Analysis and Evaluation of Business Signs Using Deviation Values

Masaaki Koyama, Yuki Takahashi and Hisao Shiizuka

Abstract This chapter proposes a new method for evaluating signs in the artisanal sign-making field. In particular, a quantitative evaluation method is used to identify sign evaluation items that can be used to improve the level of customer satisfaction (CS). Introducing the concept of "sign deviation values," the effectiveness of these methods is then examined based on the results of practical tests conducted at sign-makers' premises. The testing method initially involves deciding on items for evaluating signs, and using these items to evaluate actual signs, before and after improvements, to corroborate the effectiveness of the evaluation items. The deviation value method is then introduced to the sign evaluation to determine specific items that should be improved to increase the customer's level of satisfaction. By making comparison between the "before" and "after" versions, new scientific guidelines can be formulated for sign-making.

Keywords Business sign • Sign deviation value • Customer satisfaction

M. Koyama · Y. Takahashi
AIWA Advertisement Co., Ltd, 14-21-1 Asahicho, Machida-shi, Tokyo 194-0023, Japan
e-mail: koyama@aiwa-ad.co.jp

Y. Takahashi
e-mail: y-takahashi@aiwa-ad.co.jp

H. Shiizuka (✉)
Department of Information Design, Kogakuin University, Nishishinjuku 1-24-2, Shinjuku, Tokyo 163-8677, Japan
e-mail: shiizuka@cc.kogakuin.ac.jp

1 Introduction

Regardless of their size, signs can have a tremendous effect on a retail shop's success. While there are many possible reasons for installing a business sign, the most important may be "to get people to discover the existence of the company/shop." The history of these signs in Japan is a long one, dating from around 694, when the capital was moved to Fujiwara-kyou, to 710 when it was moved to Heijou-kyou. In both cities, an officially issued thin wooden board called a "*hyouchou*" was used as a sign for shops. In the revised versions of the *Taihou Ritsuryou* (701) and *Ryounogige* (833) decrees, so-called "*hyou*" signs were set up to show the "*dai*" or the types of merchandise or goods being sold. These "*hyou*" are said to have been the beginning of today's signs [1].

The oldest sign extant in Japan is said to be the folding screen sign of the *manju* snack food shop Toraya Bunkozo that dates from the Kamakura Period (1185–1333). During that time, small wooden boards came into use to express the goods, services, etc., that were provided by a shop in easy-to-understand terms. In modern terminology, these would be the equivalent of "illustrated signs."

During the Kambun Era (1661–1672), signs with writing on them began to flourish. During this period, seal-engraving, woodcutting, and sign-making were all performed by the same artisan, but by the mid-1800s, artisans began to branch out and specialize. This might be considered similar to today's "outsourcing." During the Edo shogunate period, signs appeared that made use of plays on words such as puns and witticisms, as well as numerous expressions that are still used today, such as "*Kamban musume*" (a female employee who is a store's drawing card) and "*kamban wo orosu*" (to permanently close a business). These signs can be considered a fusion of artistic handcrafts, calligraphy, and the wit of shrewd merchants that took root in Japan's wonderful culture and led to the development of modern signs.

The creation of these signs up to the present day has a strong "artisanal" element, and it is no exaggeration to say that they are made by experts who have developed very special skills [2]. One sign can contain many elements that are not initially known to us, such as the sign elements that can be discovered by many people and the types of elements that are concealed in the signs [3].

This chapter proposes a new method for evaluating signs in this artisanal sign-making field. In particular, a quantitative evaluation method is used to identify sign evaluation items that can be used to improve the level of customer satisfaction (CS). Introducing the concept of "sign deviation values," the effectiveness of these methods is then examined based on the results of practical tests conducted at sign-makers' premises. The testing method initially involves deciding on items for evaluating signs, and then using these items to evaluate actual signs, before and after improvements, to corroborate the effectiveness of the evaluation items. The deviation value method is then introduced to the sign evaluation to determine specific items that should be improved to increase the customer's level of satisfaction. By making comparisons before and after the modifications, new scientific guidelines can be formulated for sign-making.

2 Test Processes and Composition

This chapter will first explain about the test processes and their composition. For simplicity, the examples used here will be of CS with convenience store signs.

In order for customers to become aware of a sign which consequently is reflected in an action such as entering a shop, the sign should first have meaning. Therefore, there must be a clear understanding of the level of CS with the current sign, and if the sign needs to be improved, it must be clear what parts and to what extent they should be improved.

2.1 Concept of Sign Deviation Values

In the process of deriving the level of CS with signs, the present chapter uses the concepts of deviation values of significance and CS to find relations between the two. This reason for this is that we can think of signs as being a medium that has some sort of capability, such as attracting customers or conveying attractiveness. In other words, getting people to notice a sign and draw them into a shop is such a capability of signs, and it is appropriate to connect this with the concept of deviation values.

2.2 Customer Satisfaction (CS)

CS, for example, purchasing a product, is a concept in which the customer purchases a product when feeling some sort of satisfaction with that product. In order to periodically evaluate the degree of satisfaction on the premises of the business, shop, etc., question items are formulated and used to help develop the next line of products.

The level of importance in these question items can be derived using the single correlation coefficient. For example, assume that the sales s_i and advertising costs a_i at a number of business establishments o_i are known. At such a time, by plotting the advertising costs on the x-axis and the sales on the y-axis, a simple correlation graph of the two can be obtained [8].

Generally, the single correlation coefficient is derived from the following equation:

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \times \sum (y_i - \bar{y})^2}} \tag{1}$$

The value of this single correlation coefficient r becomes $[-1, 1]$. It becomes positive as it approaches $+1$, and the distribution can resemble a rising curve. On

the other hand, it becomes negative as it approaches -1, and the distribution can resemble a downward-sloping straight line. Furthermore, if it is 0, it expresses a non-coefficient where there is absolutely no apparent relationship between the two.

2.3 Deciding on Question Items and Evaluation Methodology

First, a questionnaire about the evaluation items is conducted. Respondents may be asked to answer each question based on a 5-level hierarchy. For example, in order to examine customers' thoughts (level of satisfaction) for convenience stores, possible question items could include "items are always in stock," "the food is fresh", "the food has a good taste," "it does not take long to pay at the register," "the store has a good image," "employees have a good attitude," "products are laid out well," "there is a large variety of goods," and "the store provides an excellent range of services as an agent for other companies." These items are rated on a scale of 1–5, i.e., (1) strongly disagree; (2) somewhat disagree; (3) neither agree nor disagree; (4) somewhat agree; (5) strongly agree, and each question item is quantified.

2.4 Comprehensive Evaluation

Next, in order to make an overall evaluation of the convenience store, respondents are asked to give it a total score: (1) extremely bad; (2) somewhat bad; (3) average; (4) somewhat good; (5) excellent.

If this comprehensive evaluation is the same as the evaluation items shown in Sect. 2.3, then it can be incorporated into the analysis.

Using such a methodology, the results of the questionnaire can be tabulated.

Next, a score of 1–5 is given to each evaluation item, which is divided into "Bad," "Average," and "Good." The degree of satisfaction for each item can be obtained through this scoring system.

2.5 Creating Graph of Customer Satisfaction

Next, the simple correlation coefficient between the evaluation item and the total evaluation is calculated. By plotting the simple correlation coefficient on the x-axis and satisfaction level (the proportion of "good" scores) on the y-axis, a CS graph can be obtained.

2.6 Deriving the Degree of Improvement

In order to identify the items in need of improvement from the CS graph derived with the methodology described above, we introduce here the "CS deviation value" and the "significance deviation value." For this purpose, we assume that

the distribution of evaluation items is a bell-shaped curve (ideally, a normal distribution).

In most cases, the deviation value is the value that shows "the position of the evaluation value within the entire body" that is derived from the points assigned by each scorer using the two conditions of average score and standard deviation in the score distribution with a uniform standard (the same as a bell-shaped curve). The middle score is usually set at 50, and the width of the bell-shaped curve ("wide," "narrow") is converted into a uniform standard using the standard deviation. It is inferred whether there is a high bias or low bias from the central part of the distribution of evaluation values for each item, and this is given a numerical value. Naturally, the closer a deviation value is to the center of the bell-shaped curve, the larger will be the number of evaluations to which that value was assigned. With the standard deviation centered on 50, the bell-shaped curve should cover 99 % of the parent population between 25 and 75.

Therefore, the formulas for deriving the values of the "satisfaction" and "significance" deviations that are being discussed here can be defined as follows:

$$\text{Satisfaction deviation value} = 10 \times \frac{\text{satisfaction} - \text{average}}{\text{standard deviation}} + 50 \qquad (2)$$

$$\text{Significance deviation value} = 10 \times \frac{\text{significance} - \text{average}}{\text{standard deviation}} + 50 \qquad (3)$$

Using these equations, we can derive the deviation values for satisfaction and significance. Furthermore, we can use these two deviation values to create a "CS deviation value graph."

We can also derive the distance from the origin to each plotted point in the CS deviation value graph. Generally, with the horizontal axis as x and the vertical axis as y, the distance R to the coordinates (x_1, y_1) can be given by the following equation:

$$R = \sqrt{(x_1 - \bar{x})^2 + (y_1 - \bar{y})^2} \qquad (4)$$

Furthermore, the angle between a line connecting the origin to point (80, 20) and a line running through other points is designated as θ. Here, the correction index r can be derived as follows:

$$r = \frac{90° - \theta}{90°} \qquad (5)$$

Therefore, the improvement level can ultimately be derived as

$$\text{Improvement level} = \text{Distance} \times \text{Correction index} \qquad (6)$$

Using the above equations, the "distance," "angle," "correction index," and "improvement level" for each evaluation item were calculated to obtain numerical guidelines for determining the actual degree to which improvements should be made.

Using the methodology described above, the next chapter will introduce a case study of detailed sign improvement tests that were conducted at actual business sites.

3 Testing Methodology

The following is a discussion of the results of the tests conducted at sign-makers' sites using the method described in 2. The first set of tests is comprised of Test 1 and Test 2.

3.1 Test 1

Purpose: To determine items for evaluating signs.

3.1.1 Test Methodology

In the present study, "purposive sampling" [7], which is well known in the fields of qualitative research, was carried out to identify items for evaluating signs. This was designed to undertake sampling that was in line with the objectives of the study to efficiently collect useful data from "informants" who were commensurate with the purposes of the present study. Therefore, the study had to be commenced after the entire design of the present study was sufficiently examined, and clear standards were set for the informants providing the data. For that purpose, 48 changes in sign contents that could help to attract more customers were provided to 10 sign specialists (people who had at least 2-year experience in work directly related to the design or planning of signs), who were asked the questions listed below. The changes in sign contents were excerpted by the testers from references [5, 6] that presented ways for making sign improvements to attract more customers.

Contents of questions: Among the elements related to attracting customers (Response Sheet 1), which of the items below do you, who are working at a company that is trying to develop better signs to attract more customers to shops, think are important? Please rate them on a scale of 1–5, as follows:

5 Extremely important
4 Somewhat important
3 No opinion
2 Not too important
1 Not at all important.

Please write your rating score in the "Evaluation Column" of Response Sheet 1. (Although there may be differences in store conditions, targets, locations, etc.,

please evaluate each of the items from the perspective of whether it is important to all stores). In addition, please select from among these items, the 5 items that you consider to be most important and denote them with a ○ in the "Important" column.

3.2 Test 2: Examples of Improvements

Purpose: Use the 9 sign evaluation items derived in Test 1 to have evaluations made of actual signs, in order to derive points for improvement. Due to space limitations, here we will present specific improvements made to the signs of a ramen shop, "K".

3.2.1 Test Methodology

1. Photographs of the shop with signs were presented to the following groups of men and women who had no direct connection with the sign industry: 43 people age 20–30; 6 people age 31–40; and 4 people age 41–50. These test subjects were asked the following questions regarding the 9 evaluation items derived in Test 1. Eight types of photos of the shop were shown, of before and after improvements were made. The test subjects were not told whether the photos were taken before or after the improvements.
2. From the results obtained in (1), a satisfaction graph was created based on scores of 4 or 5 as "Good," 3 as "Average," and 1 or 2 as "Bad."
3. In order to determine the level of improvement of the evaluation items, a simple correlation coefficient for "looking at it from an overall perspective, would you want to enter the shop?" was derived for each of these items, then a CS graph was created based on the satisfaction graph created in (2).

Contents of questions: Test subjects were then asked to look at the photographs and rate them on the following scale of 1–5 and write the number in the "Evaluation" column.

Response Sheet 1

Score	Important	Item
		Thick letters
		The sign itself is bright
		The sign conveys friendliness
		The sign itself is large
		The letters are in bright colors
		The letters are large
		The content is interesting
		The letter font matches the shop's business
		Beauty of the sign

Score	Important	Item
		The sign imparts a sense of excitement
		The sign imparts a sense of being
		The sign has an elaborate design
		The sign is easy to find
		The sign is light
		The type of business is easily understood
		The impression is strong
		The attractiveness can be felt
		The colors of the signs are coordinated
		Colors "jump out" at the eyes
		The sign seems to be new (new goods, freshness)
		There is a modern appearance
		Vivid, bright colors are used
		The sign is trendy
		Special services are posted
		There is a sense of innovation
		The sign has a distinguishing shape
		The letters are easy to read
		Lighted signs are used
		Originality
		Names of products/services not offered by surrounding shops are listed
		Sharp design
		Names of products/services are listed
		There is novelty
		There is character
		Photos of services offered are posted
		Curves are used in the design
		The shop name is recognized.
		The sign extends to the full width of the front of the shop
		The shop's floor in the building is shown
		Prices of merchandise are displayed
		The sign's shape is well-proportioned
		The sign makes the shop brighter
		The sign adds warmth
		The sign is accurate
		The sign conveys the sense of a thriving business
		The sign is matched with its target
		Simple design

Response Sheet 2

Evaluation	Item
	Looking at the overall appearance, I want to enter this shop
	The content is interesting
	The letter font matches the shop's business
	The sign is easy to find

Evaluation	Item
	The type of business is easily understood
	The attractiveness can be felt
	The colors of the signs are coordinated
	The signs make the shop brighter
	The sign conveys the sense of a thriving business

Fig. 1 Ramen shop K before and after sign improvements. **a** Before improvements. **b** After improvements
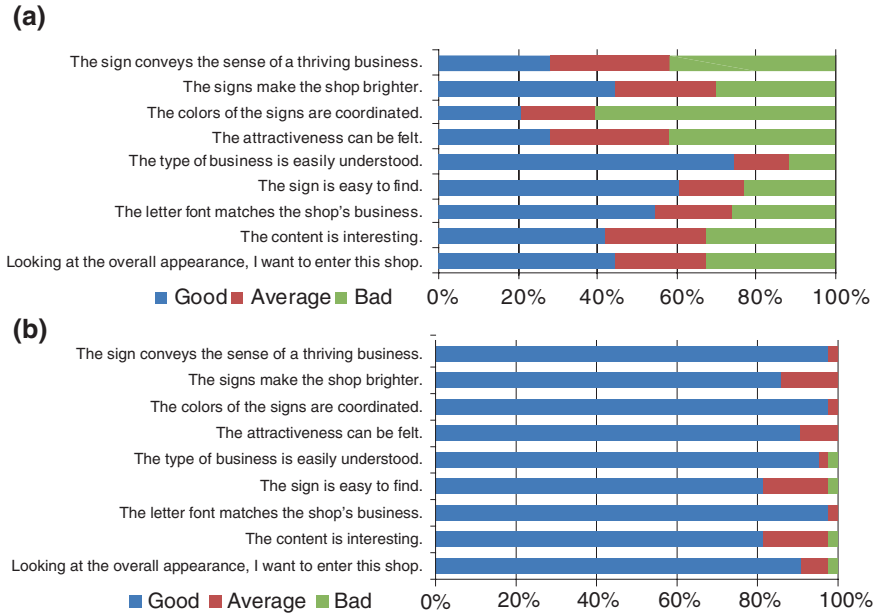
3.2.2 Before Improvements

Before the "renewal" of the signs, the shop in this example had an old-fashioned image. The matching of sign colors, the letter fonts, etc., made it seem like a chain restaurant, and as such failed to motivate potential customers to enter the shop. Because it did not have signs that expressed its goodness and sense of pride as an independent restaurant, the signs likely had little effect in "selling" the shop to passersby (Fig. 1a).
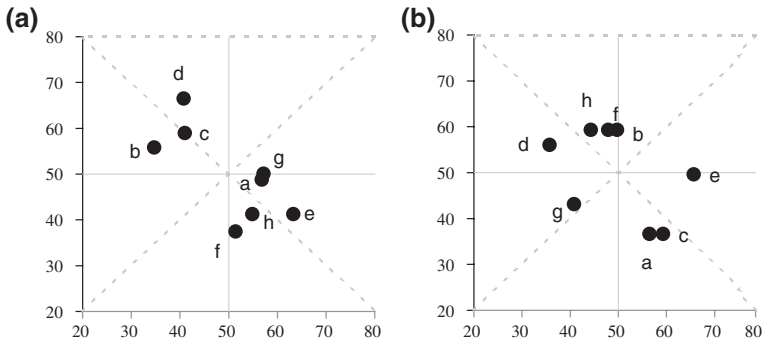
3.2.3 After Improvements

The signs were revamped to completely "push" the shop's eye-catching specialty dish, "flavorful roasted miso ramen." The shop was given storefront banners (the tops and bottoms of banners were attached to vertical poles, and hooks were attached to the ceiling and walls) to show large pictures of the shop's products, which acted to vigorously stimulate the five senses of passersby. The colors and designs of the signs evoked a consciousness of wood grain and gave the shop an image of a "cabin on the plains of Hokkaido."

As seen with this example, even if it is not clearly decorated as such, this is a method for giving a subtly dramatic feeling to the people seeing such signs. Such dramatic effects of the signs could give the shop the appearance of an independent restaurant. After the old signs were replaced, the number of customers was 120 % of what it had been in the previous year (Fig. 1b).

(a)

(b)

Fig. 2 Satisfaction graphs of ramen shop "K." **a** Tabulated questionnaire results of before improvements. **b** Tabulated questionnaire results of after improvements

(a)

(b)

Fig. 3 Significant deviation and satisfaction deviation before (**a**) and after (**b**) sign improvements at ramen shop "K." **a** The content is interesting. **b** The letter font matches the shop's business. **c** The sign is easy to find. **d** The type of business is easily understood. **e** The attractiveness can be felt. **f** The colors of the signs are coordinated. **g** The signs make the shop brighter. **h** The sign conveys the sense of a thriving business

Next, 43 test subjects were shown the photos in Fig. 1 (without being told which was the "before" and which was the "after" picture) and rated the 9 evaluation items on a scale of 1–5. The results were compiled into the satisfaction graphs shown in Fig. 2. The two graphs show that there was a clear increase in the "Good" (blue) ratings.

Figure 3 shows graphs of the results in Table 1 that were created by plotting the significance deviation on the *x*-axis and the satisfaction deviation on the *y*-axis. As we can clearly see from these graphs, the evaluation items in the fourth quadrant after improvements became less than what they had been before improvements.

Next, as has already been mentioned, the high values for level of improvement were items that had to be improved. By taking the sum of the level of improvement before and after, the state of substantive improvements can be confirmed (Fig. 4). In other words, with the exceptions of b, "the letter font matches the shop's business," which had a negative improvement value, and c, "the sign is easy to find," all items showed lower improvement levels, indicating that improvements had occurred.

4 Discussion of Test Results and Future Topics

As has been shown above, the present study, by applying the concept of deviation values to signs, was able to show the rankings of sign evaluations from the perspective of CS. In addition, in order to verify the effectiveness of this method, analyses and evaluations were made of 3 case studies where detailed evaluations had been made of signs [6]. As a result, the results of the present method and the on-site evaluations could confirm that the evaluations of the signs after improvements were better than those of before improvements.

In the present study, there were 9 items that were selected for evaluating signs, but because they have interrelationships with one another, it will remain for future study to determine whether or not it was appropriate to evaluate everything quantitatively. Actually, as can be seen in the graph of deviation values for significance and level of improvement, positive values for level of improvement indicate that improvement is needed, but negative values indicate that no improvement is needed. Therefore, by looking at changes in the sum of the positive and negative values in the significance/satisfaction graph (Fig. 4), we can see the overall level of improvement. In other words, the size of the values of level of improvement before and after are sometimes positive and sometimes negative, so by adding them together as in Fig. 4, we can get a good understanding of the overall trend in improvement level which can verify the appropriateness of the improvements.

The following is a list of several items that should be considered as topics for future research.

4.1 Generalization of the Interpretation of Sign Deviation Values

By further generalizing the interpretation of the concepts of "deviation values of signs" proposed in the present chapter, the methodology for sign deviation values will become easier to understand. Originally, deviation values were a concept that was introduced to indicate the level of academic ability of test takers within the

Table 1 **a** Deviation value before improvements. **b** Deviation value after improvements

| Evaluation item: from the overall appearance, I want to enter the shop	Simple correlation coefficient	Significance	Proportion of "Good" scores	Level of satisfaction	Distance	α (deg)	θ (deg)	r (correction index)	Level of improvement
(a)									
The content is interesting	0.33	56.79	0.42	48.81	6.89	80.03	35.03	0.61	4.21
The letter font matches the shop's business	−0.03	34.70	0.55	55.82	16.37	69.16	155.84	−0.73	−11.97
The sign is easy to find	0.07	41.00	0.60	58.92	12.68	45.26	179.74	−1.00	−12.64
The type of business is easily understood	0.07	40.77	0.74	66.51	18.92	29.21	164.21	−0.82	−15.60
The attractiveness can be felt	0.44	63.28	0.28	41.22	15.92	56.53	11.53	0.87	13.88
The colors of the signs are coordinated	0.24	51.42	0.21	37.42	12.65	6.43	38.57	0.57	7.23
The signs make the shop brighter	0.34	57.15	0.44	50.07	7.15	89.43	45.57	0.49	3.53
The sign conveys the sense of a thriving business	0.30	54.90	0.28	41.22	10.05	29.14	15.86	0.82	8.28
(b)									
The content is interesting	0.55	56.50	0.81	36.65	14.85	25.98	19.02	0.79	11.71
The letter font matches the shop's business	0.43	49.78	0.98	59.30	9.30	1.35	136.35	−0.52	−4.79
The sign is easy to find	0.59	59.30	0.81	36.65	16.27	34.87	10.13	0.89	14.44
The type of business is easily understood	0.19	35.71	0.95	56.07	15.52	66.99	113.01	−0.26	−3.97
The attractiveness can be felt	0.71	65.69	0.91	49.60	15.69	88.52	43.52	0.52	8.10
The colors of the signs are coordinated	0.40	47.89	0.98	59.30	9.54	12.77	147.77	−0.64	−6.12
The signs make the shop brighter	0.28	40.84	0.86	43.12	11.46	53.12	98.12	−0.09	−1.03
The sign conveys the sense of a thriving business	0.33	44.29	0.98	59.30	10.91	31.55	166.55	−0.85	−9.28
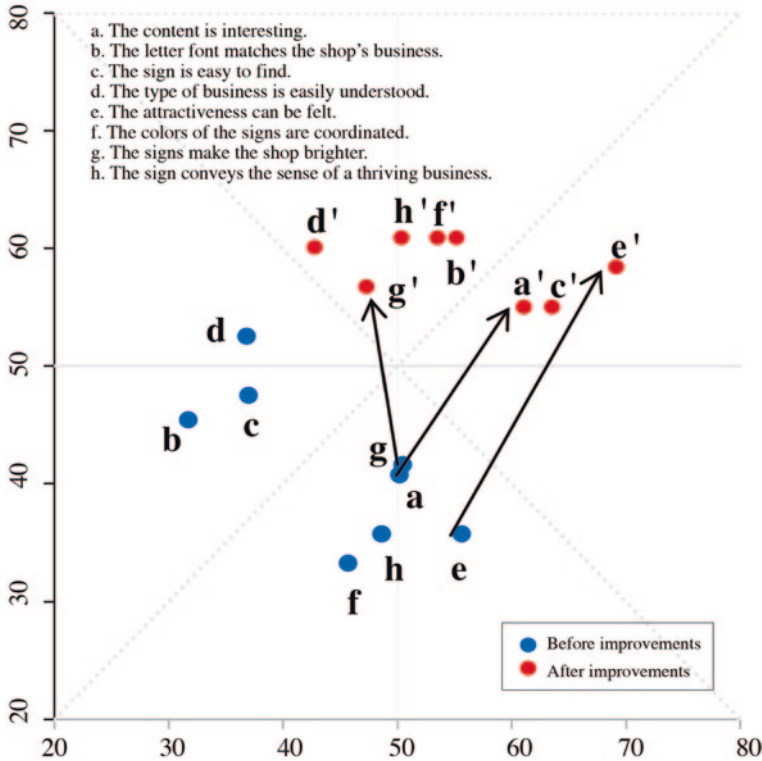
Fig. 4 Changes in the significance/satisfaction graphs before and after sign improvements at ramen shop "K"

entire group. Therefore, applying this to signs can mean that the signs correspond to "test takers" and the various evaluation items correspond to "subjects on the test." Therefore, the problem here is the necessity of developing a unique methodology for sign deviation values that considers the differences between signs and test takers. For this purpose, it will also be necessary to generalize the interpretation of sign deviation values.

4.2 Treating Signs as One System

It is important to clarify the interrelationships among the 9 evaluation items that were selected for the present study. This means treating signs as one system. For that purpose, "systems' thinking" [9] was used to identify cause-and-effect interrelationships among the evaluation items. By clarifying the behavior of the overall system as a so-called open system, the properties of a sign as a dynamic system can be revealed.

4.3 Are There Independent Evaluation Items?

The respective relationships of the sign evaluation items were reported in Sect. 4.1, but the problem is that if truly independent evaluation items exist, they must also be identified at the same time. In other words, what are called independent elements here, when seen from a linear algebraic perspective, refer to combinations of essentially independent elements (evaluation items) which, if they can express other elements, can help to resolve problems by focusing on only the smallest independent elements.

4.4 Statistical Properties Before and After Improvements

Because the evaluations of the items rated by the evaluators showed a normal distribution before improvements, we found that it was possible to apply the deviation value method. While we also confirmed that the distribution of ratings shifted to the right (=good distribution) after improvements, it is important in the quantitative investigation of the nature of signs to understand the relationship between the statistical properties of the two cases and the evaluations of the signs. In other word, the possibility remains for identifying feature values of signs from the properties of the statistical distributions.

4.5 Relation with Visual Communication

It may also be interesting to confirm the utility of this method when evaluating signs from the perspective of visual communication [4].

4.6 Sign Evaluation that Incorporates Qualitative Studies

The evaluation method proposed in the present chapter involves quantitative analysis, but naturally, considerations must also be made from a qualitative perspective. The two perspectives are not in conflict with one another; rather, they can complement the parts that the other is lacking. It would be optimal to incorporate the best aspects of each. This means that another interesting topic might be to develop a method for evaluating signs that takes qualitative studies into account [8].

5 Concluding Remarks

This chapter has introduced the concept of using deviation values to evaluate signs and has proposed a method for improving signs by raising the level of CS. The usefulness of this method was indicated by detailed tests conducted at business

sites. The authors would like to improve this method by further applying its practical aspects by including the items mentioned in this chapter

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