness of puff was carried out. In order to set up the median of a model sample, actual cosmetics products in the market were investigated and average value was deduced. Effect evaluation was performed for the usefulness of the model sample by two methods. One method is from the viewpoint of usage in business practice. Another method is from a viewpoint of discernment for evaluating feeling. From a viewpoint of discernment, it was tested to find whether it was possible to determine sensory evaluation of human touch numerically when the sample model was used. From a viewpoint in the use on business, the subject was examined to determine whether they can choose a suitable puff by using the conventional selection method or by simply choosing using a model sample. In this study, the differential limen of the hardness of a puff was found. In the judgment of roughness by visual inspection, it was found that a person could determine a more exact numeric value when the subject used the model sample. The sample model was also useful in the selection process of the puff in practical business.

Keywords: *Cosmetics puffs, Differential limen, Evaluation model sample*

1. INTRODUCTION

Many Japanese women use foundation for makeup [1]. The foundation is one type of cosmetics where kneaded powder, oil, minerals, pigments and other additives are formed into a solid or liquid condition [2]. The foundation which is popular in Japan is a portable, solid type powder foundation. In order to apply such foundation to the skin, the small sponge called the makeup puff is used [3]. The cosmetics company makes thinking the affinity of foundation and the puff are very important. For example, when the powders of various sizes are used for foundation and an uncongenial puff is used, only specific pigments of color strongly transfer, and, the evenness as for a color's appearance is different. The selection of a puff in which the function of the foundation is fully employed efficiently is important to reproduce such quality. There is a concept for foundation which various designers have, such as "smooth finishing with conceal skin", "natural finishing which is glossy and thin" and so on [4].

When companies make new cosmetics, they choose the optimal puff for each cosmetic by the feature which is thought as particularly important. However, they don't have an established original indicator. That is to say, that there is no indicator of selection which makes choice easy. In order to choose the correct puff from a large number of

samples it may take thousands of man-hours.

The purpose of this study is to build the model sample for evaluating the suitable puff for cosmetics. We already determined by previous work that physical data has a strong relation with the sensitivity data for the puff evaluation [5]. The number of characteristics for a model sample examined is three. One is the simplification and speeding up of product development in a cosmetic company. The second is technical development which records the selection process for how it is chosen. If the model sample is used, a person who could not evaluate by feeling may be able to evaluate with a physical numeric value. The term physical numeric value means the measurement able value express numerically by some measuring instruments. If the replacement to a physical-properties value can be performed, it will be recordable as sensitivity selection. Conventionally, selection of the puff is individually made for each product and the past data was not utilized. If numeric recording becomes the adopted standard of physical numeric value, the reason for selection also becomes clear and can be used for future utensils design. The third is making a common standard for the cosmetics evaluation of puffs which can be used by anyone. If this model sample can be built, the employment as standard will be tried on actual business.

In addition, first purpose effect of three purpose is simplification and acceleration of product developing at cosmetic company. We aim such effect; there is little point

in if we made the model sample far removed from actual cosmetic market. As a result, sample model should be projected on product physical numeric value of actual cosmetic market. Next, the model sample should be the product which can be supplied by the usual production process. If we use sample model which is supply impossible by usual product line, we won't get reproducibility of the record even if we provide technology about records choosing process above-referenced second aims. On a final note, width of physical numeric value of sample model should be able to sense anybody who wants to use it. If sample model aim to be standard usable anyone of difference position that each sample model need different as easy-to-detect anyone.

2. METHOD FOR MODEL CONSTRUCTION

We propose setting two physical-properties items which have a strong relation with the usage feeling of the puff on vertical axis and horizontal axis, and produce a model sample specimen in the shape of a matrix in this model. The model sample that is proposed by us assumes that the puff, which is a sample, is arranged with a physical numeric value at equal intervals in this space. Our previous work compared sensitivity data and physical data. The sensory evaluation was made using two principal components which are "feeling of spreading" and "touching feeling". "Feeling of spreading" is a factor of the puff's softness, the adhesion of the foundation to puff, spreading of foundation on the skin and homogeneous broadening. The "hardness" and "density" physical value had a strong relation to the "feeling of spreading". The second component "Touching feeling" is a factor of roughness or smoothness of the puff. This had a strong correlation with "cell size" of a physical value. The physical-properties data which controls the amount of feelings of a model is adopted as a vertical and horizontal axis. We adopted cell size for one axis. We show the scale and electron microscopic picture of the cell sizes which were used for previous work in figure 1. The standard value is shown in table 1.

The candidates for the other axis are "hardness" and "density" however; we chose "hardness" which can be distinguished simply from judgment of touch or appearance. Variation in density is less easy to feel and it is more difficult to control tightly in practice.

The model sample is arranged in four quadrants (rough cell - hard) (rough cell - soft) (small cell- hard) (small cell- soft) as shown in Fig. 2. This central point is derived from the results of a survey of an actual cosmetics market and the width of the matrix is set to the position of the distance of which one can distinguish sensuously and can

be reproduced in manufacture. We show the concept as Fig. 2.

Sensory evaluation was tested in regards to how the hardness of a puff can be distinguished with human feeling for the setup of the interval of the hardness of the model sample. There is a scale set up by sensory evaluation in our previous work. When the width of the interval about hardness and cell size is known, the range in which feasibility of manufacture is examined by us.

At the end, the effect of the created model sample is checked.

3. EXPERIMENTAL

3.1 Measurement of sense width for setting of the model sample

We researched differential limen and determined how much subjects can sense a noticeable difference. The test

Figure 1: The electron microscopic picture of a cell scale

Table 1: The standard value of cell scale

cell size scale	Measurement value (μm)
-4	1500~
-3	1000~
-2	800~
-1	700~
0	500~
+1	400~
+2	200~
+3	100~
+4	50~

Figure 2: The concept of model sample of cosmetic puff

is sensory evaluation by the pair test method [6]. The conditions of the experimental environment was indoors under electric light and 20~22°C room temperature. The samples were shown at random. All sample materials were rubber latex sponges. All shapes are rectangular and have rounded corners of 12mm radius with width of 40mm, length of 53mm, and thickness of 8mm. The color tone was also unified into the same other flesh color. Subjects are 18 women in their early twenties. We set subjects early twenties due to make standard that can be judged user who have a little experience only to use powder foundation when we make standard of model samples from differential limen. If inexperienced person can judge the standard of sample model, experienced person will be able to judge it enough. The puffs were three sets of about 7 pair from which hardness is different. The contents are shown in table 2. Combinations prepared were seven kinds of samples which had differences of “ ± 0 , +3, +5, +7, +10, and +15°” by the hardness meter to a benchmark article. The hardness meter used that made by the KOBUNSHI KEISOKUKI corporation HF hardness meter of type F. Subject’s choices were “same”, “harder” and “softer”. The subjects were made to touch the samples of this hardness and asked to judge. The method of how the subjects felt touch was by holding three fingers with thumb and pressing against the skin according to the usage.

3.2 Measurement of the center of hardness of cosmetic puffs from current market for setting the model center

It is necessary to make the model sample with respect to the utensils of an actual cosmetics market. It decided to use the median of actual cosmetics market that is investigated in a setup in the center of model sample. All the 90 kinds for which the puff is used among foundations of new product considered to have been put on the market over 2002 from 2000 were collected. The material for research is the same puff made from rubber latex as this candidate for research. The collected hardness and cell sizes of puffs were measured.

Table 2: Hardness of test sample set

Items / Set	Soft set (°)	Middle set (°)	Hard set (°)
Benchmark sample	55	63	71
Pair as same as	55	63	71
Pair +3 hardness	58	66	74
Pair +5 hardness	60	68	76
Pair +7 hardness	62	70	78
Pair +10 hardness	65	73	81
Pair +15 hardness	70	78	86

3.3 Research about reproducibility production for setting cell size for the model

The reappearance width of cell size is restricted for reasons of manufacture of puff. After deciding a vertical axis by the hardness of a sample, producible width is investigated and set up about the cell size which is a horizontal axis. By the model made from the setting value, subjects check whether a difference can be distinguished or not.

4. RESULTS AND DISCUSSION

4.1 Measurement width of sense about hardness

The rate of a correct answer is shown when a subject judges the difference in the hardness of a sample according to three kinds of combination of hardness in figure 3. By this result, we clearly showed differential limen when there was how much differences of hardness. There were some differences by what has hard benchmark value or soft thing of pair. Although what judged the sample of the same hardness to be the same hardness is as low as 44.4% when combination and a benchmark value are as hard as 71°, the correct answer rate increased as the difference of hardness widened. When the combination of a soft puff and a benchmark value are 55°, it was only 44.4% which has judged the thing of the same hardness, and when 10 degrees of hardness changed, it was 83.3% of rate of a correct answer. In the case of the middle of combination of the hardness, although the rate of a correct answer of the sample of the same hardness was comparatively as high as 61.1%, with the difference of the slight hardness of 3 degrees, the response rate was falling with 38.9%. 5 degrees or more along, the correct answer rate went up with the increase in the difference of hardness like the

Figure 3: Accuracy late of hardness judgment

hard puff. The 10-degree difference which has a correct answer rate of 80% in the combination of all the hardness was set as the width of the interval of a model.

Table 3: Accuracy late of hardness judgment

Maker	Brand name
Albion	Exage*2,Excia*2,Exage white*2, Elegance,
Awake	Awake,Skinrinovation
Ayura	Ayura, whitening
BC laboratories	Beautrism
Biotherm	White detox
Chifure	Chifure*2
Christian Dior	Christian Dior*2
Clinique	Clinique
Cuore	Glansenbon
Estee lauder	Whitelight, Equalizer
Ettusais	Ettusais
Fancl	Culfee
Guerlain	Guerlain*2,Issima
Helenarubinstein	Helenarubinstein
Ipsa	Ipsa*2
Kanebo	Revuw*5,Twany*2,Dew*1, Cynthiarowly
Kanebocosmet	Allie
Kao	Sofina*4,Sofina raysious
Ketharan Patharan	Paradu
Kose	Beaute de kose*2, Rutina*6, Sports beauty, Facio, Predia, visee
Lancome	Blanexveil, Maquicake
Max factor	Facefinity*2,Face silks
Maybelline	Maybelline NY, Pure stay cristal
Menard	Fairgrace, Dayful
Nagase beauty	Ornage*2
Noevir	001visio
Pola	one's one*2, Southencall crea
Prescriptives	Prescriptives
Revlon	Skinlight
Shiseido	Anessa neo, Elixir*2, New UV white, Proudia*7, Soukamokka
Sonia Rykiel	Sonia Rykiel*3
Yves Saint Laurent	Yves Saint Laurent

Figure 4: Distribution of cell size and hardness at actual puff market

4.2 Center of current market

The cell size and hardness of puffs which were collected are shown in figure 4. The average value of the actual physical properties of the puff of a market was 61.22 degrees of hardness, and cell size was 0.20 on our scale. We adopted the 0 of roughness scale and the 60 of hardness with the end sufficient soon to these average values as the median of a model. Table 3, the brand and manufacturer who collected are showed.

4.3 Result of reproducibility production for setting cell size for the model

Using the range of plus and minus from table 4, the mass production capability is taken into consideration and restricts the cell size range to the width of ± 2 .

By this result, the sample with the width of ± 2 was created by the hardness which defined this model. We tested whether these samples and the difference in cell size could be distinguished. Five experts were used as the subjects of the cosmetic puff evaluators. By the pair test method of examination, the puff was touched and the difference of cell size was distinguished. The conditions of the experiment was indoors under electric light and 20~22C room temperature. The samples were shown at

Table 4: The range of production propriety

Hardness Cell size	70°	60°	50°
-4	Impossible	Trial production difficulty	Trial production possible
-3	Trial production difficulty	Trial production possible	Trial production possible
-2	Trial production possible	Mass production possible	Mass production possible
-1	Mass production possible	Mass production possible	Mass production possible
0	Mass production possible	Mass production possible	Mass production possible
+1	Mass production possible	Mass production possible	Mass production possible
+2	Mass production possible	Mass production possible	Trial production possible
+3	Mass production possible	Trial production possible	Trial production difficulty
+4	Trial production possible	Trial production difficulty	Impossible

random. The material, color tone and size were made the same. Samples were divided into three combinations of hardness and each set was presented at random. Each combination was inspected 3 times. The combination is shown in table 5. The method of touch was with the thumb and index finger, pressing against the skin according to the usage. The result is shown in figure 5. All were two differences, and they have distinguished 80 percent or more. Figure 6 transposes this model to actual numerical values. From the results obtained by this research, cell size and

Table 5: Samples for judgment inspect of cell size

Sample No.	Cell size	Cell size	Hardness
1	+2	0	70
2	-2	0	70
3	-2	+2	70
4	+2	0	60
5	-2	0	60
6	-2	+2	60
7	+2	0	50
8	-2	0	50
9	-2	+2	50

Figure 5: Accuracy rate of cell size judgment

Figure 6: Numerical replacement when the samples creation for models by the experiment results

hardness, median, minimum, and maximum fix five types of model samples. It is difficult to carry out use evaluation in practical business by only the center and four extreme points compared with using the matrix-like model of Figure 6 Then, as figure 6, the sample of each interval five samples were prepared and it was made the matrix-like model sample.

5. DEMONSTRATION EXPERIMENT OF EFFECT OF THE MODEL SAMPLES

5.1 Demonstration experiment of effect for translation from feeling to physical numeric value

The effect of this model was checked by two methods. The first method is sensory evaluation. We compared whether the subject could replace the physical numeric value of the puff about the case with model and about the case without model. Ten samples from marketing and the sample of the model of table 6. were prepared for evaluation. The conditions of the experiment were indoors under electric light and 20~22°C temperature. Subjects were four expert women of puff evaluation with ages ranging from thirties to fifties. Subjects were experienced and knowledgeable about the concept of numerical value of hardness. Subjects judged the cell size and the hardness of a puff given to them. Six numerical values of -3 to +3 are choices of cell size. Hardness was filled in if a numerical value could be chosen. If subjects did not understand it, they could leave the response blank. The sample was shown to the subject at random. Ten samples were judged without a model sample in the first examination. In the second examination, the model sample could be used for comparison of judgment.

5.2 Demonstration experiment of effect on the view of utilization on actual business

Second method is a practical check. We examined the

Table 6: Ten Samples detail data

No.	Hardness	Roughness
1	60	2
2	63	1
3	69	3
4	58	2
5	68	3
6	73	3
7	82	3
8	66	1
9	66	3
10	72	-2

product with the puff that the cosmetics maker already determined optimal for the foundation. When a subject uses this model, the effect of the model is measured by the ability to function the same chosen optimal puff to be elected. Four groups which consist of two subjects were prepared for the subject. Among those, four persons of two groups are in active service at same cosmetics manufacture, and have equivalent evaluation skill. They work cosmetic development on a routine basis and they are expert who have understanding about evaluation of cosmetic enough.

Four persons of second two groups are the experts of the puff evaluation and they enlisted us at 5.1 too. The same described above powder foundation was used for evaluation.

The optimal puff from which the foundation was already chosen by the designer is set. It was a certain cosmetics manufacture and was chosen by the designer according to concept when the cosmetics designed. The election is a traditional method that begins from collecting many puffs from commercialized product and trial product from a puff maker. They pass their inquiry to three puff makers and collected 44 kinds of puffs from one maker of them. They tested the evaluation about at least 50~80 kinds of samples. The number of times of the test was performed 10 times at least for 44 samples. They had to test sensory evaluation each time. In order to test sensory evaluation on the skin, the area of an evaluation examination is very narrow. Therefore, they have to repeat applying with quite many numbers of times and washing. The examination time about the result of evaluation is also required for them. On the whole, they spent six months on selection of the optimal puff. This optimal puff was performed in subject 4 group in this research by each in the situation which is not told. Condition of experimental circumstance was indoors under electric light and 20~22°C room temperature. Nine samples of table 7. were prepared for the model sample.

Table 7: Details of evaluation model samples

No.	Hardness	Roughness
1	70	3
2	70	0
3	70	-3
4	60	3
5	60	0
6	60	-3
7	50	3
8	50	0
9	50	-3

6. RESULTS OF EXPERIMENT OF EFFECT OF THE MODEL SAMPLES

6.1 Results of Demonstration experiment of effect for translation from feeling to physical numeric value

The judgment test result by the difference of the existence of a model sample in cell size is shown in figure 7. Each data is the average of subjects. When the model sample was used, the adjustment R square value between the actual measurement value and evaluation value which was predicted subjects by regression analysis was 0.834. In the same way, when a model sample was not used, the between the actual measurement value and evaluation value which was predicted subject was seldom in agreement with 0.461 adjustments R square. That is, we interpret result that evaluation value when subjects used

Figure 7: Judgment of cell size on existence or nonexistence model samples

Figure 8: Judgment of hardness with using model sample

sample model can explain 83.4% about actual value, compared with another evaluation value when subjects didn't use sample model can explain 46.1% only. If we interpret meaning of these percentage as accuracy late, as this result, if model sample is used for comparison, that roughness can judge numerically more easily. About hardness, we made demands on the subject for the numerical value of hardness. It was not able to answer, although there was skill of enough of the puff evaluation. Only when the model sample of a proposal was used as reference, hardness has been judged numerically. A result when a subject uses a model is shown in figure 8. The adjustment R square value with the actual measurement value by regression analysis was 0.632. It was able to transpose to comparatively actual data and a near numerical value. In the condition as subjects didn't have sample model, their condition was as "0" that they couldn't describe by numeric value. We did get square R this near actual data that made subjects self-conscious about concept of replacement of evaluation by numeric value by our model samples.

6.2 The effect of the model on the view of selection

The result of the selection process of the optimal puff by the difference of the existence of a model sample is shown in table 8. The time and the number of times which a setup at the time of an actual plan took were shown in the sequence of Actual planning. The result of the selection process of the optimal puff by the difference of the existence of a model sample is shown in table 8. The time and the number of times which a setup at the time of an actual plan took were shown in the sequence of actual planning in table 8. Subject 4 group of this research was also shown in the next sequence. All the groups chose the almost same puff as the optimal actual puff to the same foundation. As a selection period, four groups using a sample were able to choose the optimal puff by the evaluation the near by only one day as often as to spend 10 times and six months of a traditional method. It was only 15~30 minutes.

Table 8: The difference of the time spent on the selection examination, and time and effort by the existence of a model sample

Result item \ Group	Actual Planning	1	2	3	4
Selection time (minutes)	600	15	15	12	17
Selection number of times (time)	10	1	1	1	1
Select puff's roughness (on scale)	2.7	3.0	3.0	3.0	3.0
Select puff's hardness (°)	53	50	50	50	50

6.3 Considerlation

We cited three effects that we need in sample model at introduction in this research. There are three that one of them is simplification and speeding up of product development in a cosmetic company, one of them is technical development which records the selection process for how it is chosen and last one of them is making common standard for the cosmetics evaluation. About the simplification and speeding up of product development, it is important that need shorten time and minimum of fuss for evaluation time of puff.

We focus result of 6.2. The evaluation time which is conventionally selection needed a half of year but it became only one day by 15~30 minutes. About labor hour, the evaluation time which is conventionally selection needed ten times over and over but it became only one time. These results look extreme at first glance; however until this point, there was not evaluation standard of puff then the evaluator judged store bought puff and new one by their sense only and selected it that they judge sensuous impressions about how difference each puffs. It needed very long time for getting the decision that they repeated evaluation because evaluator have to judge by their sense even new puff is soft or hard. In our research, we could to provide model samples for evaluation standard for effective evaluation. The second effect, we aimed technical development which records the selection process for how it is chosen. We selected cell size and hardness of physical value for method of recording evaluation. On this study, we studied much about scale of the yardstick for the case of using physical value as yardstick. In result, subjects could be extremely precise numeric conversion much better when they used model samples even though cell size that is judged by eye. If we use these numeric values, we can record the process of sense of evaluation with mixing numeric value. Example, "First, we selected hardness 60° and ±0 cell size, but we changed +1 cell size for pursuing more smooth touch." "We changed hardness to plus 10 degree for improvement putting quantity of foundation. But, it made to change to bad feeling, then we returned plus 7 degree only."

The important of these numeric conversions is understood when we have a crack at taking off these numeric value. Example, "First, we selected more smooth touch than first selecting puff. We changed for improvement putting quantity of foundation. But, it made to change to bad feeling, and then we returned."

7. CONCLUSION

In this research, we created the model sample preparing for convert to numeric value from sense value for evalua-

tion. We focused attention on cell size and hardness that have to strong relation with usage feeling of the puff. Based on the examination result, set scale which can be detected the quadrant was set up about these items. Particularly about hardness, it was found that subjects needs difference 10 degrees at least if they judge as small and soft thing as cosmetic puff. We looked appearance that subjects judge difficult when they set soft puff from the first for standard. The bodily movement of pinching puff only 8mm might be difficult their judge.

We evaluated the effect of a model about simplification of selection and judgment of cell size and hardness of puff. In judgment of physical data, the subject was able to express feeling numerically, when a model was used. The subjects who are expert of puff evaluation could not do numeric conversion for toffee at first. They could do numeric conversion first time ever when they compared model sample. About cell size, accuracy late changed a lot by model sample even though the judge method is same by eye at all.

In selection of the optimal puff for foundation, the model had simplified the time-consuming business of selection. The time and labor hour of selecting most suitable puff for foundation could cut through several hour and 9 times of evaluation time. Even though, finally the puff which was selected by them is nearly same. At actual product development, they might need fine adjustment of result a little. However, if the evaluation needs only once or twice that it contribute enough for simplification of business. It is trying about the point that is aimed third effect whether it become common standard of cosmetic evaluation or not at actual business. However, this sample already got effect and patent about planning of cosmetic puff [7].

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