Colour and shape design for outdoor billboard based on size in the historical area of Kyoto, Japan

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For outdoor billboards, size, colour, and shape design directly affect people's impression. The outdoor billboard should not only be attractive but should also be in coordination with its surrounding landscape. In particular, in historical and natural areas, coordination with the surrounding landscape may be more important than visual attractiveness. Therefore, with the historical buildings in Gion Shinbashi, Kyoto, Japan, as the research object, this study examined the design method for outdoor billboards, particularly their coordination with the traditional urban atmosphere and role of guidance. The research conducted an experiment on the colour and shape design of outdoor billboards, including the size with the highest acceptance. The results of the questionnaire survey showed that for outdoor billboards of different sizes, the acceptable colour varied. Acceptance for different shapes likewise varied. The results proved that based on the size of outdoor billboards, acceptance can be improved through colour and shape design. The study also provided a design method for outdoor billboards based on elements with high acceptance.

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Introduction

In 1826, to promote the lottery, carriages in London were plastered with lottery posters. Later, these posters were called ' urban monsters ' , subsequently removed in 1853 [1]. In Japan, in 1895, Murai Brothers setup billboards for SUNRISE HERO on the face of the mountainside of Nyoigatake in Kyoto [1]. Later, it was removed owing to their negative influence to the environment.

At present, Japan is focused on developing its tourism. For featuring traditional Japanese wooden architecture, many historical and natural areas will gradually develop as tourist attractions. However, to preserve the characteristics of historical and natural areas, outdoor billboards in these areas are required to change colours to match the historical area, such as brown. Examples include the brown McDonald's billboard shown in Figure 1. However, in meeting the characteristics of this area, the brown logo has lost its original brand feature.

Figure 1: McDonald's in Kyoto historical area (left) and McDonald's in Yokohama natural area (right).

In accordance with the current regulations on outdoor advertising restriction, signboards are restricted in colour use in most areas [2]. Meanwhile, shape is less important than size, which is calculated and restricted based on the longest side length. According to these rules and regulations, Japanese cities have imposed uniform restrictions on the colour, shape design, and size of outdoor billboards; however, comparative research has not been conducted. Restrictions for outdoor advertising in historical areas are more stringent. Therefore, this study conducts research on the design method for outdoor billboards from different perspectives.

Maki [3-4] experimented with the suitability, visibility, and logo identity of existing signboards using the pole signboard in historical streets, office areas, and rural streets. He suggested that the evaluations of signboards in these three areas are different. However, he did not discuss the characteristics of high evaluation billboards in historical streets.

Yamamoto *et al*. [5] discussed the colour combination of billboards rated with a high level of visual attractiveness, concluding that the visual attractiveness of achromatic colours is higher compared with chromatic colours. However, they pointed out that billboards rated with a high level of visual attractiveness are difficult to coordinate with the landscape.

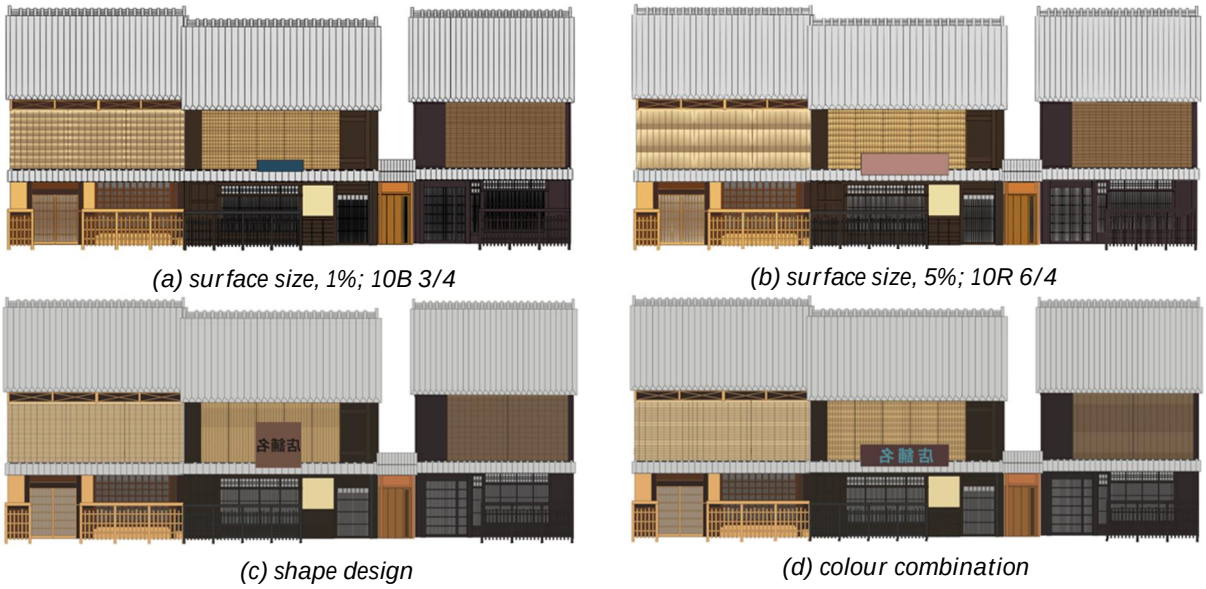
Taniguchi *et al*. [6] investigated the colour of outdoor billboards and reported that outdoor billboard colours should be related to the display location, which has certain regional variations. The outdoor billboard should be set according to different locations.

Meanwhile, previous studies have highlighted the considerable effect of outdoor advertising on the urban landscape, and different parts of the urban environment should be regulated differently. Acceptability of outdoor advertising can be improved by adjusting the colour or design. However, there are no experiments on the adjustment method based on design items. With high acceptance as the standard, this study proposed related methods to adjust the colour and design of outdoor billboards in historical areas.

Methodology

With the traditional wooden architecture of Chaya-machi in Gion Shinbashi, Kyoto, as the subject, based on the building elevation, the study works out experimental images in consideration of the surrounding environment. The images included three traditional buildings. In these images, a billboard is added on the first floor roof of the middle building, and its colour, size, and shape design are changed.

The experiment was divided into two steps. Firstly, the relationship between the background colour and the size of the billboard, as shown in Figures 2(a) and (b), was tested. Secondly, the colour combination of background and text colours and the shape of billboards, as shown in Figures 2(c) and (d), were considered.



(a) surface size, 1%; 10B 3/4 *(b) surface size, 5%; 10R 6/4*

(c) shape design *(d) colour combination*

Figure 2: Experimental images with different sizes, colours, and shape design.

In the first step, colours used in this experiment were categorised by hue, value, and chroma, according to the Munsell colour system. The hues were divided into R, Y, G, B, and P, each of which contained low, moderate, and high values. As for the chroma, with the highest chroma as the highest point, three chroma types were selected. The areas of advertising boards used in this experiment, referring to coverage, were 1%, 3%, 5%, 8%, and 10% of the actual areas of the front walls. As shown in Table 1, a total of 63 images were used in this experiment.

	Value	Value	Value	Chroma				
	3	6	8	3	6	10	11	12
R	10R 3/4	10R 6/4	10R 8/4		10R 5/6	10R 5/10		10R 5/12
SIZE	1%, 5%	1%, 5%	1%, 5%		1%,5%,8%,10%	1%,5%,8%,10%		1%
Y	10Y 3/4	10Y 6/4	10Y 8/4		10Y 5/6	10Y 6/10	10Y 8/11	
SIZE	1%, 5%	1%, 5%	1%, 5%		1%,5%,8%,10%	1%,5%,8%,10%	1%, 5%	
G				10G 5/3	10G 5/6	10G 5/10		
SIZE				1%,3%,5%	1%,3%,5%	1%, 3%		
B	10B 3/4	10B 6/4	10B 8/4	10B 5/3	10B 5/6	10B 5/10		
SIZE	1%, 5%	1%, 5%	1%, 5%	1%,5%,8%,10%	1%,5%,8%,10%	1%		
P				10P 5/3	10P 5/6			
SIZE				1%,3%,5%	1%,3%,5%			
N	N3	N6	N8					
SIZE	1%, 5%	1%, 5%	1%, 5%					

Table 1: Colours and sizes.

Three evaluation items were identified for every experimental image, namely, tradition, coordination, and acceptability. Every item was evaluated through the seven-stage semantic differential technique. The seven items, corresponding to -3, -2, -1, 0, 1, 2, and 3, were analysed separately. Negative numbers indicated rejection, where positive numbers, acceptance.

In the first experiment, when the advertising fascia used 5% of the building façade, colours in different hues had the widest acceptance [7]. Therefore, the size of the advertising board was set to 5% of the building façade in the second experiment.

Nine different design plans were used. The billboard designs were centred on changing the board shape, as demonstrated in Figure 3. Hues R, Y, B, and N were used as the base colours. The base and text colours were set to adhere to single-colour, analogous, comparative, and achromatic colour harmony. The experiment used 34 types of colour scheme, as given in Table 2. Combining 9 designs and 34 colour patterns, 43 images were used for each place.

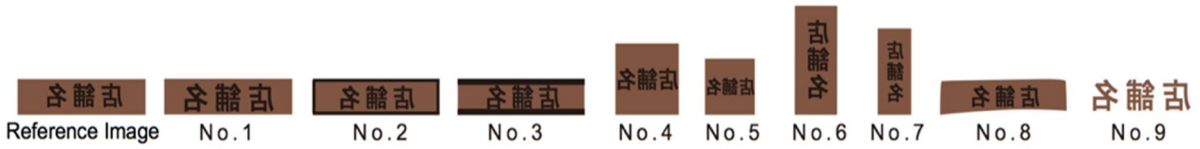


Figure 3: Pairs of samples used for the experiment.

No.	10	11	12	13	14	15	16	17	18	19			
Background Colour			5R 3/3					5R 6/6					
Text Colour	5R 6/6	5YR 6/6	5B 6/6	N1	N9	5R 3/3	5YR 3/3	5B 3/3	N1	N9			
No.	20	21	22	23	24	25	26	27	28	29	30		
Background Colour		5Y 3/3			5Y 6/6				5B 3/3				
Text Colour	5Y 6/6	5YR 6/6	5B 6/6	5Y 3/3	5YR 3/3	5B 3/3	5B 6/6	5PB 6/6	5YR 6/6	N1	N9		
No.	31	32	33	34	35	36	37	38	39	40	41	42	43
Background Colour			5B 3/6				N1			N6		N9	
Text Colour	5B 3/3	5PB 3/3	5YR 3/3	N1	N9	5R 6/6	5B 6/6	N9	5R 3/3	5B 3/3	N1	5R 3/3	N1

Table 2: Background and text colour combinations.

Taking into account the accuracy of evaluation and subjectivity, this experiment used the ME method to do the evaluation. We used the actual billboard colour which used the 5YR 3/3 for base colour and black for text colour as the reference image (Figure 3). The reference image was set as 100 point and the experimental images were judged respectively. There were three items to evaluate: visual attractiveness, coordination and acceptability.

The attributes of the experiment were divided into the participants' profession, field experience, and perception of acceptability of advertising board colours. A total of 80 participants of the 20th generation were recruited in first step. As no significant difference was observed among different nationalities, professions, field experience, and perceived acceptability of advertising [7], 20 students of the 20th generation from the University of Tsukuba and 21 older adults aged over 60 years from the Tsukuba Silver Human Resource Center were recruited in second experiment.

The experiment was carried out in a standard D65 luminous environment and at an illumination intensity if 1100 lx on desk surface. To present clearly the overall colour of the buildings, and enable better comparison with the reference picture, this experiment used 15 × 30 cm printed pictures. An eight-colour inkjet printer was used to print the experimental pictures; the colours were checked against the Japanese Industrial Standards Colour Chart after printing.

Analysis of responses

The background attributes of the participants were analysed, followed by correlation analysis of three evaluation items. Subsequently, the study conducted data analysis on the acceptability of billboards according to different data groups.

Box plotting and mean value were used in the analysis. However, when the mean and median values were significantly different, individual data were analysed. In the analysis, the mean and median values did not show significant differences. Thus, the acceptability of advertising was categorised and evaluated by means and P value.

Analysis of background of participants

According to the analysis results, the only difference was reflected by the different age groups. In other words, the replies in the results of the first experiment presented consistency. Thus, the study analysed the mean value of all experiment participants. The results of the second experiment were analysed for the replies from participants in their 20s and 60s.

Correlation analysis of evaluation items

Every image was evaluated based on three items: tradition, coordination, and acceptance. Subsequently, a correlation analysis was conducted on these three items. At $p < 0.01$, for Kyoto wooden architecture, the correlation coefficient between traditional colour and acceptance value was 0.976, and that between coordinated colour and acceptance value was 0.984.

In the second experiment, the study evaluated the three items of visual attractiveness, coordination, and acceptability. According to the responses of college students in their 20s, the coordination of the billboard was positively correlated to its acceptance, and the correlation coefficient was 0.981 ($p < 0.01$). According to the answers of older adults in their 60s, coordination and attractiveness were positively correlated to billboard acceptance. The correlation coefficient between coordination and acceptability was 0.806, and that between visual attractiveness and acceptability was 0.436($p < 0.01$).

Acceptable size and value

With the area range of 1%–5%, chroma 4, hues R, Y, and B, significant differences were observed between values 6 and 8. When the value was about 8, the acceptable degree of newly added billboard colour decreased to below 0. Achromatic colour, N, did not demonstrate such a change. Therefore, when the area was within 5%, if the value of chromatic colours was above 6, then colours were unacceptable. However, no such value restriction emerged for achromatic colours.

Acceptable size and chroma

Figure 4 shows the acceptable degree of billboard colours with different chroma types. Billboard size was divided into two ranges, namely, 1%–5% and 8%–10%, and the chroma of each hue was analysed within these two ranges.

When the usable area was within 1%–5%, there were significant differences between hue R and chroma types 6 and 10. When the chroma was 10, the acceptable degree was negative; i.e. disallowed. A significant difference in the judgment of the Y hue was noted when the chroma was between 10 and 12. When the billboard size was between 8% and 10%, the significant difference in the judgment of the R hue was between chroma types 6 and 10. The Y hue did not show any significant differences. A

significant difference in the judgment of B occurred between chroma types 3 and 6. Thus, when the area was over 5%, the R hue was allowed within chroma 6, Y hue was allowed within chroma 10, and B hue was allowed within chroma 3.

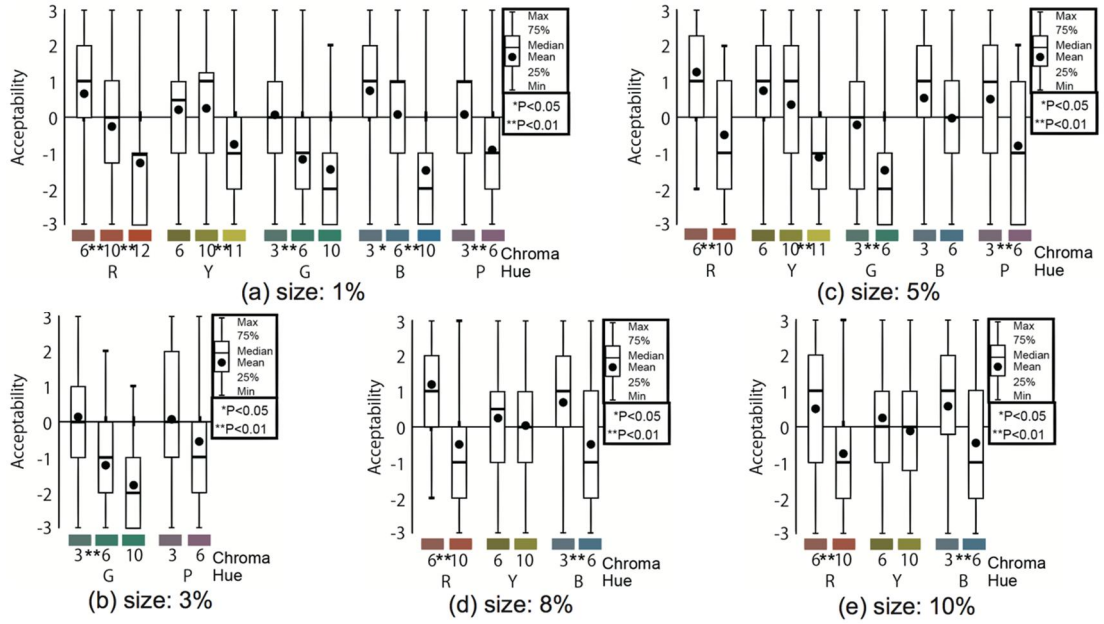


Figure 4: Acceptability for different chroma types.

Acceptable design for younger age groups

For the results of the second experiment, the acceptability of billboards designed in nine different shapes was analysed (Figure 5). According to Figure 5(a), the acceptability of image Nos. 2 and 8 was better compared with the others. The acceptability of image No. 9, designed in channel letters, was the lowest. Experimental image Nos. 4 to 7 were designed in the same shape but with different use areas. No significant differences were observed between them. As such, adjusting the size of advertising boards where appropriate did not affect their acceptability.

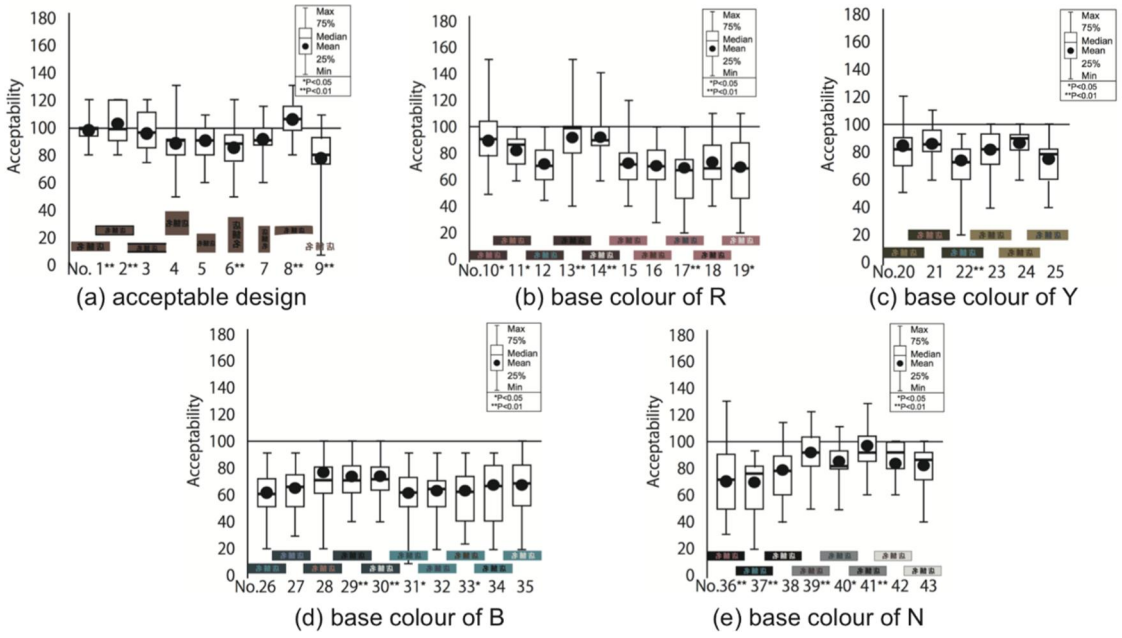


Figure 5: Acceptability for different chroma types.

Acceptable colour combination for younger age groups

Regarding the colour scheme, the study analysed the billboards based on the hue of the base colour. When R was the base colour (Fig. 5(b)), the acceptance of the billboard was a little lower compared with the reference 100. The acceptance level in the R hue could be divided into two: base colour of low value, and low chroma with a higher acceptability than the average; and base colour of middle value, and middle chroma with a lower acceptability than the average. As shown in Figure 5(b), a dark base had a higher acceptance compared with a base colour of middle value and middle chroma, except in the case of image No. 12, which used a comparative blue text.

In the Y hue (Fig. 5(c)), the acceptability of image No. 22 (low value, low chroma colour as base colour and comparative blue as text colour) concentrated in the range of 60–80 and was lower than that of the other colour combinations. When B was used as base colour (Fig. 5(d)), the acceptance level of the billboard with low value, low chroma base colour and white and black text was higher than that of the others. When achromatic colours were used in the base, the grey in middle value was more acceptable compared with white and black. No significant differences were seen in the changes in text colour.

Acceptable design and colour combination for older adults

Using the same method as that for the younger group, the study analysed the acceptance of billboard based on the experimental data of older adults in their 60s. The designs of billboard No. 1 were shown to be superior to other billboards, and acceptance was higher than the benchmark of 100.

When the background colour hue was R, billboard acceptance fell into three ranges. Among them, billboard No. 15 (background colour with low value and chroma and white text) received the highest evaluation. Billboard Nos. 10–13 (dark background) received the second highest evaluation. The billboards that received the lowest evaluation had a background colour with medium value and chroma. No significance was presented in the acceptance for different text colours. Within the Y hue, acceptance for various types of colour combination did not present significant difference, and fell within the acceptance range of 90–100. When the background colour was B, the acceptance for billboard with a background colour of low value and chroma was higher compared with those having a background colour with high value and chroma types.

Conclusions and discussion

The experiment showed that acceptance for colour only presented differences according to the ages of the participants. In other words, other than age, acceptance for colour showed uniformity.

Traditional and coordinated colours were highly correlated to acceptance. Specifically, when the participants believed that the colour satisfied the traditional or coordinated colour, their acceptance for colour increased. On the aspect of the attractiveness of outdoor billboards, according to the results of young people in their 20s, attractiveness did not affect their acceptance of the billboard. However, for participants in their 60s, attractiveness was positively correlated to billboard acceptability. In other words, attractiveness also affected their acceptance of billboards.

Based on data analysis of hue, value, and size in the first experiment, the study summarised the colour use range for billboards based on the mean date in historical blocks (Table 3).

On the aspect of chroma, based on acceptance level differences, the different sizes and acceptable hues and chroma are as shown in Figure 6.

	Value (chroma 4)		Chroma		
Area	< 5%	< 10%	< 3%	< 5%	< 10%
R	< 6	-			< 6
Y	< 6	-		< 10	X
G	-	-		< 3	-
B	< 3	-	< 6	< 3	< 3
P	-	-		< 3	-
N	○	-			
o Accepted for all values； - Not tested； X Rejected					

Table 3: Acceptable colours based on size.

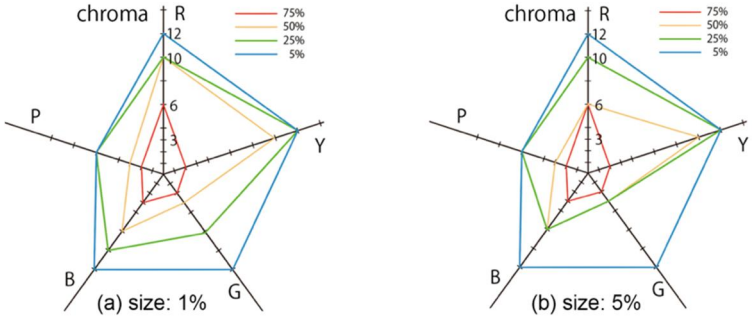


Figure 6: Acceptability colours based on acceptance level.

Based on the second experiment, the characteristics of highly acceptable billboards are summarised as follows:

1) Using a natural wooden shape or free form could make a billboard more acceptable.
2) Using traditional visual elements, such as wooden frames, can also increase acceptability.
3) Advertising on fascia that does not use background boards, such as channel lettering, should be avoided.
4) or older adults, the attractiveness of advertising on fascia is important. Increasing the size of the text or using white text against dark background boards has a positive effect on acceptability.
5) Acceptability is higher for billboards using hues R–Y as the base colour and base with low value and low chroma. For the text, it is not recommended to use high chroma comparative B colours.
6) Acceptability is also high for billboards using the colour of hue B as the base colour, and a base colour of low value and low chroma. In this case, achromatic colours are recommended for texts.
7) When the base colour used is an achromatic colour, grey is more acceptable than white and black. In this case, the range of usable text colours is relatively wide.

Based on the results, acceptability could be improved by adjusting the size, colour, and design of outdoor billboards in the historical street surveyed. However, the study has a number of limitations that should be considered. For one, only the billboard was used in this research; the other types of outdoor advertising should also be examined in the future.

To indicate the overall colours, and enable comparison with the inference image, the experimental images were printed using 15 × 30 mm sheets. The study speculated that the suggestions to improve the acceptability of advertising can be applied to actual use, but the baseline should be determined according to different situations.

Finally, the experiment was based on a single architecture type. For cities, the types of architectures and of billboards has a certain influence on the acceptable degree of advertising. Future research should conduct further explorations and studies on various street types.

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