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THE ASSOCIATION OF SPATIAL NETWORK WITH SOCIAL NETWORK IN THE HIGH-RISE SOCIAL HOUSING

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ABSTRACT

Interaction between built environment and social network has been a long research subject. Many researches have focused on interpreting social network in field of sociology. Even though they acknowledge the possible impact of spatial network on built environments, researchers lack a tool to incorporate spatial network in their research agenda.

Similarly in the space syntax community, many studies attempt to examine the interaction of using spatial network analysis. Spatial behaviour (i.e., space use pattern and cognition) is their primary concern to measure the degree of people's social interaction. They thus explain the degree of social relation by measuring indirectly. Recently few studies explain the relation of spatial configuration with social interaction by measuring it with more direct manner. Based on these researches, we can apply social network analysis to examine the association given that the interaction of spatial configuration with social interchange.

In this context, this study aims to explain characteristics of association between spatial configuration and social network. A social housing in Seoul is selected for the case study. Using space syntax and social network analysis the association is examined statistically. Questionnaire and interview survey reveals the pattern of social network among residents. Social network analysis present the pattern numerically based on questionnaire. Netminer analysis describes social network of residents. Then, finally, we investigate the relationship between the properties of spatial configuration and the intensity level of social network. The result shows that spatial network properties can explain characteristics of social network. Once we understand the relationship of spatial configuration and social network we can have a profound understanding of the interaction between space and society.

KEYWORDS

Space syntax, spatial network, social network, social housing, space syntax and social network

1. INTRODUCTION

Permanent rental apartments as a type of social housing in Korea are constructed by the public sector in the form of large high-rise complexes. Low-income people live there collectively, comprising several hundred to several thousand deprived households. Social exclusion is a serious issue in these social housing complexes, not only from the outside of the complexes but also among neighbours within the complexes. Numerous researches have argued that social housing increases the level of isolation and conflicts among residents (Kim et al, 2008; Ha, 2007; Kim, 2004), particularly because they are mainly old, handicapped and unemployed people, deprived of social activities and interaction with their neighbours (Kim, 2002). These researches focus on the phenomenal aspects of the issue, that is, the exclusive nature of residents who do not want contacts with neighbours or of outsiders who believe they are superior to those social housing residents. However, few have dealt with the spatial aspects of the issue, which deem more important from an urban design point of view.

The social network of residents is embedded in physical environments, since the configuration of residential space cannot but affect the way in which people behave and interact socially (Francescato et al., 1989). Space syntax researches (Hillier and Hanson, 1984; Hillier, 1996) provide a set of ideas and methodologies to investigate such relationships. Through analysing the configuration of architectural and urban spaces, space syntax tries to establish the relationship between spatial structure and spatial behaviours. Hillier et al. (1993) have shown how the spatial configuration of urban streets could form natural movements within them, and Kim and Penn (2004) have explained how the configuration of streets in residential area, the density of spatial uses and the cognitive map of residents could be correlated to each other. Kim and Cho (2015) have explained the degree to which residents in a village of dosshouses interact to each other in the context of its spatial configuration. These studies imply an important hint at how spatial configuration can affect the formation of neighbours in residential areas. Also, although not about social housings, there are many studies which try to explain the relation of spatial configuration and social interaction by measuring it in a more direct manner. Sailer and Penn(2007) have reported that interaction pattern was examined by measuring social interaction between students and teachers in school. In a similar way, Wineman et al (2009) show the relation between the number of published research papers and space syntax properties of workplaces. Sailer and McCulloh (2012) also attempt to translate the relationship between spatial configuration and social relation in knowledge-intensive workplaces.

Based on those two kinds of previous researches, one about the social exclusion in social housing and the other about the effects of spatial configuration on the formation of social relationships, we try to investigate the relationship between the spatial configuration of social housing and the de/formation of social community within it. We assume that social network in residential area is a crucial factor for the formation of community. It is particularly the case for social housing where its residents are mainly old, handicapped and unemployed, because the absence of social network among them make it more difficult to form community in social housing.

More specifically, it is our aim to reveal how the spatial configuration of social housing may foster or impede the formation of social networks. There are not many previous researches found in this line of investigation. Some study about the social phenomena of isolation and exclusion but do not take into account the relationship between spatial configuration and social network. Others that have considered the latter relationship do not seem to have much interests in the formation of community required especially for social housing.

Also in space syntax, it is generally argued that the more integrated a space is, the more actively spatial uses and social encounters occur in it. However, those researches on the issue of social exclusion in social housing seem to argue the opposite, since they observe the more severe level of social exclusion and isolation among neighbours who are spatially more accessible to each other. In this respect, we are interested in verifying the presence of correlation between the space configurational properties of integration or accessibility and the level of social communication in the context of social housing. If the properties of spatial configuration are

found closely related to those of social network, we will further investigate how they are so. That is to say, we wish to confirm either if residents living in more accessible spaces are more interacted socially or it is the other way around.

This paper deals with the results of a case study. First, we analyse quantitatively the properties of social network based on empirical surveys. Second, through spatial analysis, we examine the accessibility of facility spaces which residents in social housing frequently use. Finally, we investigate the relationship between the properties of spatial configuration and the intensity level of social network. We have employed Depthmap for spatial analysis, Netminer for social network analysis, and SPSS for statistical analysis on their relationships.

2. SPATIAL CONFIGURATION AND SOCIAL NETWORK IN SOCIAL HOUSING COMPLEX

2.1 THE PROPERTIES OF SOCIAL NETWORK

Social housing in Korea has been provided by the government, from the early 1980s in a way to resolve housing problems for urban poor. But since then, the issue of social exclusion has emerged as social housing has the form of segregating socially deprived classes spatially at a collective scale (Kim et al., 2008). Residents in social housing are discriminated by middle-class people who live outside social housing complexes (Kim, 2004). Internally, residents are psychologically repressed so that they tend to avoid neighbours for themselves. Also, it has been reported that the high rate of senior citizens, the handicapped and the unemployed among neighbours in social housing causes naturally a lack of social activity and restrictions in communication among neighbours (Kim, 2002). These external and internal factors of social exclusion conjoin together to deteriorate the problems of segregation and the collapse of social network.

Although there are also some reports on the issue of slumism that causes distrust and avoidance among neighbours (Rankin and Quane, 2000), it does not yet apply to social housing in Korea. Instead, social housing in Korea has its own share of social problems, including high rate of suicides, conflict among neighbours, alcohol-related disturbances and noise issues, which hinder the formation of community consciousness (Kim, 2004). We regard these social problems in Korea cannot be explained by the progression of slumism, which is not yet present, but by a lack of social network within social housing complexes. It seems therefore necessary to investigate thoroughly the essential properties of social network, and particularly, its structure.

2.2 THE RELATION OF SPATIAL CONFIGURATION AND SOCIAL NETWORK

The idea of social network is often employed to explain the social behaviours of people who are included in a network following a particular protocol (Mitchell, 1969). Also, the idea of social network is useful as it is capable of expressing spatial relationships in cities (Butts, 1982). But few have examined the relationship between spatial and social networks. Sailer and Penn (2007) studied the interaction between spatial phenomena and communication among students at schools. It is among the first attempts to explain the correlation between spatial and social networks, and presents a guideline to approach the question at hand. Wineman et al. (2009) showed a positive correlation between the relative position of researchers in a spatial configuration and the number of publications through co-works. That is, it is found that the more accessible researchers are to each other in the spatial configuration of research institute, the more potential interactions they have and thus the larger number of publications they produce. In a similar manner, Sailer and McCulloh (2012) investigated spatial properties that help to generate social interaction in office spaces.

These relationships between spatial configuration and social interaction are also important in studying those in residential areas. The degree of social interaction among neighbours will have great impacts on the formation of community. We can expect that active social interaction would strengthen community consciousness and social solidarity and it would in turn contribute

to the reduction of social problems in social housing. Therefore, apart from schools and research institutes, to study about the relationships between spatial configurations and social interactions may well gain importance on its own.

3. RESEARCH DESIGN AND METHODOLOGY

3.1 RESEARCH MODEL

Based on the assumption that spatial properties can affect the degree of social interaction, this research attempts to define the key properties of spatial configuration and social network and test the following hypotheses:

Ho: There is no difference in the average properties of social network among different spatial accessibility groups

H1: There are differences in the average properties of social network among different spatial accessibility groups

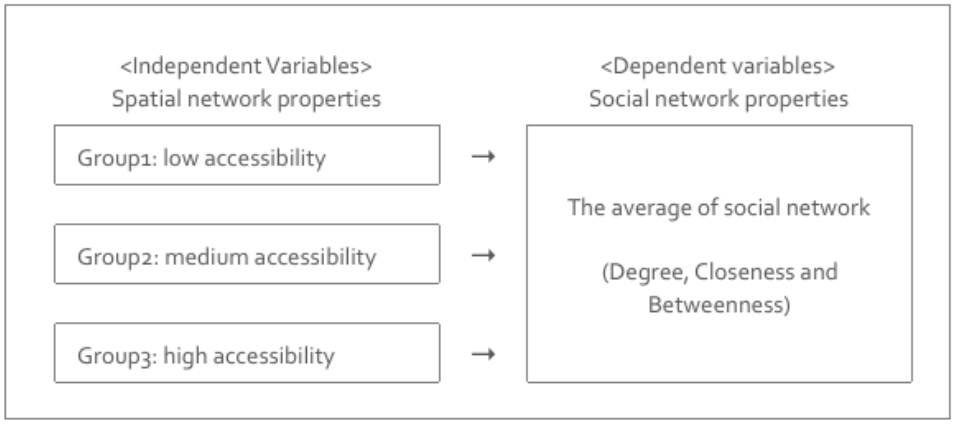

Figure 1 - Model of Analysis

3.2 MEASUREMENTS

Our research model defines the space configurational properties of individual housing units as the independent variable. Individual households are represented by their entrance spaces and their accessibility is measured by integration indices in space syntax (Hillier and Hanson, 1984). Three groups of low, medium and high accessibility are classified to reflect the hierarchical space structure of a social housing complex. A social network is formed based on acquaintance relationships, so that it is assumed to be simple, unweighted and undirectional. Network properties of degree, closeness and betweeness are then measured for this social network.

3.3 CASE STUDY SITE

The study site was a high-rise social housing complex 'A' in Seoul, constructed and operated by the public sector. The complex 'A' was completed in 1991, with 7 buildings of 15 stories and 1,807 units in total. All buildings are of corridor access type, 6 of which are L-shaped and the other is line-shaped. Average unit size is very small, ranging from 25.2m2 to 39.6m2. Common facilities include stores, community welfare centre, senior citizens centre, maintenance office and walkways. As of 2015, 77% of the residents were 60 years or older; 21.4% were handicapped; 52.4% have been living in the complex 20 years or longer. The complex has its share of social problems, including high rate of suicides, conflict among neighbours, alcohol-related disturbances, and noise issues (Nakhyunjae, 2014).

3.4 METHODOLOGY

Firstly, the research carries out social network analysis based on empirical surveys. Respondents are asked to reveal which neighbours they meet frequently and where the meetings take place within the complex. Using Netminer, a social network is formed and its properties are further analysed. The spatial properties of meeting places are also examined. Second, the spatial configuration of the housing complex is analysed and the relative accessibility of households and meeting places. Each household is represented by its entrance space and its integration index is calculated using Depthmap. Integration values of meeting-places are averaged over the social sub-networks of respondents who have chosen them. Third, the correlation between the spatial and social network properties is analysed in a way to define the most salient variables. The defined spatial properties are taken to be independent variables and classified according to their intrinsic distribution. One-way ANOVA test is then employed to find out if there are significant differences in the average social network properties among the classified spatial groups. ANOVA test is particularly useful in distinguishing group differences. Finally, if there are significant social differences among the spatial groups, we try a post-hoc description of group differences in a qualitative manner.

4. RESULTS

4.1 SOCIAL NETWORK ANALYSIS

For analysis of the social network, 1,807 surveys were distributed (i.e., all units in the complex) and later collected through the maintenance office of the complex. 450 surveys were collected (response rate: approximately 24.90%), with 336 valid samples. 611 network nodes were generated from the analysis of the valid samples. The number of nodes is greater than that of valid samples because residents from non-valid samples are included in the social network.

Figure 2 is the spring map for social network analysis in the complex. It shows that 250 out of 611 nodes are isolated, while 360 nodes (59%) are connected. These connected nodes are concentrated around some particular nodes, which are Tong Jang (i.e. voluntary community head) and the complex administrative managers. Other connected networks without Tong Jang are of much smaller size and usually consists of less than 10 nodes. If we remove the complex administrative managers from the network, it is sub-divided into a group of small disconnected networks. This means that the social network in the complex depends a good deal on the presence of those managers.

Table 1 and Figure 3 shows the result of individual measures – degree, closeness, betweenness – for the social network. The distribution of degree is highly skewed in such a way that low degree values are extremely common. On the other hand, for the connected parts of the network, the distribution of closeness is skewed in the opposite way. Finally, only 12% of the total nodes (76 out of 611) have non-zero betweenness values, indicating that most residents behave as end-nodes and do not mediate any social relationships at all within the complex.

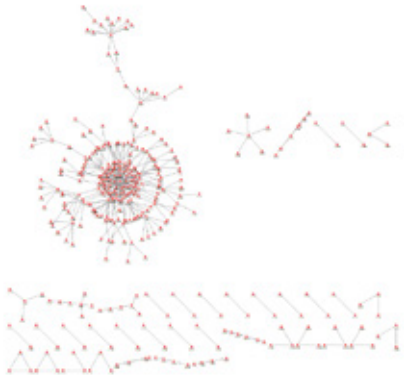

Figure 2 - Illustration of social networks

		Degree	Closeness	Betweenness
N	Valid	611	611	611
	(of links)	(250)	(250)	(535)
	Mean	0.98	0.04	0.00
	Minimum	0.00	0.00	0.00
	Maximum	12.00	0.13	.03

Table 1 - social network analysis

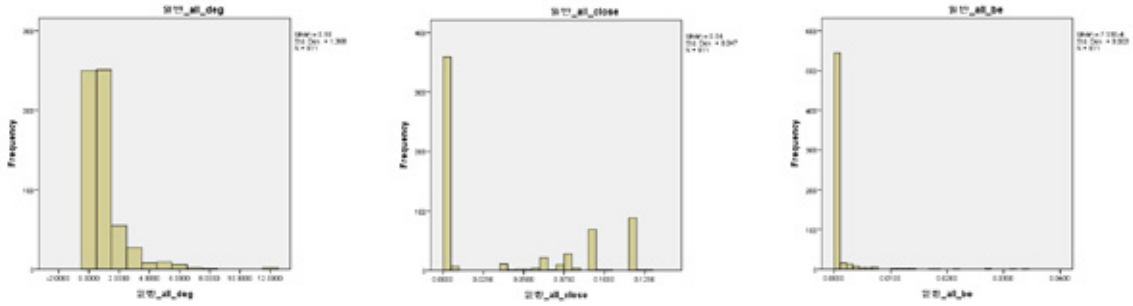

Figure 3 - Histograms for social network analysis (degree, closeness, and betweenness)

The graph in the figure 4 shows the results of multiple responses regarding the meeting places of the residents in the complex. It turns out that they meet mostly in their own or neighbours' houses. The next frequent places are corridors or elevators. Community welfare centre, playgrounds and walkways follow in turn, while residents rarely choose maintenance office and parking garages as their meeting places. Analysis of Spatial Configuration

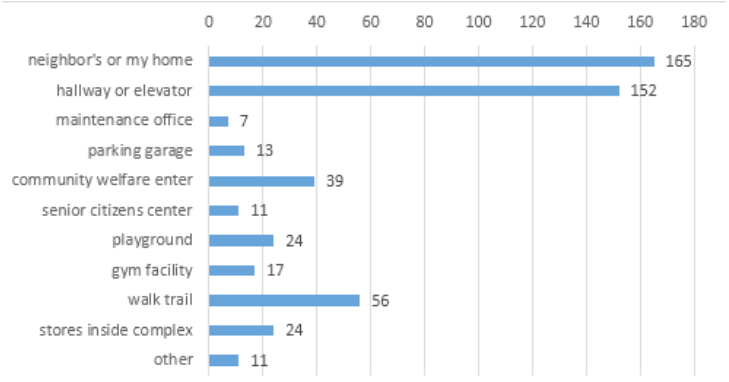

Figure 4 - Types of meeting places

To study the spatial configuration, an axial map analysis of the complex was conducted. The result is presented in Figure 5, displaying its spatial accessibility. As it shows, the complex is separated by a stream in the south-west side and connected to main artery roads in the north-east side. This locational conditions result in the high accessibility in the northern and eastern sides and this affects the internal structure of the complex. In the Internal complex, the highest local integration value is 2.15, found on the road along the east and northeast side of the complex connected to the main entrance. It is followed by the east-west axis through centre of the complex at 1.71; the value for the north-south axis is 1.67. On the other hand, low values are found at walk trail, gym facility and community center, which are supposed to be functioning as interaction spaces.

Figure 6 shows the results for the space configurational properties of meeting places. The highest local integration value of 2.75 is found at maintenance office, followed by corridors or elevators at 2.65, within-complex stores at 2.48 and parking garages at 2.30. Walkways (1.49) and gym facilities (1.50) are those places with the lowest integration values. The results show that community facilities such as gym, senior citizen centres and welfare centres are rather segregated spatially against their intended function to increase the communication of neighbours.

Figure 5 - Axial map analysis

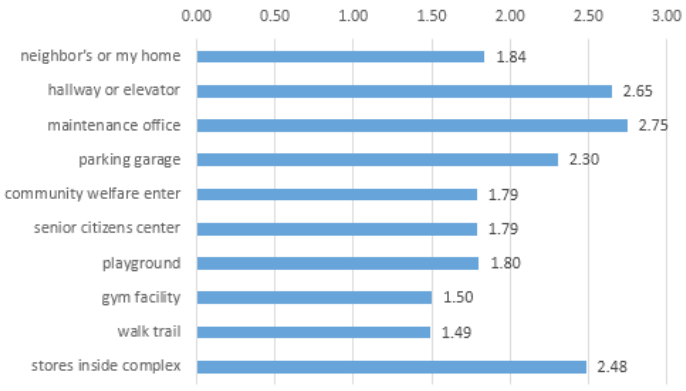

Figure 6 - Average local integration of meeting place

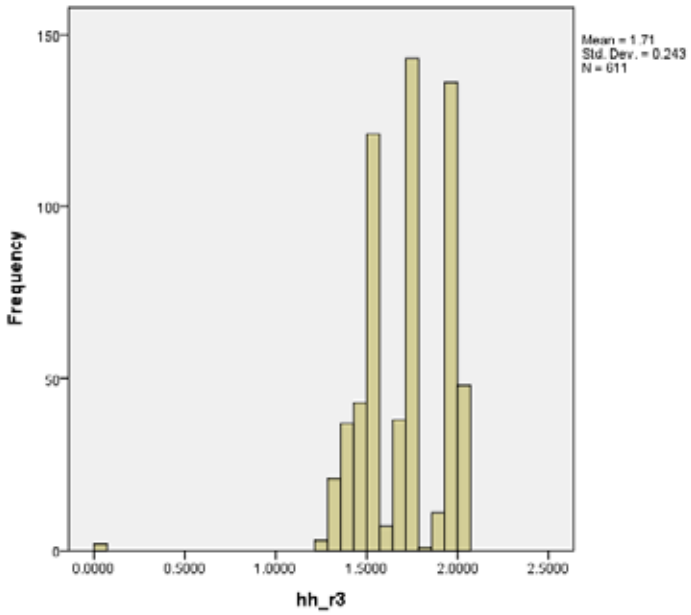

Figure 7 - Histogram of local integration

We also have a look at the frequency distribution of local integration for the households participated in the valid samples, from Figure 6. It is possible to divide the samples into the three groups by their local integration values. This natural division reflects the hierarchical space structure of the complex in which individual buildings are connected to the outside of the complex.

That is to say, the complex is structured in a sequence of main roads connecting it directly to its outside, distributive roads diverging from the main roads, and local roads serving individual buildings.

Table 2 shows how meeting places for neighbours are differentiated according to the different groups of spatial accessibility. 27.5% of residents from the low spatial accessibility group meet their neighbours at their own or neighbours' home, while the figure is much higher at 34% for residents from the high spatial accessibility group. A similar pattern can be found for meeting places such as hallways, elevators and maintenance office. This shows that residents from the high spatial accessibility group tend to meet their neighbours at highly accessible spaces where casual encounters are favoured. On the contrary, we find the opposite tendency for community welfare centre and walkway which 12.5% and 15% of residents from the low spatial accessibility group respectively have chosen as meeting places, while on ly 6.4% and 9.6% of residents from the high spatial accessibility group use them to meet their neighbours. Since community welfare centre and walkway are located at low accessible spaces, it may be taken to imply that residents from the low spatial accessibility group prefer places where long-lasting and intended meetings are facilitated

			Total	Their own or neigh-bours' home	Corridors or eleva-tors	mainte-nance offices	parking garages	com-munity welfare centres	senior citizens centres	Play-grounds	gym facili-ties	walk trails	stores inside complex	other
local integration	Low	(N)	80	22	22	3	3	10	1	1	2	12	1	3
		(%)	100.00	27.50	27.50	3.75	3.75	12.50	1.25	1.25	2.50	15.00	1.25	3.75
	Medium	(N)	221	69	69	1	5	15	3	9	10	23	14	3
		(%)	100.00	31.22	31.22	0.45	2.26	6.79	1.36	4.07	4.52	10.41	6.33	1.36
	High	(N)	218	74	61	3	5	14	7	14	5	21	9	5
		(%)	100.00	33.94	27.98	1.38	2.29	6.42	3.21	6.42	2.29	9.63	4.13	2.29
Total		(N)	519	165	152	7	13	39	11	24	17	56	24	11
		(%)	100.00	31.79	29.29	1.35	2.50	7.51	2.12	4.62	3.28	10.79	4.62	2.12

Table 2 - Frequency of meeting place uses classified by the accessibility of households

4.2 CORRELATION ANALYSIS BETWEEN SPATIAL CONFIGURATION AND SOCIAL NETWORK

We have found that the most correlated variables are local integration values from spatial configuration and degree from social network. As mentioned earlier, it is the case that the local integration values of household are affected by the location of buildings to which they belong in the complex. From this natural distinction, we have classified the households into three categories by applying Jenks Natural Breaks algorithm. The results show that local integration values for the lower accessibility group ranges from 0 to 1.5, for the medium accessibility group it changes up to 1.8 and for the higher accessibility group it is greater than 1.8. Next, we turn to analyse social network properties for these different accessibility groups.

		Degree	Closeness	Betweenness	Local integration	other
Degree	Pearson Correlation	1.00	0.50	0.60	-0.10	
	Sig.		0.00	0.00	0.01	
Closeness	Pearson Correlation	0.50	1.00	0.29	-0.05	
	Sig.	0.00		0.00	0.26	
Betweenness	Pearson Correlation	0.60	0.29	1.00	-0.01	
	Sig.	0.00	0.00		0.77	
Local integration	Pearson Correlation	-0.10	-0.05	-0.01	1.00	
	Sig.	0.01	0.26	0.77		

*significance level p<0.05

Table 3 - Correlation of spatial configuration and social network

Table 5 shows the results for the significance of ANOVA and permutation tests. Table 6 and Figure 8 show the average values of social network properties for each accessibility group. Firstly, ANOVA test shows that F-value is 7.79 with the degree of freedom of 2 and 608 for between-groups and within- groups respectively, so that there is insufficient evidence to accept the null hypothesis at the significance level of 0.05. Therefore, we confirm that there are differences in the average properties of social network among different spatial accessibility groups. The same result is confirmed also by permutation test, in which we have the probability of F-value greater than the test statistic is zero.

For the post-test descriptions of average degree of social network, we report that residents from the low accessibility group has 1.02 and those from the medium group has 1.17 and those from the high group has 0.68. The test result can be thus interpreted as evidencing that those residents who live at high accessible spaces has relatively weak social interaction.

Now we can safely interpret group differences. Residents who live in low accessible spaces have higher values of degree for their social network. On the other hand, those who live in more accessible spaces have lower values of degree and thus participate weakly in social networking. These results confirm that spatial properties affect the social networking of residents, but the reason why they are so contrary to previous studies shall have to be interpreted in the particular context of permanent social housing.

DATA COUNT

	Count	Percentage(%)
Valid	611	100%
Missing	0	0%

RESULT OF ANOVA VECTOR

Source of variation	Sum of Squares	d.f.	Mean Square
Between groups	28.542	2	14.271
Within groups	1,113.295	608	1.831
Totals	1,141.836	610	

PERMUTATION TEST

Observed	Expected(mean)	Std. Dev.	P (>= Obs.)	P (== Obs.)	P (<= Obs.)
7.794	1.005	0.997	0	0	1

Table 4 - Results of ANOVA

	N	Mean	Std. Deviation
Low	106	1.0189	1.4735
Medium	309	1.1650	1.4865
High	106	0.6786	1.0247
Total	611	0.9836	1.3682

*100,000 permutations (significant the level of P<0.05)

Table 5 - Mean and standard deviation of the different accessibility groups

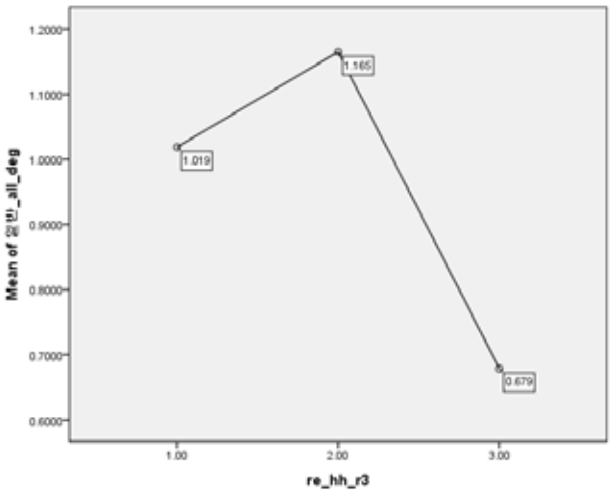

Figure 8 - Means plots of ANOVA

5. CONCLUSION

This paper analysed the effects of spatial configuration on the social network of residents in social housing in Korea. The first results showed that there is a weak positive correlation between the local integration of spatial configuration and the degree of nodes in social network, but no significant correlations are found for such other social network properties as closeness and betweenness. We have then classified the position of households in the social housing complex into the three different groups of local integration and examined how these different accessibility groups have different nature in the degree formation of social network. It showed that residents who live in more integrated spaces have weak social connections with their neighbours, and vice versa.

The results seem counter-intuitive, since most previous researches have reported the higher frequency of social interaction in more integrated spaces (for instance, Hillier et al., 1993; Wienman et al., 2009). To fully understand this, we need to focus on the special circumstance in which social housing is placed in relation to other residential areas. The social housing complex we have studied in this paper is highly exclusive both internally and externally, in which residents do not want to meet not only their neighbours but also outsiders. It is a "socially marked" space (Ha and Seo, 2006; Hong, 2005), where its residents suppressed desires to interact with others. When no such desire is present, the common spatial mechanism is reversed. The results only reflect residents' willingness to deny social interaction in any kind.

Even in this exclusive environment, however, the behaviour of its residents can be explained spatially. We have shown that residents who live in relatively more integrated spaces tend to meet others, if they should, at hallways or lobbies that are easily accessible but allow only temporary or transient encounters. They do not want any further interaction to unfold but rather look for permanent isolation. On the other hands, residents who live in relative less integrated spaces and have even less opportunities to meet neighbours choose such meeting places as community facilities where long-lasting relationships can be secured. Their segregated positions within the complex seem to turn their nature positively and these common facilities help them to form relatively strong social network.

Finally, this paper suggests that a new social model is required for exclusive residential areas where deprived people live collectively. According to such a model, we may need to increase the defensibility of individual households while allowing community facilities to be located at relative more accessible spaces. In this way could we be able to enhance both privacy and community consciousness in social housing complexes. In particular, for social housing where its residents are mainly old and handicapped, the placement of community facilities at more accessible spaces would make it easy to induce strong social network effects.

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