THE EFFECTS OF GREENERY ON THE FEELING OF RESIDENTS TOWARD RESIDENTIAL NEIGHBORHOODS

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Introduction

During the process of rapid urbanization in Japan, many cities have suffered substantial losses of natural green spaces. As the natural green spaces decrease and the natural environment of cities grow worse, it is likely that the quality and quantity of green spaces will grow in demand.

In recent years, as reviewed by TAKAHASHI,[8] some investigations have been made to clarify the standards of the quantitative green spaces. Although these studies showed the relationship between the degree of people's satisfaction with greenery and the percentage of tree-covered areas or natural areas in their neighborhood, it is less well-known, how the greenery effects the affective assessment and livability of the residents (a state of well-being or overall satisfaction) of the neighborhoods.

It is probable that there are many psychological characteristics associated with environmental attributes. Hence, one method which would appear to be appropriate for examining some of the ways of describing the experience of the residents and the reaction to their neighborhood is the semantic differential method proposed by OSGOOD *et al.*[6] or similar methods. Although, the semantic differrential procedure has been used in investigating the reactions of human observers to various kinds of environmental situations, there are only a few examples regarding greenery.

In the present study, the feeling of residents toward their neighborhoods have been investigated by the semantic differential methods. The chief interest are the relationships between the degree to which the greenery effects the feeling of people and the livability of the neighborhood.

Method

In the summer of 1979 a sample of residents were surveyed by questionnaire. A random sample of households (mainly households and housewives) were drawn proportionately from a map which showed each family name and the location of each house. Fifteen typical residential areas in Sapporo were chosen for this survey. The size of each study area which was surrounded by main streets or some natural boundaries was about 300 m × 300 m. About 200 questionnaires were distributed to the chosen houses in each area. Table 1 shows the used districts of each area and the number of effective respondents.

TABLE 1. The survey areas and number of respondents

survey area	efficient reply	use district	location
A. Shinoro	152	Exclusive residential district 1*	Newly developed housing estate
B. Koyo	170	Exclusive residential district 1	Urban area
C. Azabu	153	Exclusive residential district 2	Housing estate in urban area
D. Okadama	159	Exclusive residential district 2	Urban fringe
E. N. 23~24- W. 6~8	158	Exclusive residential district 2	Urban area
F. Yamanote	151	Exclusive residential district 2	Urban area
G. Meien	190	Exclusive residential district 2	Urban area
H. Soen	136	Residential district	Central urban area
I. Kosai	127	Residential district	Urban area
J. Koto	169	Semi-industrial district	Central urban area
K. Sakaigawa	130	Exclusive residential district 1	Urban fringe
L. Misono	162	Exclusive residential district 2	Urban area
M. Hongo	161	Exclusive residential district 2	Urban area
N. Makomanai	179	Exclusive residential district 1, 2	Housing estate in urban area
O. Kawazoe	148	Exclusive residential district 1	Urban fringe

The distributed number was about 200 in each area.
* "1" means the first kind and "2" means the second kind.

This questionnaire asked residents to rate their impressions of their neighborhoods on 21 semantic differential scales and on livability. For this study, adjective pairs applicable to residential areas were gathered from previous studies and the author compiled a new list. However, the list is by no means exhaustive nor comprehensive. Each respondent was asked to consider the concept of a neighborhood (the residential area in which he or she was living) and to place a check mark next to the word which they felt best represented the concept. The scales were divided into five steps as follows; quiet —: —: —: —: —: noisy. From left to right in the above example a check in the blank would indicate; extremely quiet, quiet, neither quiet nor noisy (or not applicable), noisy, or extremely noisy. This scale ran from five points to one point. The author asked residents to rate livability on a scale of five.

The questionnaire also asked for items of personal information such as sex, age, house type and period of residence, etc.. The following findings on respondents were presented as the background for the next analysis. Thirty seven per cent of the respondents were male and 63% were female. Age profiles of respondents were as follows; 15-24 years old···8%, 25-29 years old···11%, 30-39 years old···31%, 40-49 years old···21%, over 50 years old···29%. In terms of the house types in which respondents lived, about 61% were individually-owned houses, 21% were apartment houses or rental rooms and the remaining 18% were others. The percentages regarding the length of residence in survey areas were as follows; within 1 year···13%, 2-4 years···19%, 5-9 years···24%, 10-19 years···27%, over 20 years···17%.

Results and Discussion

1. Analysis of Variance

In order to test the significance of the differences in response among respondent groups and survey areas, the scores of each scale were analyzed in a one way analysis of variance. The results of the testing are given in Table 2.

Though, relatively low F-values were found in the "warm-cool", "open-closed", "old-new" and "active-passive" categories as predicted, ratings in all scales were significantly different at $p<.001$ between survey areas. The results indicate that the responses of respondents were influenced by the many attributes of their neighborhood because the survey areas were chosen on the basis of environmental differences. Then the high F-values in the "natural-artificial" and "a lot of greenery-lack of greenery" categories are

TABLE 2. Differences in ratings of the scales by characteristics of respondents and the survey areas according to one way variance analysis

(F values)

scale	survey area	sex	age	living ages of present address	house type
quiet-noisy	29.74***	.73	6.98***	.09	15.92***
calm-disturbing	19.06***	.37	11.67***	1.30	12.38***
healthy-unhealthy	32.68***	.13	6.20***	1.55	13.77***
safe-unsafe	15.02***	9.88**	24.16***	6.93***	28.16***
diverse-uniform	26.63***	.59	1.72	.30	.80
unique-common	18.20***	.10	2.87*	.65	1.01
natural-artificial	95.91***	16.62***	.97	2.39*	2.22
a lot of greenery-lack of greenery	74.20***	4.99*	3.78**	.21	4.15**
♯uruoigaaru-sappukei	39.30***	4.45*	2.55*	.38	7.27***
beautiful-ugly	47.89***	4.82*	5.06***	.81	5.34**
warm-cool	3.74***	4.67*	1.72	2.48*	7.15***
friendly-unfriendly	5.38***	3.15	3.36**	4.14**	5.69***
open-closed	5.05***	.08	.74	.11	.70
light-dark	14.92***	6.86**	2.15	1.35	5.74***
active-passive	5.34***	17.14***	.20	2.00	.83
ordered-chaotic	24.85***	.00	2.25	1.71	4.03**
clean-dirty	29.24***	.02	7.28***	2.90*	4.92**
soft-hard	11.01***	.19	2.64*	.99	3.73*
old-new	7.44***	.61	1.44	3.47**	4.63**
convenient-inconvenient	53.76***	1.14	5.67***	17.58***	2.59
pleasant-unpleasant	27.23***	.12	4.81***	1.33	11.34***
livability	17.50***	.19	8.22***	3.19**	7.48***
number of category	15	2	5	6	4

***, **, *: Significant at the 0.1%, 1% and 5% level, respectively.
There are some scales having no exactly fitting words in English.
♯: Although it is difficult to translate this scale into English, "lush-bare or tasteless" is similar in meaning.

easily suggested. And the high F-value of the "convenient-inconvenient" category seems to be much different in relation to the distance from the central business district of the city.

Ratings in 8 scales were significantly different at $p<.05$ between male

and female. Except in the "safe-unsafe", category in remaining 7 scales, females had a tendency to respond more positively than males. The author has not as yet sufficient data to clarify the reason for the higher ratings of female respondents. But about the lower ratings by females in the "safe-unsafe" category the author can suggest that it is due to the earnest wish of ladies for safety in the neighborhood.

Significant differences in age groups were found in 14 scales. In most of the scales, older respondents, especially those over 50 years responded more positively than younger age groups. The author feels that one reason is because more older people were living in better environments, for example, individual houses with gardens or good residential areas, than younger groups in this survey.

Ratings in 8 scales were significantly different ($p<.05$) regarding the period of residence in each survey area. In the differences it was found that respondents who had been living for long time in the survey area tended to respond more positively than newcomers. This is perhaps related to the saying: "once you live in a place, it grows on you".

Furthermore, respondents living in individually-owned houses tended to rate more positively in most scales, especially, in the "safe-unsafe", "healthy-unhealthy", "calm-diturbing", "quiet-noisy" categories than those living in apartment houses or rental rooms. A higher rating in the "a lot of greenery-lack of greenery" category by respondents living in individually-owned houses was probably in part due to their gardens. The findings are in accord with results of some previous investigations.[1,2,4] Then, when we discuss the differences in response we must consider the effects of the rate of housing type in each survey area.

As mentioned above, although there were some significant differences between respondent groups, there were a lot more clear differences between survey areas. In this context, LOWENTHAL and RIEL reported that "the linkages of environmental association that characterize types of observer groups are less numerous, less statistically significant, and less structurally consistent than those that differentiate urban milieus".[3]

2. Image Profile

If we join the mean values of each scale by lines, we can draw a profile of the survey areas. The profiles are useful to grasp the overall differences between survey areas. To save space, ratings of only 3 typical areas and means of total respondents are shown in Fig. 1.

Attributes of the survey area are as follows; area J was generally low rated except in the "convenient-inconvenient" and ratings in the "a lot of

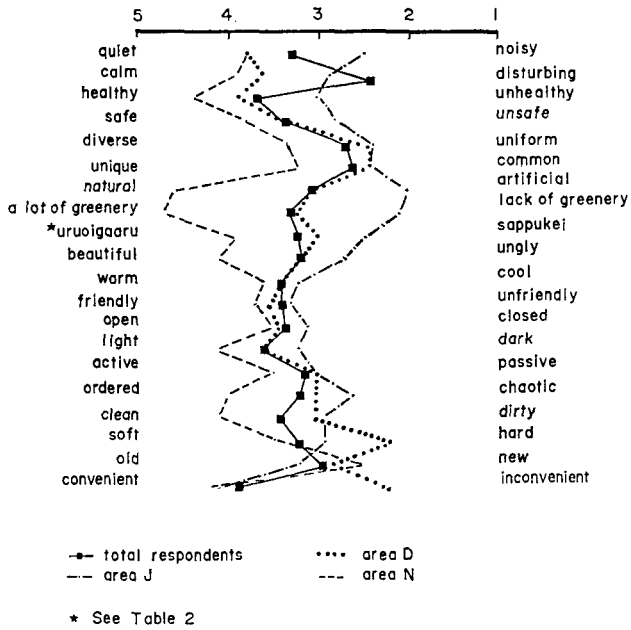

Fig. 1. Image profiles of some typical areas of the survey areas.

greenery-lack of greenery", category "natural-artificial" category were especially low. It seems that the results are due to lower tree-covered areas (9%) in the survey areas. In contrast, area N was generally highly-rated in most every scale and the "a lot of greenery-lack of greenery" and "natural-artificial" categories were rated especially high. The tree-covered rate of this area was about 30%. Ratings in most scales of area D were medium. In area D, the tree-covered area rate was about only 6%, but the rate of grass-covered area or fields was high (about 50%). According to the results, the author can easily suggest that the ratings of many scales were influenced by the quantity of trees and grasses in the areas.

3. Relationships Between Greenery and the Affective Scales

Using the correlation coefficient, the author showed the relationship between the greenery which people felt and the affective scales. As Table 3 shows, all the scale are significantly correlated to the "a lot of greenery-lack of greenery" category ("convenient-inconvenient" ; $p<.05$ and the other scales; $p<.001$). As predicted the highest correlation was found between the "a lot of greenery-lack of greenery" and "natural-artificial" categories. This means that greenery is important to maintain a feeling of nature and that is a key indicator of the natural condition of residential areas. A great many

TABLE 3. Correlation coefficients between the "a lot of greenery-lack of greenery", "pleasant-unpleasant" and "livability" and the other scales

scale	a lot of greenery-lack of greenery			pleasant -unpleasant	livability
	total respondents	15–24 years-old	over 50 years-old		
a lot of greenery -lack of greenery	—	—	—	.51	.41
natural-artificial	.76	.77	.72	.52	.42
beautiful-ugly	.58	.48	.58	.54	.46
*uruoigaaru-sappukei	.57	.57	.57	.53	.46
healthy-unhealthy	.52	.42	.54	.69	.48
pleasant-unpleasant	.51	.39	.56	—	.55
diverse-uniform	.48	.34	.44	.36	.31
calm-disturbing	.44	.34	.44	.50	.47
clean-dirty	.43	.28	.53	.48	.45
light-dark	.41	.32	.40	.47	.45
ordered-chaotic	.41	.35	.41	.41	.40
quiet-noisy	.39	.28	.40	.50	.41
soft-hard	.39	.21	.44	.39	.35
unique-common	.36	.33	.32	.29	.24
safe-unsafe	.36	.30	.33	.48	.38
friendly-unfriendly	.33	.35	.37	.44	.38
warm-cool	.31	.32	.28	.41	.37
open-closed	.29	.27	.23	.33	.30
active-passive	.19	.15	.17	.24	.23
convenient-incovenient	.06	−.04	.04	.15	.31
old-new	−.09	.01	−.10	−.09	−.08
number of respondents	1697	141	465	1923	1697

*see Table 2.

of the scales have relatively high correlation coefficients. It may be of interest to note that green spaces positively influenced many subjective assessments or feelings. Although the high correlation coefficients do not indicate the direct effects of green spaces on various affective responses, it would be easy to say that in order to increase the desirability of the neighborhood, one should consider the quality and quantity of green spaces. Green spaces will necessarily effect the visual appearance of residential areas and their beauty, variety and orderliness. Futhermore the high correlation of

the "a lot of greenery-lack of greenery" category with the "healthy-unhealthy", "pleasant-unpleasant" and "quiet-noisy" categories will mean that greenery is felt as a basic component of residential areas by its residents.

When the author examined the differences in ratings between the respondent groups, there were no significant differences between in the results based on the male group and female group. As the typical comparisons are shown in Table 3, there were some significant differences between older groups and younger groups. However, higher correlation coefficients were found in some scales based on older groups than younger groups. Then the results will show that green spaces are more influential to affective response of older groups than younger groups.

On the same table the correlation between the "pleasant-unpleasant" category and the "livability" and all the other scales are shown. Except the "old-new" category, all the correlation coefficients were significant at $p<.01$ positively. It is noteworthy that the correlation coefficient between the "livability" and the "pleasant-unpleasant" category was high and the correlation coefficient between the "convenient-inconvenient" category and the "livability" was relatively high and that correlation coefficient between the "pleasant-unpleasant" and "convenient-inconvenient" categories was not high.

Comparing the correlation coefficients between the survey areas, relatively broad ranges (from the highest correlation to the lowest correlation) were found on many scales (Table 4). For example, the ranges of the "old-new", "convenient-inconvenient", "healthy-unhealthy", "unique-common" and "clean-dirty" categories were over .40. Although it may be noted that some low correlations were found in some areas with narrow variations in greenery due to a lot of or lack of green spaces, the reason for the differences were not clear. But it may be suggested that the attributes of green spaces in the survey areas would cause the differences of many correlation coefficients between the survey areas.

4. Factor Analysis

Except for the "pleasant-unpleasant" category which has a high correlation with the "livability" which itself was intended to be used as a dependent variable after this analysis the intercorrelation between other scales was calculated. The resulting 20×20 correlation matrix was factor analysed by the principle axis method and four factors with eigenvalues greater than or eaual to 1.0 were extracted. And the factors were rotated to a simple structure using the varimax criterion. These four factors accounted for 50% of the total variance among all judgements. Factor loadings and communalities for the scales are shown in Table 5.

TABLE 4. Difference of correlation coefficients between the "a lot of greenery-lack of greenery" and the other scales

scale	the highest correlation	the lowest correlation	number of survey areas with significant correlation	
			$p<.01$	$p<.05$
quiet-noisy	.42	.10	10	2
calm-disturbing	.45	.20	13	2
healthy-unhealthy	.62	15	13	0
safe-unsafe	.42	.09	11	2
diverse-uniform	.48	.17	13	1
unique-common	.50	.04	10	2
natural-artificial	.79	.55	15	0
*uruoigaaru-sappukei	.59	.23	14	1
beautiful-ugly	.56	.22	14	1
warm-cool	.47	.12	9	4
friendly-unfriendly	.47	.10	14	0
open-closed	.41	.11	10	2
light-dark	.39	.17	11	3
active-passive	.27	−.02	4	3
ordered-chaotic	.42	.11	9	2
clean-dirty	.47	.03	13	0
soft-hard	.53	.20	12	3
old-new	.30	−.27	1	2
convenient-inconvenient	.33	−.16	3	4
pleasant-unpleasant	.63	.27	15	0

* See Table 2.

An inspection of the factor loadings for the first three factors reveals a relatively clean solution in that some variables had high loadings on only one factor. Factor 1, accounting for 18% of the total variance, can be labeled "basic evaluation as residential area". Categories with high loading on this factor include "quiet-noisy", "calm-exciting", "healthy-unhealthy" and "safe-unsafe". Factor 2, accounting for 14% of the total variance, might be described as "diversity and closeness to nature". Categories included in this factor were the "diverse-uniform", "unique-common", "natural-artificial" and "a lot of greenery-lack of greenery" categories. In Factor 3, accounting for 12% of the total variance, the "warm-cool", "frendly-unfrendly" and "open-closed" categories were included. The mean factor scores were not very different from area to area, but varied according to the number of years

TABLE 5. Varimax rotated factor matrix

scale	factor				communality
	1	2	3	4	
quiet-noisy	.73	.15	.13	.01	.58
calm-disturbing	.66	.20	.20	.10	.52
healthy-unhealthy	.66	.24	.25	.01	.56
safe-unsafe	.60	.09	.16	.02	.39
diverse-uniform	.10	.65	.22	.19	.52
unique-common	.13	.54	.11	.21	.37
natural-artificial	.46	.68	.14	.02	.70
a lot of greenery-lack of greenery	.46	.64	.16	−.01	.65
*uruoigaaru-sappukei	.46	.52	.22	.26	.60
beautiful-ugly	.52	.50	.12	.33	.64
warm-cool	.23	.11	.78	.12	.69
friendly-unfriendly	.22	.15	.77	.07	.66
open-closed	.15	.20	.61	.08	.44
light-dark	.34	.27	.40	.48	.59
active-passive	−.04	.28	.32	.48	.41
ordered-chaotic	.48	.28	.05	.42	.48
clean-dirty	.51	.30	.12	.44	.56
soft-hard	.32	.32	.37	.24	.40
old-new	−.01	−.04	.05	−.25	.07
convenient-inconvenient	.02	.01	.13	.28	.10
Variance %	17.70	13.71	11.62	6.61	49.64

* See Table 2.

resided in the neighborhood. Thus the factor appears to describe social intimacy. The forth factor was not directly interpretable in terms of the 20 variables. No categories had high loadings on it and it accounted for only 7% of the total variance.

MASUKAWA *et al.*[5] reported that "naturality" was one of three common factors of assessment of a residential area. And PETERSON[7] showed the importance of "harmony with nature" as the determinant factor of visual quality of a residential area. Factor 2 in this investigation was similar to these factors. However, it should be noted that the "a lot of greenery-lack of greenery" category had not only a high loading on Factor 2, but also had a relatively high loading on Factor 1. Thus the result indicates that greenery has a great influence on assessment of residential area in two

TABLE 6. Main factor loadings (over or equal .40) based on the analysis of over 50 years old group and 15–24 years old group

over 50 years old group		15–24 years old group	
Factor 1 (22.0%)		Factor 1 (12.8%)	
calm-disturbing	.77	warm-cool	.73
quiet-noisy	.71	friendly-unfriendly	.70
healthy-unhealthy	.69	open-closed	.60
safe-unsafe	.63	light-dark	.51
clean-dirty	.62	active-passive	.45
pleasant-unpleasant	.62	Factor 2 (12.7%)	
beautiful-ugly	.61	unique-common	.72
a lot of greenery-lack of greenery	.56	diverse-uniform	.60
natural-artificial	.53	ordered-chaotic	.55
*uruoigaaru-sappukei	.51	*uruoigaaru-sappukei	.51
ordered-chaotic	.50	beautiful-ugly	.49
Factor 2 (12.6%)		clean-dirty	.42
warm-cool	.86	active-passive	.41
friendly-unfriendly	.80	Factor 3 (11.5%)	
open-closed	.58	quiet-noisy	.71
light-dark	.42	healthy-unhealthy	.63
soft-hard	.41	calm-disturbing	.58
Factor 3 (11.4%)		safe-unsafe	.57
unique-common	.79	pleasant-unpleasant	.41
diverse-uniform	.64	Factor 4 (8.1%)	
*uruoigaaru-sappukei	.45	natural-artificial	.73
natural-artificial	.44	a lot of greenery-lack of greenery	.65
beautiful-ugly	.42	*uruoigaaru-sappukei	.47
Factor 4 (4.4%)			
natural-artificial	.46		
a lot of greenery-lack of greenery	.41		

Figure in ( ) is variance of each factor.
* See Table 2.

dimensions.

In order to clarify some systematic difference of response to neighborhood between respondent groups, the factor analysis of correlation matrix for the demographic subgroups (sex and age) was examined. Factor analysis solution obtained from the male and female groups led to interpretations similar to those of all subjects combined. Thus, the four factors of both groups were about the same as for all subjects. However, there were some differences between age groups. For example, Table 6 represents factor loadings (over .40) for the case of the age groups "15-24 years" and "over 50 years". For the 15-24 years old age group, the four dimensions could be interpreted as "social intimacy", "uniqueness", "basic evaluation", and "naturality" and the fifth factor was not clear. Meanwhile, for the over 50 years old age group, the dimensions could be interpreted as "basic evaluation", "social intimacy", "uniqueness" and "naturality" and the fifth factor again was not clear.

The differences between 15-24 years old group and over 50 years old group were found in two ways. The first factor extracted from the over 50 years old group had a greater variance (22.0%) than the first factor extracted from the 15-24 years old group (12.8%). And the first factor extracted from the 15-24 years old group corresponded to the second factor extracted from the over 50 years old group. There was a distinct drop in the variances after the first factor of the over 50 years old group and the "a lot of greenery-lack of greenery" category had a high loading in the first factor. It implied that association between the "a lot of greenery-lack of greenery" category and the other many scales in over 50 years old group were closer than that of 15-24 years old group.

Figure 2 shows the mean factor scores (Factors 1 and 2) of the survey areas. Areas K and N with large positive scores on Factor 1 were described as good residential areas. On the contrary, areas with large negative scores on Factor 1 were E and J. Factor 2 separates areas K, N and O from the other survey areas. Thus, according to Factors 1 and 2, the fifteen survey areas were grouped into 3 groups. The first group had high scores on Factors 1 and 2. These areas have much green space and natural areas in them or nearby. These areas are also located relatively near to the central business districts so use of many public facilities, traffic and shopping is convenient. The areas in the third group had low scores on Factors 1 and 2. These areas are located in the inner city and have very little green space, traffic noise and air pollution are problematic. The second groups had medium points on Factor 1 and low points on Factor 2.

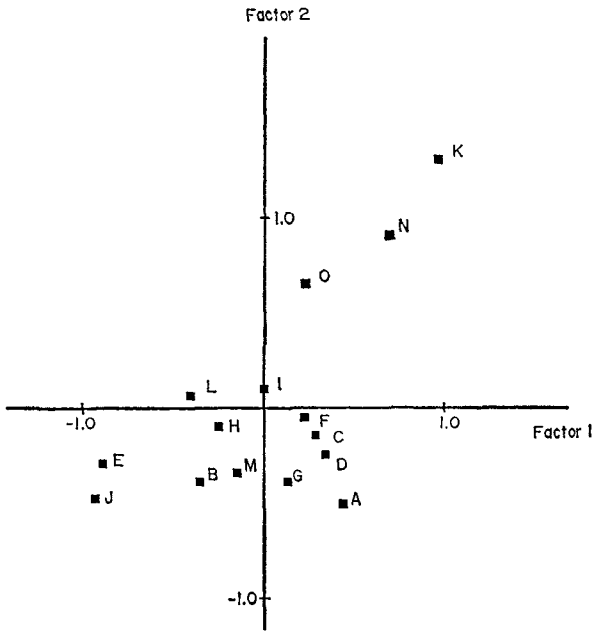

Fig. 2. Distribution of the survey areas accordding to mean factor scores of Factors 1 and 2.

The results indicate that in most cases, urbanization decreases greenery, but there are some residential areas with greenery which are not far from central business districts such as areas K and N. If the author examine in detail both areas, however, the reasons for the abundance of greenery are not the same. Area N has been developed as a housing estate with consideration to green space during planning. Area K is located on a hillside. A lot of greenery is due to undeveloped area such as steep slopes, a protected forest and there is a relatively large private estate. Thus the author suggests that not only creating residential parks, but also preservation of natural area and the size of housing lots are important for greenery.

5. Determinant Factors of Livability

The factor scores of respondents were used to derive regression equations with the normalized mean. Ratings of the "livability" were used as the dependent variables.

If the four previously mentioned factors are used as independent variables the model becomes;

$$Y = 0.59X_1 \times 0.25X_2 + 0.30X_3 + 0.11X_4 + 3.54 \qquad (R^2 = 0.53)$$

where Y corresponds to the "livability", X_1 is factor score of Factor 1, X_2 is the factor score of Factor 2, and so on. This relationship explains 53% of the variance of the "livability".

Excluding Factor 4 does not change r significantly. A model using only three factors is estimated as follows;

$$Y = 0.60X_1 + 0.28X_2 + 0.30X_3 + 3.54 \qquad (R^2 = 0.53)$$

The multiple equation showed that Factor 1 is the most important variable in determining the "livability" of residential areas. Importance of Factors 2 and 3 was almost the same.

The following equation shows the relationships between the "livability" and the first factor, the second factor and the "convenient-inconvenient" category.

$$Y = 0.39X_1 + 0.29X_2 + 0.22X_5 + 2.92 \qquad (R^2 = 0.65)$$

Where X_5 is the "conveient-inconvenient" category. The equation indicates the importance of X_1, X_2 and X_5. From the view point of physical planning of residential areas, these three are especially important. Then, the effect of greenery on the "livability" is through both Factors 2 and 1, that is to say directly and indirectly.

Summary

In metropolitan areas, there is a considerable emphasis on the advantages of green space for well-being or livability of residential areas. The main object of this report was to clarify the relations between greenery which people feel and the affective meaning of the people on their neighborhood by using semantic differential method. For this purpose, a questionaire survey was carried out in fifteen typical residential areas in Sapporo.

The major result suggested that within the range of the ratings which people use in their subjective assessments of their neighborhood, there may be three major dimensions. The first factor was labeled as basic evaluation of residential areas. The second factor appeared to be the diversity and closeness to nature or greenery and the third factor appeared to be social intimacy.

Although factor analysis solution obtained from the male group and female group led to similar interpretations to those of all subjects, there were some differences in the factor analysis solution obtained from different age groups. Older age groups had a high percent of variance in Factor 1

(basic evaluation as residential area). A lot of higher correlations between the "a lot of greenery-lack of greenery" and the other scales were found in the older age groups.

It was noteworthy that the "a lot of greenery-lack of greenery" category had a high correlation with Factors 1 and 2. This means that greenery had a broad effect, direct and indirect, to the assessment of residential areas. Thus it is necessary to clarify how to increase the quantity and quality of greenery.

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