Interaction of activity involvement and recreational location selection behavior in Lowland City: A case study of public parks in Saga City, Japan

IAMTRAKUL Pawinee[1], TEKNOMO Kardi[2], GE Jian[3], HOKAO Kazunori[1]

(*[1]Department of Civil Engineering, Saga University, Saga 840-8502, Japan*)

(*[2]Institute of Lowland Technology, Saga University, Saga 840-8502, Japan*)

(*[3]Department of Architecture, Zhejiang University, Hangzhou 310058, China*)

E-mail: 02ts52@edu.cc.saga-u.ac.jp; kardi@cc.saga-u.ac.jp; gejian@cc.saga-u.ac.jp; hokao@cc.saga-u.ac.jp

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Abstract: Public parks provide many benefits to the community as the representatives of green area. The allocation of public places plays an extremely important role in the daily lives of inhabitants especially for recreational use that could enhance the quality of life of residents in the vicinity. To understand park users' behavior is one of the most important prerequisites for assessing the participation in public service from the park users' point of view. The pattern of park utilization on location and activity selection are important elements in behavioral study, while the public parks topograph may also influence the typical user's behavior. Questionnaire survey on park utilization was used to investigate the interaction between activity involvement and recreational location with the use of linear discriminant analysis (LDA) model. The study found that public park users' behavior is influenced not only by social characterics but also by the recreational activities and their specific location characteristics. We found that about 45 percent of park visitors are local residents living within a radius of 3 km preferred travel to parks near their residential area. This implies that location selection behavior is correlated with travel distance, travel time and travel cost. Visit frequencies and on site expenditures reflect the recreation behavior for different type of activities. The overall information can be usefully applied by decision makers to launch appropriate public policy in consistence with the useful results of this study.

INTRODUCTION

Public parks are representative of city green areas that provide numerous recreation opportunities to the people in the community. At the same time, public parks offer social, economic, and environmental benefits. High quality park service contributes to urban quality, but requires a large city government budget on personnel, parks resources, and administration to maintain public parks' high quality of service. In order to maintain and explain the budget for public parks, the local city government must understand the need of public parks, especially from the local residents' point of view and what type of activity

people in the park are involved in. The observed recreational location selection and activity of park visitors may serve as important indicator reflecting the lifestyle of residents in the community. The objective of this study is to understand leisure behavior of park users in the interaction of activity involvement and location selection.

To understand the phenomena of various benefits that a public park may offer to the surrounding residents, this study considered the behavior of park users at different level of socioeconomic characteristics with variation of attractiveness level and accessibility of the park. Japan's Saga City located in the lowland area of Kyushu Island was selected for investigation

due to the city's large number of parks in different setting. The selected city with only around 200 thousand population is proud to maintain more than 200 small parks and more than 6 huge parks. It means that Saga City has a very high number of parks per population ratio. This high ratio of park/population gives the local resident many choices in selecting their leisure activity in the parks.

This paper is organized as follows. First, the suggested method for examining the interaction between the activity and location selection among park users is presented and the relevant literature is reviewed in the next section. Following that, a number of basic principles and assumptions to guide the development of an analysis on the enhancement park service quality is given in detail. The main concepts are subsequently applied in the methodology and illustrated in this section. Before the conclusion, the collected data are used in the application and analysis section.

CONCEPTS OF PARKS

Public park is one type public space in a city or suburban containing planted trees or grass for recreational, activities, social life, natural systems preservation and conservation, aesthetic purpose, education, as economic assets, or cultural heritage. Public parks provide many different activity opportunities to users or visitors of the park. Various different behavior and preference on park utilization may be formed (Iamtrakul *et al.*, 2004) among different groups of people. The investigation on the availability of public space revealed some user recreational activities patterns that should be taken into account. In this study, the interaction of recreation activity is classified into recreational behavior of location choice and activity involvement.

Recreational location

The concept of recreational location choice may be considered from the aspect of access to the recreational sites and their attractiveness. Selection of park as recreational location must be established. As pointed out in Hwang *et al.*(2005), the interaction between park users and park location is one of the key elements linking park planners and local residents.

Park service can be seen as "point-specific" service in which travel costs, together with time and effort, all tend to increase with distance (Erkip, 1997). The access to recreational location plays a major physical environmental factor on recreational activity participation (Giles-Corti and Donovan, 2002). The accessibility to park is measured by travel characteristics variables such as travel expense, safety concerns, comfort levels and journey time. Public parks have multiple functions for the community. Park attractiveness variables include several park characteristics influencing users behavior such as frequency of visit, duration, expenditure, and other attributes of park characteristics; and opportunities for users to take part in activities.

Activity involvement

Public parks provide a mixture of opportunities to visitors, not only the direct benefit to the pleasure of sensory contact with nature but also contribute to the social and cultural meanings to the people in the community. As the results, there are varieties of activities that visitors can engage in at the site. The assessment of activity characteristics and behavior of different group of park visitors may provide useful information to the local city government to develop appropriate policies and management practices. Bright (2003) stated that a common theme in recreational and natural resource research has to be understood in order to know the behavior of the individual. Therefore the users' opinions that were examined through this study were used to retrieve relative information on the characteristics of activities while they were participating in various forms of recreational behaviors, in the specific destination areas. We follow Gobster (2002)'s suggestion on park activities classification that group people activities in the park into: passive activity (PA), active individual (AI) activity, active group (AG) activity. Passive activity is the activity in providing relaxation and recreation or enhancing socializing of park visitors such as meeting friends, reading, etc. Active individual activity is defined as activity involving a range of sporting activity including both indoor and outdoor activities done individually such as jogging, walking, etc. Active group activity is similar to active group individual activities but are done by team or group of park users playing basketball, football, etc. Other activities

not related to recreational purposes are excluded from the valid recreational activities.

METHODOLOGY

The survey

To identify the interaction between recreational location choice and activity involvement, the actual behavior of park visitors could be captured through a questionnaire survey. Consequently, three big and most popular public parks in the city under investigation, namely Saga Castle Park, Kono Park and Shinrin Park were selected according to different functions the parks served for the community. Shinrin Park is located in the outskirts of Saga City while the other two parks are located in central Saga. On-site personal interview surveys to assess the users' behavior on park utilization in Saga City were conducted during spring of 2004, about 289 valid questionnaires were collected. The samples were distributed in the following ways: location (32.2% Saga Castle Park, 32.6% Kono Park, 32.2% Shinrin Park) and day of week (20% weekday, 80% weekend).

The design of the questionnaire survey consisted of three sections. The first section was a screening survey including questions about participation in recreational activity and socio-demographic information; the second section provided information about recreational trips to parks activities; and the third section was about users' park utilization preference and participation in park improvement program. Other variables such as group size, visit duration and frequency of visits per month that reflect the recreation pattern behavior of park visitors were also integrated in this study based on Roovers *et al.*(2002)'s suggestion.

Method of analysis

Linear Discriminant Analysis (LDA) is a well-known statistical method to classify individuals or objects into mutually exclusive and exhaustive groups based on a set of independent variables. Due to its excellent group classification performance, this study employed this technique to explain the participation of park users in leisure activity and the selection of each recreational location. Based on this approach, the variables discriminated between three park locations connected with specify activity so that users' characteristics could be determined. The linear combinations of independent variables (x) influencing three parks were assumed to discriminate between groups (G). The collected data on various users' characteristics and behavior in different parks were then inputted into the model as a conditional probability which can be explained in term of Bayes Theorem expressed in Eq.(1).

$$P(G_i \mid x) = \frac{P(x \mid G_i)P(G_i)}{\sum_{i=1}^{n} P(x \mid G_i)P(G_i)} \tag{1}$$

To classify each category of activity in different parks, the classification model would select the object with the highest conditional probability (Mitchell, 1997). Therefore, the group of different parks could be assigned by Eq.(2):

$$\frac{P(x \mid G_i)P(G_i)}{\sum_{i=1}^{n} P(x \mid G_i)P(G_i)} > \frac{P(x \mid G_j)P(G_j)}{\sum_{i=1}^{n} P(x \mid G_j)P(G_j)}, \text{when } i \neq j \tag{2}$$

Two assumptions were necessarily adopted to obtain this study's linear discriminant function showing that the collected data distribution must be independent and normally distributed with the same covariance matrix. Based on this assumption, consequently, the final classification function could be expressed as Eq.(3):

$$f_i(x) + \ln(P(G_i)) > f_j(x) + \ln(P(G_j)), \text{when } i \neq j \tag{3}$$

By using Eq.(3), the functions to discriminate three parks in each activity were calibrated with the collected data on different users' socioeconomic and various activity characteristics. The results of analysis could then be used to determine which variables are the best predictors of park location and activity choice that are explained in the next section.

RESULTS OF ANALYSIS

Based on the LDA, various combinations of

several variables were investigated to determine the most suitable classification model that allows the best discrimination among three locations of park with a mixture of activity characteristics. The relationship between the location and activity engaged in were considered under three categories of activities (PA, AI and AG activity) to investigate the factors influencing park users' behavior pattern. Based on the analysis of variance (ANOVA) results shown in Table 1, the *F* test revealed that all independent variables were important to the discriminant function and could be accepted for calibrating the model shown to be significant at confident level of 0.05. Furthermore, Box's *M* test revealed that all activity cases significantly met the assumption of homogeneity of covariance matrices due to the assumption and agreement under an obligation to utilize this statistically method. Table 1 shows that all different activities variables are useful for explaining the discriminant functions. The investigations were conducted through a combination of more than 100 variables, but only variables found to be the optimal combination of variables could be used to classify the activities of park users.

Based on the methodology explained in the previous section, the generalized discriminant function in Eq.(4) could be used for determining to obtain the most suitable case. There were three classification functions of each activity to classify park user's behavior in different park location. Each function allows us to compute classification scores for each case of different group, by applying Eq.(4):

$$S_i = c_i + w_{i1}x_1 + w_{i2}x_2 + ... + w_{im}x_m \qquad (4)$$

In Eq.(4), the subscript *i* denotes the respective group; the subscripts 1, 2, ..., *m* denote the *m* variables; c_i is a constant for the *i*th group; w_{ij} is the weight for the *j*th variable in the computation of the classification score for the *i*th group; x_j is the observed value for the respective case for the *j*th variable; S_i is the resultant classification score. Consequently, the successive functions could be determined as shown in Table 2.

Substitution of the coefficients from Table 2 into Eq.(4) yields the linear discriminant functions of each park location for different activities. The meanings of

Table 1 Tests of equality of variable means

Activity	Test of variable means	Statistics	*Df*1	*Df*2	*Df*3	Exact *F*			
						Statistics	*Df*1	*Df*2	Sig.
Passive (PA)	Age of visitor (Year)	0.819	1	2	145	15.970	2	145.00	0.000
	Money spent for activity	0.767	2	2	145	10.205	4	288.00	0.000
	Travel distance (km)	0.724	3	2	145	8.344	6	286.00	0.000
Active individual (AI)	Age of visitor (Year)	0.719	1	2	55	10.743	2	55.00	0.000
	Travel cost (Yen)	0.574	2	2	55	8.624	4	108.00	0.000
	Income of visitor	0.495	3	2	55	7.441	6	106.00	0.000
Active group (AG)	Frequency of park visits	0.880	1	2	147	9.986	2	147.00	0.000
	Travel time (min)	0.826	2	2	147	7.302	4	292.00	0.000

Table 2 Classification function coefficients

Activity	Variable	Function		
		Shrinrin Park	Saga Park	Kono Park
Passive (PA)	Money for activity (Yen)	0	−3.52E−05	0.001
	Travel distance (km)	0.158	0.078	0.096
	Age of visitor	1.507	2.214	1.889
	(Constant)	−4.459	−7.034	−5.800
Active individual (AI)	Travel cost	0.004	−0.002	0.005
	Age of visitor	1.250	2.339	1.682
	Income of visitor	0.365	0.282	0.94
	(Constant)	−3.518	−6.912	−7.014
Active group (AG)	Frequency of park visits	1.241	0.792	1.128
	Travel time (min)	0.063	0.026	0.059
	(Constant)	−4.086	−2.106	−3.605

the variables derived from the discriminant functions are as follows.

The factor with most influence on PA activity is park visitors' age. The positive sign of this variable indicates that elderly people prefer to engage in PA activity in all parks especially, Saga Castle Park. Accessibility of public park in term of travel distance (km) was found to have significant effect on the recreational site selection among park users. In terms of activity, the amount of money spent in the park plays not so important a role on park location selection as engaging in PA activity.

For the AI activity, the proportion of males devoted to this activity in all parks is still appreciably greater than that in the female sample: 56.9% compared with 43.1%. The analysis result in Table 2 demonstrated that the same significant influence of users' characteristic variable on the discrimination group is age of visitor. In addition, the income of visitor also influences the selection of the kind of activity in different park location. Different selection of site for active individual activity depends on the accessibility of each location. For AI activity, the travel cost is representative of the easy access to different park location.

The most popular activity is AG activity with gender division by male of 46.7% and female 53.3%. The Pearson Chi-square value, 0.018 indicated that the null hypothesis that the two genders group has dependency on the activity was rejected at significant level 0.05. It means that male and female park users participating in active group activity are independent of each other and that AG results are different from other activity results. Furthermore, the discrimination function of this activity indicated that two main variables affecting discrimination of AG activity were

frequency of visits and travel time. The classification results of the LDA for the interaction of location selection and activity involvement for this case study is shown in Table 3.

The results indicated the percentage of correctly classified varies from 52.7%, 69.0% and 47.3% from PA, AI and AG activity, respectively. The overall acceptable percentage correctly obtained by classifying for all park locations was only in the case of AI activity. The percentage on diagonal classification represents the goodness of classify in all cases. Non-diagonal elements are pointed to be misclassified elements toward location for each activity. Due to quite big misclassification, the results of PA and AG activity were not satisfied and would be excluded from further analysis. An increase in the number of data for training LDA toward on an analysis set is necessary to balance the numbers of activity cases in each park location.

DISSCUSSION

The results of analysis revealed a very clear pattern of the interaction between the activity involvement and location selection behavior of park users when the simple discriminant model was used. A case study of Saga City yielded interesting results indicating that different discriminating groups of park users within the community show different patterns of park usage for various activities and different behavior in selecting park location. The interaction diagram in Fig.1 summarizes the relationship between activity involvement and location selection. Analysis of study area survey data showed that, the actual behavior of park users could be captured, and that three main inte-

Table 3 Classification results for activity

Activity	Park name	Predicted group membership			Correctly classify (%)
		Shinrin Park	Saga Castle Park	Kono Park	
Passive (PA)	Shinrin Park	66.67	22.92	10.42	
	Saga Castle Park	26.92	67.31	5.77	52.70
	Kono Park	35.42	41.67	22.92	
Active individual (AI)	Shinrin Park	80.77	7.69	11.54	
	Saga Castle Park	38.89	55.56	5.56	69.00
	Kono Park	14.29	21.43	64.29	
Active group (AG)	Shinrin Park	55.77	28.85	15.38	
	Saga Castle Park	12.50	75.00	12.50	47.30
	Kono Park	40.00	48.00	12.00	

raction factors influencing park users' behavior could be identified. The diagram of the interaction between activity involvement and location choice covers users' socioeconomic characteristics, activity characteristics and location characteristics (Fig.1).
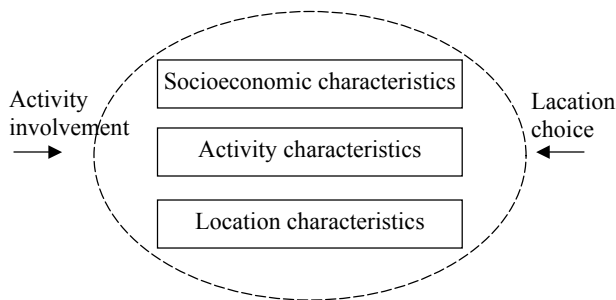

Fig.1 Interaction diagram of interaction between activity involvement and location selection

Park users' socioeconomic characteristics

Age of users (Year): A very high value of this coefficient plays an important role in discriminating the group of park users engaged in PA activity and active individual activity. The elder users prefer doing PA activity in Saga Castle Park to other parks. An interesting characteristic of Saga Castle Park is the presence of prefecture library, Saga Castle and prefecture museum that might be the attractive points for old people who enjoy social activity in this park.

Income of users (Yen): The coefficient of this variable indicates that high income park users discriminated to the group of users who engage in AI activity at Kono Park because the appealing characteristic of this park is the existence of zoo and amusement park inside. So park users who come here can pay for playing and enjoy the facilities inside.

Activity characteristics

Expense for engaging in various park activity (Yen): This variable reflects the fact that in case of the high coefficient value implied that the particular park could induce users to spend their money. As expected, high value was estimated for the case of Kono Park since the existence of highly attractive facilities such as zoo and amusement facilities are available to users for them to enjoy their expenditure while they get pleasure from activity in this park.

Frequency of park visits: This behavior of park users was estimated for only AG activity. It can be said that more frequent of park visits would persuade users to this activity. It is reasonably inferred that the parameter of this variable has high value for the case of Shinrin Park since this park is suitably designed for any kind of strenuous activity. This park is the most suitable for strenuous group activity since park has wide play area, play field and baseball gymnasium for users who prefer sport activity.

Location characteristics

Travel distance (km): Different estimated parameters associated with travel distance to each park location have its own meaning from its sign and value. The highest value of this variable is used to categorize the group of users who selected Shinrin Park to engage in passive activity. This coefficient value was greater than that of Kono Park and Saga Castle Park respectively. To verify the independency of analysis groups we conducted tests on different level of travel distance. The null hypothesis was rejected at significance level of 0.05 (Pearson Chi-square 0.00). It means that three categories of distance from short ($\leq$1.65 km), medium ($\leq$5.8 km) and long (>5.8 km) were independent one another. The high proportion of medium and long distance occupying 43.1% and 54.6%, respectively could also be used to confirm that most park users who travel longer distance would engage in PA activity in Shinrin Park.

Travel cost (Yen): This variable is the other term of travel distance that influences the discriminate of park users who engage in active individual activity. The slightly different coefficient value of different group of park users who visit Shinrin Park and Kono Park has opposite sign in Saga Park. Therefore, the dependency test was performed to verify that different groups of travel expense are independent of one another. Pearson Chi-square value was 0.00 so the null hypothesis of dependency at significant level of 0.05 was rejected. The result obviously showed that 94.4% of users visited Saga Castle Park without travel expense, which indicates that most visitors to Saga Castle Park are pedestrians and cyclists with residence or working place near this park.

Travel time (min): The variable has positive sign coefficient for all park locations. The highest coefficient value falling on Shinrin Park means users must spend longer travel time to engage in AG activity in this park. The dependency test was also conducted to

recheck the portion of different level travel time. The Pearson Chi-square value of different travel time level was 0.00 so the null hypothesis of dependency at significance level of 0.05 was rejected. The categories of travel time level are short (≤11 min), medium (≤20 min) and long (>20 min). Base on this classification, it was found that 57.7% of Shinrin Park visitors are grouped in long travel time level.

CONCLUSION

This study used linear discriminant analysis (LDA) to identify the interaction between recreational location choice selection and activity involvement in the case of public parks. Based on this simple approach, a variety of park activities utilization could be categorized and the different pattern of park usage on different location was identified at the same time. The results of analysis clarified that the users' characteristics and behavior have influence on the discrimination of park users groups that result to different pattern of interaction between location selection and activity involvement. Recreational location was found to play an important role in activity selection since park users would selection the activity to engage in different park based on their socioeconomic characteristics and activity characteristics. This information can provide insight into actual park users' behavior on their recreational activity and location selection choice. Among other findings, this study revealed that active group activity was the most popular recreational activity that people in Saga City participated in on pleasure trips, followed by passive activity and active individual activity, respectively. Park users' characteristics also have influence on user discrimination according to age of visitors and income. Park users' behaviors can be explained in terms of recreation activity but mainly in terms of activity expense and frequency of park visits. The other significant groups of variables include accessibility of each recreational site, travel distance, travel cost and travel time that are useful for discriminating park users to different park location. Three categories of activities which broadly cover the range of leisure pursuits is discussed under the main category of the variables'

effect on discriminating park users groups. Several extensions of the current study can be accomplished with more comprehensive data in order to retrieve more reasonable and reliable results than the existing results. This approach would be a useful case study for improving the opportunity to obtain good public park service and enhancing appreciation of park site visits based on users' behavior study since this valuable result can reflect the need from the user's point of view. Better quality of park service may contribute to the city's livability that is one of the determinants for sustainable conurbations. The relevance of parks to peoples' everyday lives provides an opportunity to enhance the residents' quality of life in the community. Therefore, the improvement of park service quality rests on the provision and maintenance of a good system of parks as demanded by public opinion must be seriously considered by relevant government units concerned with administration of public parks.

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