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Paper:

Experimental Study on Shapes of Tactile Signs for Distinguishable Identification on Body Soap Containers

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Japanese Industry Standards (JIS) S 0021 (Packaging – Accessible Design – General Requirements) indicate the design policy for easy-to-use packaging and containers, targeting various individuals including elderly persons and individuals with disabilities. The JIS S 0021 includes tactile signs that are necessary to ensure the ease of distinguishing and handling as well as the ease of using those packaging and containers. The JIS S 0021 prescribes tactile signs on shampoo containers and notches for beverage paper packaging containers as tactile signs to distinguish the contents of the package and to differentiate between containers with the same or similar shapes. The policy was expanded to include tactile signs for body soaps when the standard was amended in 2014, and this was attributed to the fact that organizations of visually impaired demanded tactile signs for body soap, since body soap is often packaged in containers with shapes similar to those for shampoos and hair conditioners. Hence, tactile signs prescribed for body soap in JIS S 0021 guidelines were recently expanded to commercially available body soap containers. In the present study, experiments were performed to study the shapes of tactile signs for distinguishable body soap container. Specifically, shapes were studied through the following two steps: 1) tactile signs were selected based on experiments to evaluate the ease of distinguishing between multiple tactile signs, in a hearing survey involving visually impaired; and 2) experiments were performed to evaluate the tactile signs assuming that they were manufactured in collaboration with the Japan Cosmetic Industry Association, which is an industry organization of manufacturers for body soap and other products. It should be noted that the experiments involving distinguishing between products prioritized tactile signs on the top surfaces of the containers instead of on the side, since visually impaired tend to distinguish between pump containers by touching the top surfaces of the containers in hotels and public restrooms. The results of the experiments were used for tactile signs in the amended JIS S 0021 in 2014 for body soap. This study described evaluation experiments performed on the distinguishability of tactile signs on the top surfaces of pump type body soap containers to determine the factors that should be considered when establishing JIS tactile signs for body soap containers.

Keywords: tactile signs, body soap, distinguishability, visually impaired, packaging and container

1. Introduction

Japanese Industrial Standards (JIS) S 0021 [1] standardize for the design and evaluation of packaging and containers assuming usage by elderly persons and individuals with disabilities. The standard covers various categories of individuals including elderly persons and individuals with disabilities, and thus includes requirements to ensure the ease of distinguishing, handling, and using the contents of the packaging and containers. The standard considers cases related to the issues involving distinguishing between the packaging contents and containers with the same or similar shapes, and therefore recommends the use of indented tactile signs on the top or side surfaces of a shampoo container. Conversely, a linear tactile shape can be added on a body soap container. Specifications related to body soap tactile shape were added in an amendment to JIS S 0021 in 2014, in which the recommendations included different tactile distinguishing signs for shampoos and body soaps. This amendment was closely related to the issues raised by organizations of vi-

sually impaired in 2012 that tactile distinguishing signs for body soap containers were usually similar to those for shampoos and hair conditioners. Surely, it is difficult to distinguish between the containers of body soaps, shampoos, and hair conditioners unless the relevant containers include tactile signs on the top surfaces. This often leads to the inaccurate identification of these containers in facilities including hotels, inns, and public restrooms. In response to this demand, a study on tactile signs that provide tactile distinguishable indications on body soap containers was commenced in collaboration with corporate organizations involved in body soap and shampoo manufacturing as well as with universities and national research institutes. It should be noted that these organizations included the Japan Cosmetic Industry Association (an industry organization of manufacturers for body soaps and other products), the Japan Hotel Organization and the Japan Ryokan & Hotel Association (which purchases and uses the containers), the Japan Packaging Institute, the Japan Standards Association, and the Japanese Industrial Standards Committee (which establishes and manages the relevant standards).

During the amendment of the provisions to add new tactile signs to the body soap containers, it was necessary to examine experimentally whether the tactile signs were distinguishable for individuals with impairments. Therefore, the present study experimentally examined the distinguishability of tactile sign shapes on body soap containers that were created in collaboration with relevant organizations and facilities for visually impaired. The experiments involved tactile signs on the top surface instead of the sides for visually impaired, who often distinguish pump containers in hotels and public restrooms by touching the top surfaces of the containers. The experiments examined the ease of distinguishing between each tactile sign when the participants for our experiment touched the top surfaces of the body soap containers with the candidate tactile signs, shampoo containers with tactile signs, and hair conditioner containers with no tactile signs. The results obtained in the experiments were reported by a study committee in a relevant organization and its practical usage was investigated. As a result of these studies, the tactile signs as shown in **Fig. 1** were added in the amended JIS S 0021 in 2014. It should be noted that the study results related to tactile signs on the top surface of body soap pump containers were effectively used in the JIS amendment and were accorded a high evaluation by individuals in the relevant field. Additionally, newly stipulated tactile signs in the amended JIS S 0021 were added to the body soap containers released by private companies. However, the experimental results related to the evaluation of the ease of distinguishing between body soap tactile signs were not published. Interested parties have requested that the experimental results including useful findings related to the examination of tactile signs should be published.

This study reported the experimental results involving tactile sign shapes used to distinguish between body soap containers. The shapes were studied in the following two steps: 1) tactile signs were selected based on the needs of consumers as determined by experiments evaluating the ease of distinguishing between six tactile signs listed in a hearing survey involving members from an organization of visually impaired (Japan Federation of the Blind) and a social welfare corporation (Japan Braille Library); and 2) experiments were performed to evaluate the tactile signs assuming that they were manufactured in collaboration with the Japan Cosmetic Industry Association (an industry organization of manufacturers for body soaps and other product).

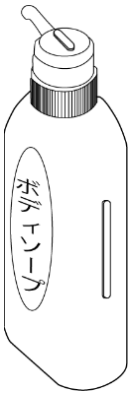


Fig. 1. Image of a tactile sign on a body soap container as shown in JIS S 0021.

2. Evaluation Experiment on the Ease of Distinguishing Between Tactile Signs Through a Hearing Survey Involving Visually Impaired

This section describes the experimental results that involved hearing surveys to evaluate the ease of distinguishing tactile signs on the top surfaces of body soap pump containers for visually impaired. Experiments to distinguish between the top surfaces of shampoos, hair conditioners, and body soap pump containers were performed based on the demands of visually impaired, to improve the ease of distinguishing between shampoo, hair conditioner, and body soap containers by means of tactile information provided on the containers.

2.1. Experiment Attendees

Seven males and females between the ages of 30 and 60 years participated in the experiments. Injuries or anomalies did not exist on their hand and finger skins. All the participants understood the tactile signs on the shampoos and totally knew that there were no signs on the top surfaces of the hair conditioner containers. Additionally, the participants used such tactile signs on a daily basis. Owing to ethical considerations, the details of the experiments were explained to the participants in advance, and the informed consents of the participants were obtained.

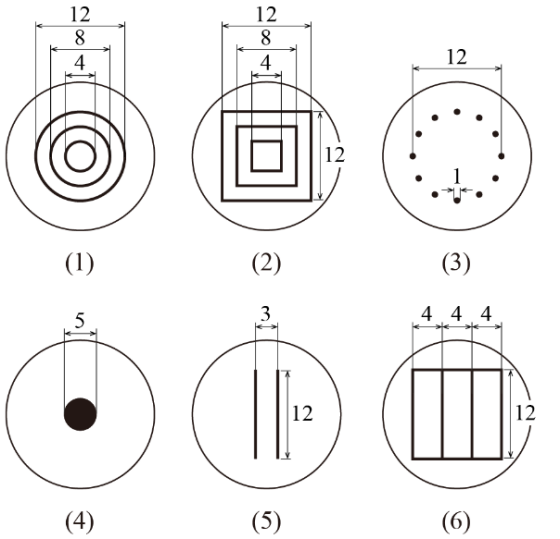


Fig. 2. Tactile signs and dimensions used for experiments.

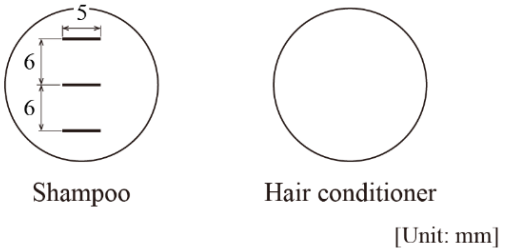


Fig. 3. Dimensions of the top surfaces of the tactile sign on the shampoo and the hair conditioner container pumps.

In addition, the experiments were based on ethical policies specified by the National Institute of Special Needs Education.

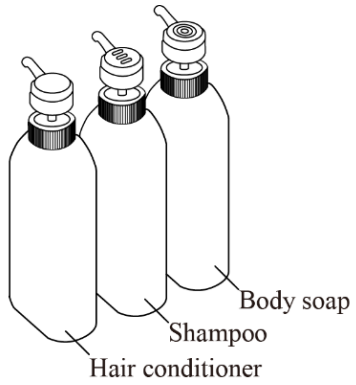
2.2. Tactile Signs

Six tactile signs as shown in (1)–(6) of **Fig. 2** were used as stimulations. These signs were selected because they were likely to be distinguished from the tactile signs on the top surfaces of pump shampoo containers based on a hearing survey that involved employees of an organization of visually impaired (Japan Federation of the Blind) and a social welfare corporation (Japan Braille Library) as well as academic experts of support technology for visually impaired. Tactile sign (1) was based on the convex lines on the black and white circular surface of an Othello game for visually impaired. Tactile sign (2) consisted of a simple geometric square that was easy to recognize. Tactile sign (3) was based on the convex signs on watch faces for visually impaired. Tactile sign (4) was based on a convex point seal on information devices and appliances that can be recognized by touch. Tactile sign (5) was composed of two lines that were orthogonal to the tactile sign for shampoo containers as shown in **Fig. 3**. Tactile sign (6) involved Tactile sign (5) surrounded by a square. These six tactile sign were used in experiments to distinguish between tactile signs on the top surfaces of shampoo containers. It should be noted that these tactile signs were printed on circular seals with a diameter of 22 mm by using a printer that could apply precisely controlled ultraviolet cure resin ink [2]. The experiments used vacant containers (manufactured by Yoshino Kogyosyo) with the signs on the pump top surface. Ultraviolet cure resin ink was used because it possesses stiffness equivalent to the material for the body soap container and can be formed in arbitrary shapes for the tactile sign sample as a stimulation. **Fig. 3** shows the dimensions of the tactile signs on the top surface of the shampoo and hair conditioner containers. The shampoo containers were prepared by referring to the dimensions of commercially available products based on "notches on the pump top surface" that were included as tactile distinguishing indication as prescribed by JIS S 0021 [1]. Circular seals with no signs were applied on the top surfaces of hair conditioner container pumps.

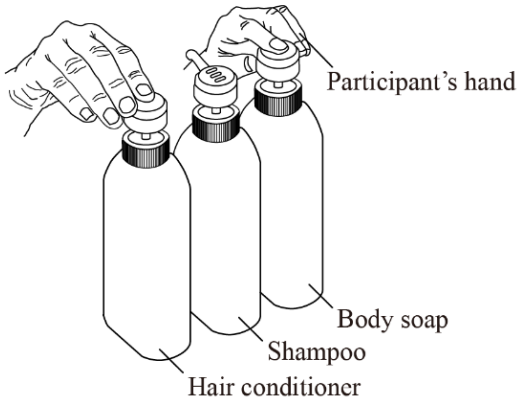
2.3. Experiment Processes

The details and processes of the experiments were orally explained to the participants prior to the experiments and the informed consent of the participants was obtained. The participants possessed an understanding of the experimental processes such that they could smoothly perform the experiments. The participants were then seated in front of a desk on which the body soap, shampoo, and hair conditioner containers were randomly arranged. The participants were allowed to touch tactile signs on the top surfaces of the pumps in natural positions. They were instructed to touch the containers freely with both hands. The containers were arranged in order to maintain the direction of each tactile sign as shown in **Figs. 2** and **3**.

Figure 4 shows the experimental processes. First, a starting signal was given when the subjects were ready, and the subjects then commenced the experiment (**Fig. 4(a)**). The participants freely touched tactile signs on the top surfaces of three pump containers with their finger pads. They stopped touching the containers, the moment when they recognized body soap, shampoo, or hair conditioner containers (as shown in **Fig. 4(b)**). In the process, the tactile sign that was touched first was not designated, and the participants were allowed to touch signs in any order. The participants then answered questions related to the container type (body soap, shampoo, or hair conditioner) and the ease of distinguishing between tactile signs on a scale of 5 (where 1 corresponded to 'difficult to distinguish' and 5 corresponded to 'easy to distinguish'). It should be noted that hearing surveys were also



(a) Randomly arranged body soap, shampoo, and hair conditioner containers (an example).



(b) The tactile signs for the body soap, shampoo, and hair conditioner containers were freely touched with both hands; Participants stopped touching when they recognized the type of containers and orally reported the result.

Fig. 4. Experiment flow.

performed in an oral free answer manner with the participants after the experiments.

The total number of trials was 36, because the body soap, shampoo, and hair conditioner containers could be arranged in six ways for six tactile signs. Each participant took approximately 45 min to perform the experiments, and the physical burden on the participants was considered from an ethical point of view. The number and shapes of tactile signs were explained to the participants, and they touched the signs ahead of the experiment.

2.4. Results

A one factor dispersion analysis with the factor of body soap tactile sign was performed as a statistical analysis to obtain the relevant results. In the analysis, the mean participant data was used. Additionally, multiple comparisons based on the Bonferroni method were conducted when the main effect was observed to study the significant difference between the levels. The significant level was set as 5%.

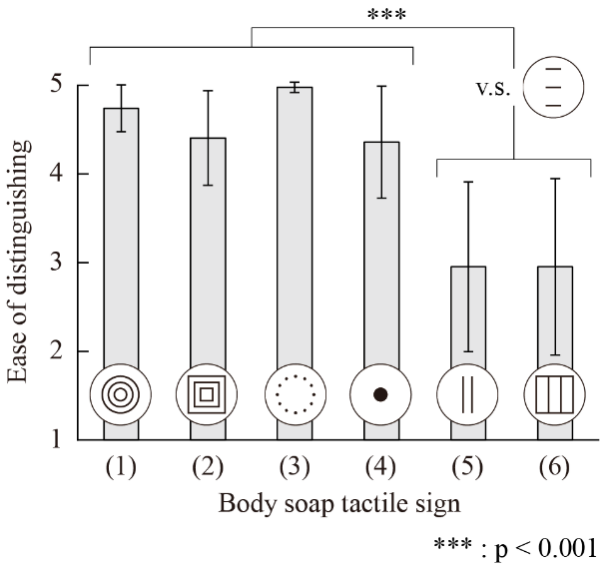


Fig. 5. Ease of distinguishing between tactile signs on the top surfaces of body soap and shampoo pumps.

Figure 5 shows the results for the ease of distinguishing between tactile signs on the top surfaces of body soap and shampoo pump containers. The error bar in the figure shows the standard deviation, and thus, an increasing height of the bar in the figure is associated with an increase in the ease of distinguishing between tactile signs on the top surfaces of body soap and shampoo pump containers. The results of the statistical processing indicated that the main effect of tactile signs was significant [$F(5, 30) = 13.48$, $p < 0.001$]. The result of the multiple comparison indicated that the ease of distinguishing between tactile signs (1)–(4) was significantly higher than that of tactile signs (5) and (6) ($p = 0.001$ in all cases). **Fig. 6** shows the results of the ease of distinguishing between tactile signs on the top surfaces of body soap pumps and the top surface of hair conditioner pumps. In the disperse analysis, the main effect of body soap tactile signs was not observed ($p = 0.27$). Generally, tactile signs (1)–(3) were relatively easy to distinguish, while tactile signs (4)–(6) were relatively difficult to distinguish. **Fig. 7** shows the results of the ease of distinguishing between the tactile sign on the top surface of shampoo pumps and the top surface of hair conditioner. All the participants answered that the shampoos and hair conditioners were easy to distinguish (rating point 5) for each tactile sign. To summarize the above results, the tactile signs (1)–(3) were easy to distinguish from those of shampoos and hair conditioner pumps and did not affect the ease of distinguishing between shampoo and hair conditioner pumps.

In the hearing survey of oral free responses, a subject commented that tactile sign (3) was easy to distinguish because it provided clear stimulation with respect to the finger tips. Conversely, multiple attendees stated that it was difficult to rapidly distinguish between tactile signs (1) and (2) with wet hands because they involved com-

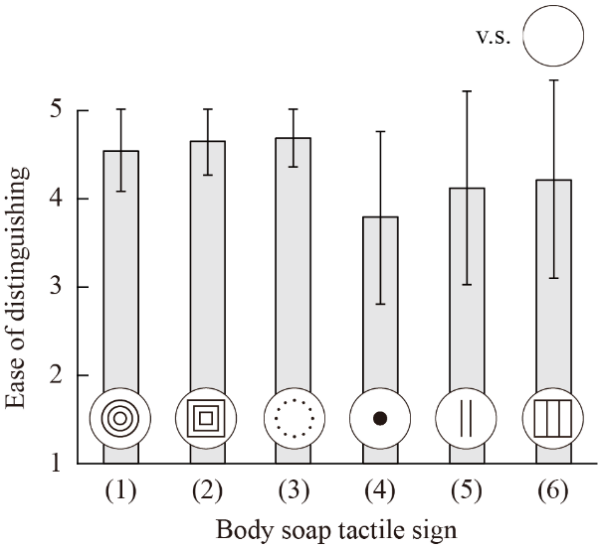


Fig. 6. Ease of distinguishing between tactile signs on the top surfaces of body soap and top surfaces of hair conditioner pumps.

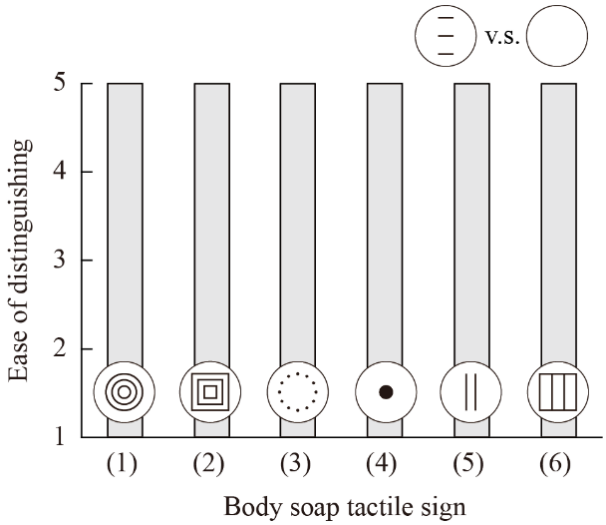


Fig. 7. Ease of distinguishing between tactile signs on the top surfaces of shampoo pumps and top surfaces of hair conditioner pumps.

plicated forms. Furthermore, the subjects tended to confuse tactile signs (5) and (6) with the shampoo tactile sign based on the position and direction of touching through fingertips.

These results indicated that tactile signs (1)–(3) were easy to distinguish from shampoo and hair conditioner containers, and tactile sign (3) was especially favored by visually impaired.

2.5. Discussion

Visually impaired assigned a high evaluation to tactile sign (3) that arranged 12 convex points with a diameter of 1 mm in concentric circles. In contrast, other tactile signs mainly consisted of convex lines. The mechanical receptive unit of the skin related to perception of convex lines or points is considered as a Slowly Adapting type I unit (SAI) composed of Melkel's discs [3]. The ignition frequency of neural impulses increases based on the pushing depth of skin [4]. Therefore, in the case of tactile sign (3) that consisted of convex points with a diameter of 1 mm, it was considered that the local skin points of the fingertips significantly deformed to increase ignition frequency of neural impulses at SAI. This resulted in a relatively higher ease of distinguishing between containers. This result was presumably related to the high generation frequency of neural impulses because of multiple points stimulation (or temporally frequent stimulation) on the skin because of active touch on dispersed convex points of tactile signs (3).

2.6. Brief Summary

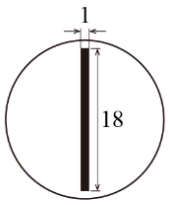
The experiments evaluated the ease of distinguishing between tactile signs by visually impaired by performing a hearing survey on tactile signs on the top surfaces of body soap pump containers. The results indicated that tactile sign (3) in which convex points were arranged in concentric circles was easy to distinguish from shampoo and hair conditioners and did not affect the ease of distinguishing between shampoo and hair conditioner pumps. Additionally, tactile sign (3) was favored by visually impaired in a free answer hearing survey.

3. Study on Tactile Sign Shapes and Evaluation Experiment of Ease of Distinguishing Assuming Body Soap Production in Collaboration with Industry Organizations

Experiments were performed to evaluate the ease of distinguishing between tactile signs through a hearing survey involving visually impaired in relation to tactile signs on the top surfaces of body soap pump containers. The results of the experiments indicated that it was easy to distinguish tactile sign (3) with convex points in concentric circles between shampoo and hair conditioner pumps. This section describes evaluation experiments on tactile signs assuming body soap production in collaboration with an industry organization (the Japan Cosmetic Industry Association).

3.1. Study on Tactile Signs Assuming Body Soap Production in Collaboration with an Industry Organization

Tactile sign (3) was highly rated by visually impaired in the experiments described in the previous section. Discussions in a study committee in a relevant industry organization (the Japan Cosmetic Industry Association) based on the fore-mentioned results indicated the following issues given an assumption of actual production. The discussion indicated that it was necessary for the sign design to



(7) [Unit: mm]

The outer frame of each tactile sign corresponded to the top surface circumference of the top surface of a pump.

Fig. 8. Newly devised tactile sign (7).

be added on side surfaces in addition to the top surfaces. Additionally, water retention was unlikely on the top surface because body soap is usually used during bathing. By considering these points, the Japan Cosmetic Industry Association suggested a tactile sign shaped as a convex line (**Fig. 8**). This simple shape could be added on the side surfaces of body soap containers and was less likely to retain water when used while bathing. Therefore, it was considered as promising candidate for a new tactile shape assuming practical use and the performance of new evaluation experiments on the ease of distinguishing between the tactile signs.

This section describes the evaluation experiments for the new tactile sign as shown in **Fig. 8**, to examine the ease of distinguishing shampoos from hair conditioners. The experiments compared tactile sign (3) (**Fig. 3**) and the new tactile sign in terms of the ease of distinguishing between containers (**Fig. 8**).

3.2. Evaluation Experiments on the Ease of Distinguishing a New Tactile Sign

3.2.1. Experiment Method

Six males and females with visual impairments with ages ranging from 30 to 60 years participated in the experiments. Injuries and/or anomalies were absent on their hand and finger skins. All the subjects understood the shampoo tactile signs and the fact that there were no signs on the top surfaces of hair conditioner containers well, and they positively used such tactile signs on a daily basis. As an ethical consideration for the attendees, the experiment details were explained to the subjects in advance, and the informed consent of the subjects was obtained. In addition, the experiments were based on the ethical policies prescribed by the National Institute of Special Needs Education. It should be noted that the subjects of the experiments described in Section 2 did not participate in the present experiment to exclude the effect of experimental experience, given the similarities in the two experiments. The experiment processes were the same as those described in the previous section. First, a starting signal was shown when the subjects were prepared, and the subjects commenced the experiments. The subjects freely touched the tactile signs on the top surfaces of three pump containers with their finger pads and stopped touching, the moment when they were able to distinguish between body soap, shampoo, or hair conditioner containers. In the process, the tactile sign that was touched first was not designated, and the subjects were allowed to touch the signs in any order. The subjects then answered questions on the type of container (body soap, shampoo, or hair conditioner) and the ease of distinguishing between tactile signs on a regular five interval scale (where 1 corresponded to 'difficult to distinguish' and 5 corresponded to 'easy to distinguish'). Hearing surveys involving the subjects were also performed in an oral free answer manner after the experiments.

A new tactile sign as described in the previous subsection (tactile signs (7)) was prepared with the dimensions shown in **Fig. 8**. In addition, tactile sign (3), which was favored by visually impaired in the experiments described in the previous section, was designated as tactile sign (3) (**Fig. 2**). The two tactile signs were adopted as stimulations in the current experiment. Each sign was tested once, and it took approximately 15 min for each subject to perform the experiment. Ethical considerations for the subjects involved reducing the time spent for the experiment. The conditions of arranging orders were excluded because they did not affect results in the experiments described in the previous section. Body soap, shampoo, and hair conditioner containers were randomly arranged.

The same evaluation index as that described in the previous section (2.3) was used for analysis. The mean and standard deviation of the ease of distinguishing between body soaps and shampoos, body soaps and hair conditioners, and shampoos and hair conditioners were based on the rating points orally assigned by the subjects after each test.

3.2.2. Results

A corresponding t-test was performed, and the significance level was set as 5%.

Figure 9 shows the results for the ease of distinguishing between tactile signs (7) and the tactile sign on the top surface of the shampoo pump containers. The error bar in the figure shows the standard deviation, and it indicates that an increase in the height of the bar in the figure was associated with an increase in the ease of distinguishing between tactile signs (7) and the tactile sign on the top surface of the shampoo pump containers. The t-test results indicated that there were no significant difference between tactile signs (3) and (7) [$t = 1.58$, df=5]. **Fig. 10** shows the results of the ease of distinguishing between tactile sign (7) and the top surface of hair conditioner pump. The t-test results indicated that the mean of tactile sign (7) was lower, while there were no significant differences between the two tactile signs [$t = 1.46$, df=5]. **Fig. 11** shows the results of the ease of distinguishing between the tactile sign on the top surface of shampoo pumps and the top surface of hair conditioner when using tactile sign (7). All the subjects answered that

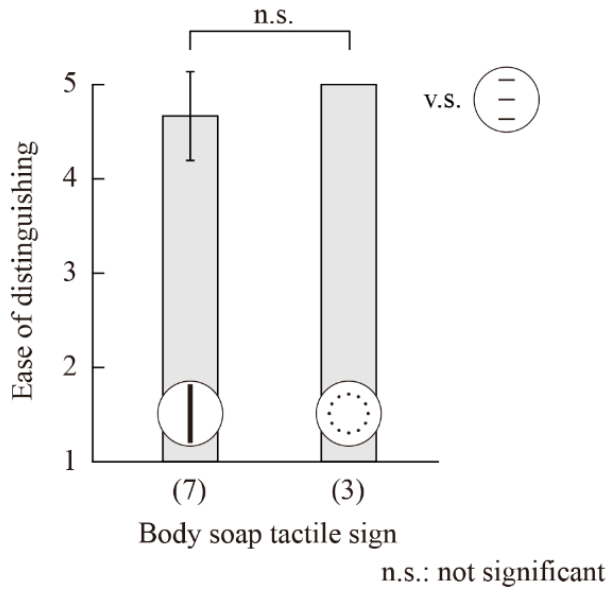


Fig. 9. Ease of distinguishing between tactile sign (7) and the tactile sign on the shampoo pump top surface.

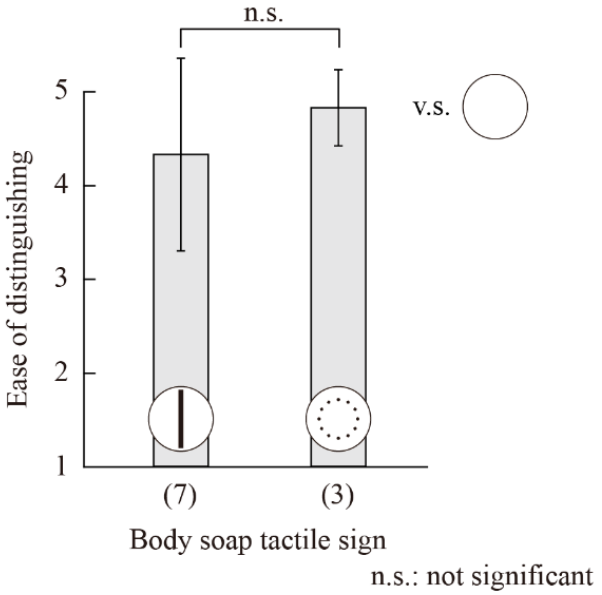


Fig. 10. Ease of distinguishing between tactile sign (7) and the tactile sign on the top surface of the hair conditioner pump.

shampoo and hair conditioner pumps were easy to distinguish (rating point 5) for both tactile signs (3) and (7), and this indicated that there was no difference between the two conditions. To summarize the above results, tactile sign (7) (in which body soap production was assumed) was compared with tactile sign (3) that was proven as distinguishable in the experiments described in the previous section. The comparison indicated that there was no significant difference in the ease of distinguishing between containers and equivalent tendency.

In a hearing survey of free responses following the experiments, a subject commented that tactile sign (7) was distinguishable by touch because of its simple shape. Conversely, tactile sign (7) that comprised of a convex line on side surfaces was confused with the joints of the container unless the line possessed sufficient height and width.

The above results indicated that the newly devised tactile sign (7) was not inferior to tactile sign (3) (which was indicated to be preferable as indicated by the experiments described in the previous chapter).

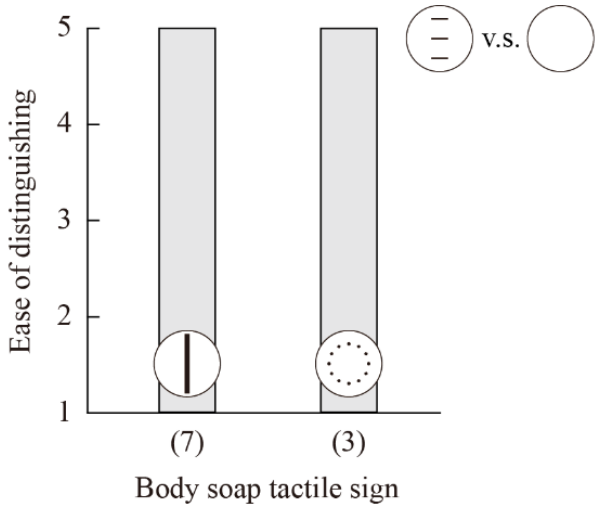


Fig. 11. Ease of distinguishing between tactile sign on the top surface of the shampoo pump and tactile sign (7) on the top surface of the hair conditioner pump.

3.2.3. Discussions

There were no significant differences between tactile sign (7) and tactile sign (3) in terms of the ease of distinguishing between containers. Furthermore, tactile sign (7) was advantageous when compared to tactile sign (3) when the ease of production and the practical advantage of less water retention on the pump top surface were considered. However, a subject commented that a convex line such as tactile sign (7) could be confused with the joint of a container unless the line had sufficient height and width. This indicated the necessity of considering dimensions of tactile signs when manufacturing containers with tactile signs. In the case of the stimulation presented in this experiment, the line had a height of 0.5 mm, and this was sufficient to distinguish the line from the touch characteristic. Hence, it is important to ensure sufficient height and width while manufacturing products.

As a result of these findings, tactile sign (7) was included as the body soap tactile sign in the amendment to the JIS S 0021 standards in 2014. Currently, a few body soap products have this tactile sign. However, a few issues were still unresolved. The new tactile sign could not be used effectively unless sufficient information was provided to the users. Additionally, the JIS S 0021 standard

does not provide dimensions (height, width, and length) of the distinguishable body soap tactile sign. Thus, future studies should experimentally examine distinguishable dimensions that can be added to JIS S 0021, in addition to shape provisions of the tactile sign.

3.2.4. Brief Summary

This section describe the results of the evaluation experiment involving tactile sign (7) with respect to the results described in the previous section assuming that manufacturing was performed in collaboration with the Japan Cosmetic Industry Association (an industry organization of manufacturers for body soaps and other products). A new tactile sign (7) with a one-line convex shape was examined in terms of the ease of distinguishing between shampoo and body soap pumps. The experimental results indicated that there were no significant differences between tactile sign (7) and tactile sign (3) in terms of the ease of distinguishing between containers. This was in contrast to the findings of the evaluation experiments described in the previous section. Additionally, the results of the oral open-ended hearing survey suggested that it is important to ensure sufficient height and width of the line.

4. Conclusion

This study reported the results of the experiments conducted to investigate tactile sign shapes used to distinguish between body soap containers. Tactile signs were selected based on the experiments to evaluate the ease of distinguishing between multiple tactile signs as listed in a hearing survey involving visually impaired. Experiments were then performed to evaluate tactile signs assuming that they were manufactured in collaboration with the Japan Cosmetic Industry Association (an industry organization of manufacturers for body soaps and other products). A new distinguishable tactile sign for body soap containers was included in the JIS S 0021 based on the findings of the experiments. It is expected that the tactile signs on body soap containers will expand given the fore-mentioned amendment of the JIS, and this will allow visually impaired to be more independent.

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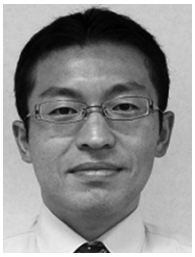

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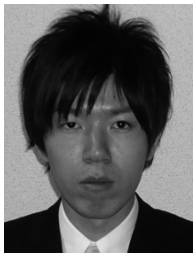

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