ANALYTICAL STUDY OF PUBLIC EVALUATION OF A STATION FORECOURT LANDSCAPE

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Abstract

A railway station forecourt is the first place in a city that may make an impression on first time visitors. Their first impression is influenced by the view of the city from the station. This study had two objectives: one was to clarify the evaluation structure of a station forecourt landscape and the other was to clarify the effect of landscape elements on public preference using multivariate analysis, and to discuss the problems of designing a station forecourt. In order to accomplish these objectives, psychological experiments based on photos of station forecourts were carried out, and the relationship between public preference and landscape elements was analyzed. A significant relationship between public preference and elements of a station forecourt landscape was quantitatively observed and several problems inherent to station forecourt design were identified.

1. Introduction

A railway station forecourt is not only a nodal transportation point; it has also become a central location for information gathering and dissemination in recent years For many first-time visitors, it also contributes to the first impression they form of a city, since many cities have developed around stations. A station is the gateway to a city, and the first impression may be influenced by the view from it. An accommodating atmosphere of familiarity, relaxation, or happiness may favorably impress visitors from other cities. Therefore, this study investigates public preferences for, and attitudes towards, railway station forecourt landscapes.

2. Literature review and objectives

There have been many studies from the structural viewpoint regarding the facilities, capacity and scale of station forecourts. For example, Kawauchi (1997) discussed the Japan Railway (JR) Company's efforts with respect to accessibility for the elderly and people with disabilities. However, the recent recognition of the railway station as a central information location means that we must study it from various viewpoints. Usui et al. (1999) used Sapporo Station as a case study to analyze the changes of function that have occurred in response to city development. Takeda et al. (1996) proposed the creation of station space based on these new concepts.

This study complements previous analyses by using psychological experiments to examine public preferences

for station landscape. It also summarizes the diversity of preferences by a principal component analysis. In addition, we use a logistic regression analysis to clarify landscape elements that influence individual preferences and to discuss landscape design.

3. Methods

(1) Psychological experiments

Forty Kure University students participated in this study. Participants used the thirteen adjectives in Figure 1 to rate their preferences for color slides of station forecourt landscapes.

rating score	5	4	3	2	1	
familiar						not familiar
open						pressed
urbane						rural
beautiful						not beautiful
neat						squalid
showy						plain
natural						artificial
modern						classic
attractive						not attractive
light						dark
harmonious						not harmonious
individual						commonplace
favorable						not favorable

Fig. 1 Adjectives and their rating scale.

(2) Photos used for the experiments

Photos of thirty-two stations on the JR Sanyou line were used in these experiments. In order to standardize the photography conditions, all the photos were taken at eye height in fair weather with a 30-mm lens.

(3) Landscape elements at a station forecourt

During design, forecourt landscape elements are classified into two categories, those that can be controlled and those that cannot. This study deals with both types of elements as outlined in Table 1.

(4) Analysis of psychological experiment data

There were two units used in the analysis of the psychological experiment data. One was the photo in an aggregate rating scale of a photo and the other was the participant in an individual rating scale; this permitted the diversity of the participants to be taken into account.

Table 1. Landscape elements of a station forecourt.

Physical feature	Description
Sky	nothing/small/middle/large
Billboard	nothing/letter/picture
Tall buildings	nothing/near/middle/far
Windows in buildings	nothing/little/middle/many
Surface of road	nothing/small/middle/large
Trees	nothing/few/middle/many
Low trees	nothing/few/middle/many
Buses	nothing/being
Cars	nothing/few/middle/many
Shape of roof	nothing/roundish/square
Distant view of mountain	nothing/small/middle/large
tent	nothing/being
Guide board	nothing/being
Stores	nothing/being
Low buildings	nothing/being
Temporary dwellings	nothing/being
Vending machines	nothing/being
Sidewalk	nothing/tiled/asphalt
Bus stop	nothing/with roof/without roof
Streetscape	nothing/being
Utility poles	nothing/pole/street lamp/wire/ traffic signal
People	nothing/few/middle/many
Barricade for construction	nothing/being
Parking lot	nothing/being
Weather	fine/cloud/shadow
Objet	nothing/tower/fountain/ferris wheel/ stone wall/other
Left bicycle	nothing/being

It is important for designers to know the effect of landscape elements on public preference. Therefore, we must judge public preference for a photo. The results of analysis with the aggregate rating scale are directly applied in design. However, when we have to consider more elements, we must conduct further psychological experiments using a large number of photos. On the other hand, the diversity of public preference expressed by means of disaggregate analysis are reflected in landscape design. In this case, the data is the product of the number of photos and participants, hence statistical analysis is perfectly achieved. However, the result of the analysis based on individual data must be represented by a photo. It is important to compare and discuss the results of

aggregate and disaggregate analysis.

(5) Specification of prediction model

As many landscape elements are expressed as dummy variables, the assumption of multivariate normal distribution in regression analysis is not realistic. The maximum likelihood method was used to analyze the relationship between preferences and landscape elements. In addition, logistic regression analysis was used, since the preference rating scales were limited within the upper and lower ranges.

Objective functions of the logistics regression equation are expressed by the ratio of probabilities of non-occurrence to occurrence, the equation is written as follows:

$$y = P(\mathbf{x})/\{1-P(\mathbf{x})\} = \exp(a + b\mathbf{x})$$

Let us assume that only the explanatory variable xj changes to xj- xj, other variables do not change. Then the ratio of probability changes just xj times. This change of ratio is called the Odds ratio, and it is one index for evaluating the degree of effect of landscape elements (Tango et al., 1997).

4. Preferences for station forecourt landscape

(1) Summary of various preferences

A principal component analysis was conducted after quantification on a five point rating scale. Table 2 shows the result of principal component analysis using the rating scores of individual participants. If a rating score increases as shown in Fig. 1, the weight of each preference also increases. The proportion of the first component is 43.1% and those of the second, third, fourth and fifth components are 17.4%, 6.6%, 5.9% and 5.1%, respectively. The cumulative proportion until the second component is about 60.5%, those until the third, fourth and fifth components are 67.1%, 73%, 78.1%, respectively. The thirteen adjectives are summarized as three or four principal components.

Table 2. The results of a principal component analysis (individual rating score).

Adjectives	First	Second	Third	Fourth	Fifth
favorable	0.876	-0 071	0.080	-0.183	-0.050
attractive	0 866	0.011	-0.016	-0 248	0 020
beautiful	0 860	-0.023	-0 205	-0.011	-0.036
light	0.784	0 266	0 018	0 043	-0 047
open	0 720	-0.237	-0.144	0 481	-0 073
familiar	0 715	-0.272	0.156	-0.095	-0 064
neat	0 711	-0 271	-0 205	0.461	-0.087
harmonious	0.581	-0 267	0 606	-0.095	-0.127
individual	0 550	0 333	-0.557	-0 307	-0.064
natural	0 476	-0 579	-0 075	-0 207	0 424
modern	0 378	0 557	0.124	0 183	0.641
showy	0.367	0 722	0 005	-0.111	-0.164
urbane	0.239	0 781	-0 058	0.157	-0.088

According to Table 2, all weights of the first principal coefficient are positive and distributed within the range of 0.24 to 0.88. It is understood that the first component indicates desirable landscape evaluation by young people, meaning the positive direction is desirable and the negative direction is undesirable. With regards to the second component, words such as 'individual', 'modern', 'showy', and 'urbane' are located in the positive direction, while 'natural', 'familiar', 'neat' and 'open' are located in negative direction. The second component expresses regional characteristics. The positive direction means the hustle and bustle of the city and the negative direction means the rurality of the city.

For the third component, 'harmonious' is located in the positive direction, but 'individual', 'neat' and 'open' are located in the negative direction. With respect to the fourth component, the principal coefficients of 'neat' and 'open' are 0.46 and 0.48, respectively, but the others are very small. 'Modern' and 'natural' are located in the positive direction for the fifth component, but all other adjectives are either located in the negative direction or their weights are very small.

(2) Structure of consciousness of average participants

We also compared the structure of public preference derived by averaging participant diversity with that obtained when diversity was permitted. Correlation

coefficients between components based on aggregate and disaggregate rating scores were calculated and the results are shown in Table 3. The correlation coefficient between the first components based on both aggregate and disaggregate data is 0.878, so the first components are in agreement. The correlation coefficients of the second, third and fourth components are 0.994, 0.980 and -0.947, respectively.

Table 3 Correlation coefficients among components

disaggregate	Aggregate data(by a photo)			
data	First	Second	Third	Fourth
First	0.878	-0.549	-0.217	-0.026
Second	-0.549	0.994	-0.068	0.030
Third	-0.217	-0.063	0.970	0.159
Fourth	-0.024	0.030	0.159	-0.947
Fifth	-0.280	-0.043	0.035	0.264

Since all components are in agreement between the analyses that average and permit diversity, study participants do not significantly influence the structure of landscape evaluation for a station forecourt. Besides, in the case of principal component analysis based on aggregate data, the proportion of the first component is 65%, the proportion of the second is 22.3%, and the cumulative proportion until the second is 87.3%. When engineers consider the design of a station forecourt, they must aggregate diverse public preferences. According to this study, this should be discussed until the second component.

(3) Correlation coefficients between components and public preference

In this section let us calculate the correlation coefficients between each component and each preference. However, as these coefficients have been already calculated in Table 2, show that Table.

In particular, the correlation coefficients between the first component and 'favorable' and 'attractive' are more than 0.8, and those between the first component and 'beautiful', 'light', 'open', 'familiar' and 'neat' are more than 0.7. On the other hand, the correlation coefficients between the second component and 'showy' and 'urbane' are more than 0.7 and those of 'modern' and 'natural' are relatively large. The correlation coefficients between the third component and 'harmonious' and 'individual' are relatively large. There are no significant correlation coefficients for the fourth component.

Considering the above mentioned results and section (2), the first and second components are interpreted as composite variables that express public preference.

(4) Distribution of principal component score by components

We can plot principal component scores on a first and second component graph. We will examine the cause of the distribution of principal component scores in the next chapter. If these causes are explained by various landscape elements, it is possible to account for the basic elements of station forecourt design.

5. Relationship between public preference and physical features of the landscape

(1) Influence of landscape elements on a desirable station forecourt (first component)

If the component scores yi for the first component are positive, $y_1 = 1.0$. Conversely, if they are negative, $y_i = 0.0$. The frequencies of $y_1 = 1.0$ and $y_i = 0.0$ are 650 and 629, respectively. Elements entered into the logistic regression equation are decided by a stepwise procedure. Table 4 shows the best model. Chi-square analysis of the likelihood ratio test and the score test shows significance with $p = 0.0001$, indicating that the obtained model is significant.

The probabilities whose component scores are negative are obtained by logistic regression analysis; if the parameters are positive, the component scores are also positive. Positive parameters indicate a desirable station forecourt, negative parameters decrease landscape evaluation. According to Table 4, greenery in a station

forecourt, tiled sidewalks, street lamps and objects such as a ferris wheel increase the public perception of landscape at a station forecourt. These Odds ratios are also greater than 1.0. Conversely, asphalt sidewalks, the streetscape, weather conditions, cars, awnings and close views of the building decrease public preference.

Table 4. The best model of the first component.

Variables	Df.	Parameter	Wald Chi-Square	Pr>Chi-Square	Odds Ratio	Design
Intercept	1	2.591	27.29	0.0001	.	
Large sky	1	-0.785	14.208	0.0002	0.456	C
Close view of building	1	-1.099	15.91	0.0001	0.333	C
Windows in building	1	-0.393	5.111	0.0238	0.675	C
Relatively many trees	1	1.562	32.376	0.0001	4.766	A
Many trees	1	1.45	36.522	0.0001	4.261	A
A few low trees	1	0.609	6.126	0.0133	1.839	A
Relatively many cars	1	-1.131	32.775	0.0001	0.323	C
Awning	1	-1.025	15.034	0.0001	0.359	C
Tiled sidewalk	1	0.66	6.745	0.0094	1.935	A
Asphalt sidewalk	1	-2.288	53.969	0.0001	0.101	D
Streetscape	1	-1.619	71.878	0.0001	0.198	C
Street lamp	1	1.433	31.734	0.0001	4.192	A
Parking lot	1	-0.805	14.31	0.0002	0.447	C
Weather fine	1	-1.328	17.211	0.0001	0.265	C
Ferris wheel	1	3.425	18.722	0.0001	30.72	A

Adoption A-B-C-D Improvement

(2) Landscape elements producing regional characteristics (second component)

Table 5 shows the best model derived by the same method as the previous analysis. The frequencies of yi = 1.0 and yi = 0.0 are 629 and 650, respectively. Chi-square analysis of the likelihood ratio test and the score test show significance with p = 0.0001.

Landscape elements with a negative value have the effect of increasing the rurality of the city. Conversely the positive parameters increase the hustle and bustle of it. Parameters such as stores, low buildings, utility poles, electric wires, towers, and stone walls are negative, on the other hand, open sky, trees, information boards and bus stops are positive.

Table 5. The best model of the second component.

Variables	Df.	Parameter	Wald Chi-Square	Pr>Chi-Square	Odds Ratio	Design
Intercept	1	1.338	35.933	0.0001	.	
Large sky	1	1.195	47.608	0.0001	3.304	A
Relatively many trees	1	0.535	7.986	0.0047	1.708	A
Guideboard	1	0.604	10.555	0.0012	1.829	A
Store	1	-1.86	59.956	0.0001	0.156	C
Low building	1	-1.324	55.049	0.0001	0.266	C
Bus stop	1	1.015	31.395	0.0001	2.76	A
Utility pole	1	-2.083	99.409	0.0001	0.125	D
Electric wire	1	-1.786	19.01	0.0001	0.168	C
Tower	1	-2.77	65.661	0.0001	0.063	D
Rotary	1	-1.196	19.829	0.0001	0.302	C
Stone wall	1	-2.153	20.108	0.0001	0.116	D

Adoption A-B-C-D Improvement

(3) The effect of improvement of landscape elements on public preference

The effects of landscape elements on public preference are shown in the right corners of Tables 4 and 5. The effect of each element is classified as B, C or D, according to the signs of the parameters. If the Odds ratios are more than 1.0, B is revised to A. These tables can provide guidance for station forecourt design.

6. Conclusion

This study arranged landscape elements at a station forecourt, analyzed public preference for them and then discussed an evaluation of station forecourt landscapes. Although many subjects are left for future study, a summary of the results is given below.

(1) Thirteen words were summarized into two or three preferences, indicating desirable city and regional characteristics.

(2) There was no significant difference between the results of analysis based on average and individual preference. In other words, no significant difference of evaluation structure was seen among the participants.

(3) Composite variables that express public preference were obtained by a principal component analysis. It is necessary to evaluate the effects of composite variables with regard to the correlation coefficients for each

preference.

(4) Statistically significant models that explain the relationship between composite variables and landscape elements were obtained by logistic regression analysis.

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