ISSN: 2008-5079 / EISSN: 2538-2365
DOI: 10.22034/AAUD.2019.92452

Evaluation of Sociability of Urban Environment Using "Cognitive Maps" and "Spatial Configuration Maps"

Saeid Alitajer[a]– Pooria Saadati Vaghar[b*]– Ahmad Heidari[c]– Amir Mohammad Farrokhi[d]– Hassan Sajjadzadeh[e]

[a] Assistant Professor of Architecture, Faculty of Arts & Architecture, Bu-Ali Sina University, Hamadan, Iran.
[b] M.A. of Architecture, Faculty of Arts & Architecture, Bu-Ali Sina University Hamadan, Iran (Corresponding Author).
[c] M.A. of Architecture, Faculty of Architecture and Urban Planning, Shahid Beheshti University, Tehran, Iran.
[d] M.A. of Architecture, Faculty of Architecture and Urban Planning, Shahid Beheshti University, Tehran, Iran.
[e] Associate Professor of Urban Design, Faculty of Arts and Architecture, Bu-Ali Sina University, Hamadan, Iran.

Received 03 February 2016; Revised 06 June 2016; Accepted 31 July 2016; Available Online 22 September 2019

ABSTRACT

The presence and social interaction of people in the public spaces of architecture and urbanism lead to the spaces' sociability. In the present research, the subject of discussion was the sociability of public spaces. The quality of sociability is the inseparable feature of the urban public spaces but, it has been faded or lost in some urban public spaces. The present study sought to answer this question: how and with what parts, the measurement of the environment sociability is performed with focus on the two human and environmental approaches? To do this, Oudlajan neighborhood of Tehran was selected and investigated as the case study. Possible platforms of social interactions' formation were investigated in this area (from two environment-based and human-based aspects). In this research, proper literature, theoretical foundations, the studied indexes, and research method were collected and classified using first hand resources. The present methodology included two cognitive and spatial sections. In the cognitive section, using available documents and maps, the area map was prepared. After field visits and interviewing with the local and nonlocal residents, cognitive findings were collected and cognitive maps were produced. The spatial configuration of the neighborhood was evaluated through quantitative parameters of the space syntax method. Finally, comparing qualitative and quantitative data, sociability of the Oudlajan neighborhood was analyzed. Findings of the research showed that it has been useful to consider the space syntax computer modelling as a principal in the evaluation of social concepts, althought it was not enough. In order for somatic activities to improve social status of the urban tissues, it is required to use complementary methods such as cognitive maps.

Keywords: Sociability, Spatial Cognition, Cognitive Map, Spatial configuration.

* E-mail: architect.pooria@gmail.com

1. INTRODUCTION

In the sociable environments, somatic space based on its spatial features results in the formation of activity hubs and eagerness to activity in certain parts of the space (Daneshgarmoghaddam, Bahrainy, & Einifar, 2011). Sociable spaces are the place of forming social interactions and actions among individuals (Shojaee & Partovi, 2011) and have a close relation with the individuals' social life (Mohammadi & Ayatollahi, 2015), so that the planning of proper somatic-spatial bed for the presence and having social interactions is one of the purposes of the formation of the architectural and urban social spaces. Presence and promotion of the citizens' social interactions in the urban environments and supplying their social needs, increase their cooperation spirits and attachment and result in the mobility and vitality of the environment (Ghalambor Dezfuly & Naghizadeh, 2014; Karimi & Mohammadhoseini, 2018; Daneshpour & Charkhchian, 2007). But, this issue has been less investigated in public spaces of the neighborhood. Public spaces can promote social life through reinforcing social interactions of the citizens (Montgomery, 2013) and contributing to the social stability (Harun, Zakariya, Mansor, & Zakariya, 2014). By considering this issue, the present research was conducted with the purpose of assessing the environment sociability by comparing cognitive maps and spatial configuration maps. To reach the mentioned purpose, Oudlajan neighborhood from Tehran`s old tissue was investigated. In the performed researches of this area, the effect of spatial configuration of the artificial environment on the human behavior has been observed but, spatial cognition which is the result of the analogous relationship of the human and environment, has been less interesting. Spatial configuration refers to the relations between the environmental details (Hillier, Penn, Hanson, Grajewski, & Xu, 1993) but, spatial cognition is the result of corresponding the relation of the human and environment (Hart & Moore, 1971). Hence, the question is that does spatial cognition of the people from the environment and spatial configuration of the environment have commonalities in the identification of cumulative life bed in urban spaces? If it is so, in the studied bed that is Oudlajan old neighborhood of Tehran, which spaces are the most sociable spaces according the analysis of cognitive maps and spatial configuration maps? And if cognitive maps and spatial configuration do not have commonalities in the identification of sociable places, which of these two maps can be considered as the action criterion of authorities and planners of the urban designs to promote the individuals' social interactions?

2. LITERATURE REVIEW

With the attempts of Professor Bill Hillier, the theory of spatial configuration has been designed and developed to identify the organization of urban spaces and to predict the behavior and social activities of the citizens (Mollazadeh, Barani-Pesyan, & Khosrowzadeh, 2011). In recent decades and due to the following reasons, this approach has attracted many attentions: the expansion of this approach in a vast spectrum of urban and architectural environments, developing software skills of this approach and providing the possibility of numerical comparison of various spatial configurations and global organizing of discussions of this approach (Jafary Bahman & Khanian, 2013; Penn, Hillier, Banister, & Xu, 1998). But criticisms like the lack of social foundations and inability to study the complexities of life has been imported to this theory (Jafari Bahman & Khanian, 2013) and it seems that the spatial configuration method is not responsive of social events, alone and needs combinatorial methods to make the results of researches more reliable that can assess human social events through computer modellings of space syntax. Cognitive maps are one of these methods. Cognitive map theory was first used for mental representations of the physical environment (Tolman, 1948). It is assumed that these maps are formed gradually and by receiving information from the environmental elements (Tversky, 1993). Cognitive maps are formed by the collection of the identification of the environmental structure and features of mental meanings of the environment (Sidanin, 2007). Cognitive maps are of key subjects in the environmental studies and are considered to be of important areas in the urban designing, architecture, and architectural aspect and there are various methods to assess it (Asadpour, Faizi, Mozaffar, & Behzadfar, 2015). In this section, some of the performed researches with cognitive maps approach have been reviewed. Pourjafar et al., 2011 in a research evaluated the position of urban signs in the cognitive maps of Yazd citizens and stated that distinct signs from the around tissue according to the citizens' views has had more importance near main arteries that have historical value with religious, cultural, commercial, and urban element usages (Pourjafar, Bemanian, Taghvaee, & Montazerolhojjah, 2011). Imani et al., 2013 investigated historical tissue of the Sangsiah neighborhood in Shiraz to study the individuals' navigation process and concluded that people's cognitive knowledge in the form of cognitive maps facilitates the navigation process (Imani, Taki, & Tabaeian, 2013). Moreover, Asadpour et al. 2015, in their study evaluated and analyzed the data of cognitive maps and mental images and showed that different types of available concepts in the field of perceptual-mental maps can be divided into two types of "topologic representation" and "verbal representation". Further, methodology has classified the imitation of images and cognitive maps into two types of design-descriptive models (generative) and evaluation-recognition models (non-generative) (Asadpour et al., 2015). In another research, Seqhat

al-Islami and Behnamifard, 2012 with the purpose of knowing people's mentality of the concept of neighborhood and comparing it with the definition of neighborhood in the urban management showed that the conventional neighborhood defined by the municipality are distinct from people's mentality of neighborhood (which is the result of interaction of social and local concepts). Despite the studies mentioned, in Iran few researches have been performed about overlapping data of features of cognitive and spatial configuration of the environment. This issue has been investigated in some internal and external articles. In one of the researches that investigated the relations of these two methods, Didehban et al, 2014, studied some neighborhoods of Dezful to investigate the relations between spatial cognition and spatial structure using cognitive mapping (qualitative) and spatial configuration. Long et al., 2007 also, investigated the effects of spatial configuration in spatial cognition and legibility of the urban environment. To do so, they used the space syntax (to measure spatial configuration of the neighborhoods), mental cognitive map and also interview (to measure the environment legibility and spatial cognition of people) methods (Long, Baran, & Moore, 2007). In the Zhai and Baran`s 2007 study, the relation of spatial configuration of parks and the behavior of the citizens' walking was investigated. Researchers classified the walking behavior of the citizens by drawing maps and evaluated spatial configuration of parks relying on the space syntax. Other researches like Lee et al., 2005; Kim, 2001; Ali Tajer et al., 2018; Shokouhi, 2009 investigated the relations of spatial configuration, spatial behavior and spatial cognition. According to this experimental literature, in this research, "sociability" was investigated through comparing "cognitive maps" and "spatial configuration maps".

3. RESEARCH METHODOLOGY

The present methodology included two parts. In the first part, the research's statistical population were evaluated using cognitive map method. The statistical population of the research included two types of people: 1. Oudlajan neighborhood residents 2. Oudlajan neighborhood visitors. Among them, 40 individuals were selected voluntarily using sampling method so that half of the population were residents and the other half were visitors (non-local). First, the available situation of the neighborhood was investigated. In the following and in the interaction with the respondents, a copy of the neighborhood map was put before them, descriptions were provided about their participation in the research process and they were asked to classify the situation of paths, nodes, and neighborhood signs according to the occurrence of social interactions. In the second part of the research, relying on the space syntax simulations and based on the axial analysis system, the spatial configuration of the neighborhood was analyzed. Quantitative parameters of the space syntax in this research were: connectivity, integration, depth , and intelligibility . To analyze the mentioned parameters, axial map of Oudlajan neighborhood in the environment of the Auto Cad program was prepared and stored by Dxf suffix. Then, axial map of the neighborhood was analyzed in the environment of Arc gis software (to overlap connectivity and integration maps with equal amount of weight) and UCL Depth Map. In the output map of the software, the value of the calculated parameters was specified using color spectrums. Finally, by comparing cognitive maps (in which familiarity with the environment was taken into account) and the spatial configuration maps, sociability of the Oudlajan neighborhood was analyzed.

4. DOMAIN OF THE RESEARCH

Oudlajan neighborhood: This neighborhood is located in the 21th district of Tehran municipality and has a land of 150 hectares. The scope of Oudlajan neighborhood includes Panzdah Khordad street in the south, Naser Khosro street in the west, Amirkabir street in the north and Rey street in the east. Today, this neighborhood has three main parts: Imamzadeh Yahya in the east, Pamenar neighborhood in the middle, and Naser Khosro neighborhood in the west (Rezaei & Hannachee, 2015; Google Map, 2016) (Fig. 1).

Fig. 1. Images of the Nodes and Paths of the Oudlajan Neighborhood

5. THEORETICAL FOUNDATIONS

5.1. The Spatial Layout

The main concept of space syntax (spatial layout) is based on the spatial cognition and spatial behavior. space syntax is a research method that investigates spatial configuration role as an independent variable in social systems. The focus of this approach is on developing representation and analysis of the spatial structure (from the scale of internal spaces to the large

urban systems) used in society (Kim & Sohn, 2002). This theory along with theoretical developments and improving techniques and computer analysis methods has attracted the attention of architectures and the urbanists (Siadatian & Pourjafar, 2015). In this method, the pattern of spatial communications is analyzed using graphs and is investigated through syntactic variables. Using these tools, the identifying spatial structure is performed through the analysis of the relation between these social variables and qualities, since individual aspect of these variables has not any value (Hillier & Vaughan, 2007; Rismanchian & Bell, 2010). In this theory and method, using indexes such as integration, depth, connectivity, intelligibility, etc., the spatial layout has been analyzed (Long, Baran, & Moore, 2007; Hillier & Hanson, 1984; Bafina, 2003). Actually, the space syntax is posed to describe configuration, connectivity, and articulation of the constructed places (including buildings and passages network). This interpretation of configuration is suggested to describe different psychological and environmental features of the studied area. Features include the experience of the neighborhood by people, preference of the movement base of people in the place and understanding and recalling the place (Montello, 2007).

Moreover, according to the theory of "natural movement" (Hillier et al., 1993), distribution of the pedestrian flow is derived from spatial configuration (Zhani & Baran, 2016). If people show more willingness to use some paths (in relation to other paths) (like paths with high integration and connectivity), it may be assumed that some physical elements (such as signs and nodes) are in these paths that can be reflected explicitly in their cognitive maps. This process in turn will help to the individuals' navigation (Long, Baran, & Moore, 2007). So, the situation of spatial configuration of the neighborhoods and cognitive maps of the residents can be related to each other.

5.2. Cognitive Topography

Hart and Moore, 1971 have defined the spatial cognition in the form of internal representations and reconstruction of space in the mind. In other words, according to them, spatial cognition has been defined in the form of cognitive representations related to the structure, factors, and spatial relations.

In the definition of Downs and Stea, 1973, the complex set of information that are in different environments, forms cognitive topography process. The final product of this process is creation of a cognitive map. Burnett, 1978, defined perception and recognition of the relation of human and the around environment as a psychological process that is related to the human behavior. Five key elements including path, node, edge, area, and sign are identified by Lynch and other researchers of this area as the users' cognitive map details (Lynch, 1960; Long, 2007). In this research, by focusing on the elements of path, node, and sign, it is tried to progress the research subject. Different methods are used to extract cognitive maps and each of them has their own usage. In the production of cognitive maps, variables such as simplifying and quality of drawing the elements and details (Asadpour et al., 2015) result in the production of errors in the extraction of correct information. So, in this research, it was tried to use a method that can somehow remove available decreases. Hence, respondents do not have a generative and active role in the production of informational maps, rather they have a non-generative role in the classification of the spaces. The reason to use such a method was using a complementary method to reach the research purpose. In this research, it was assumed that citizens show more willingness to have presence and social interaction in parts of the neighborhood that have more appropriate spatial structure. However, is it enough to rely on the computer modelling of the space syntax to measure the individuals' social activities? Studies have shown that spatial configuration and spatial cognition have relations to each other (Kim, 2001). So, in this research, in addition to relying on the quantitative parameters of the space syntax method, a complementary qualitative method called cognitive maps (the map that is the result of spatial cognition of the environment users) was used in the identification of formation of beds of cumulative life. The purpose of adaptation of these two methods was to identify points of the neighborhood spatial structure that in the two methods have an undeniable role in the attraction of people to the environment and interaction between them and to understandthe accuracy amount of the findings of the space syntax method.

6. ANALYSIS AND DISCUSSION OF THE FINDINGS

6.1. Analysis of Findings of the Cognitive Features

In this part, two cognitive maps have been provided. One of these maps was the result of overlapping cognitive maps of local residents and the other was formed by overlapping of the classified cognitive maps by non-local people (Figs. 2 & 3).

In the cognitive map of local residents, in addition to Pamenar and Mostafa Khomeini axis, environmental axis such as Rey, Panzdah Khordad, and Naser Khosro and some union axis of the mentioned main frameworks were also of proper familiarity among citizens in order to establish social interactions. However, in the cognitive map of non-local people, the individual's emphasizes was on the mentioned main axis and the internal axis of the tissue had less importance among them and had an acceptability of 25-50% among individual .

The other eminent difference of the two cognitive

maps, according to the two groups of respondents, was defined in the urban signs. Local respondents had more ability in the recognition of the urban signs due to the long familiarity but, non-local respondents had difficulty in the recognition of the signs. Finally, regarding the spatial nodes, it can be said that the two respondent groups had commonalities in the recognition of the environmental nodes that were placed on the main frameworks of the neighborhood but, the two groups were different in the recognition of internal nodes that showed inability of non-local respondents in the recognition of internal nodes.

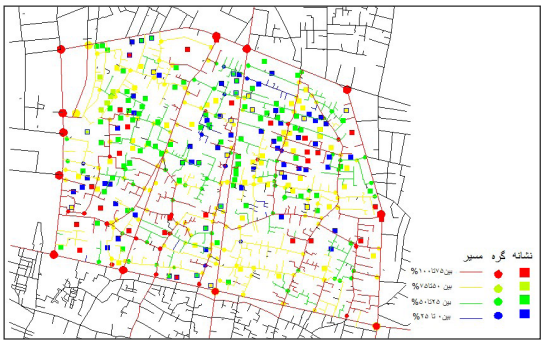


Fig. 2. Cognitive Map from Local Residents

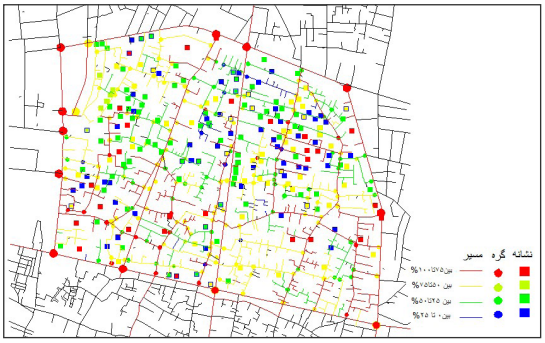


Fig. 3. Cognitive Map of the Neighborhood from the Point of View of those Who Are Not Local, But Who Use the Neighborhood and Less Familiar to Them

6.2. Analysis of the Findings of the Spatial Configuration

In the table 1, the findings of the analysis of the spatial configuration indexes have been presented in the map of the available situation of Oudlajan neighborhood. These findings included connectivity, integration, depth, and intelligibility. In the presented maps, the color spectrum was used to show values. So that in places that component had the most value, diagram was red and in places that had less amount of component, diagram was blue (Table 1).

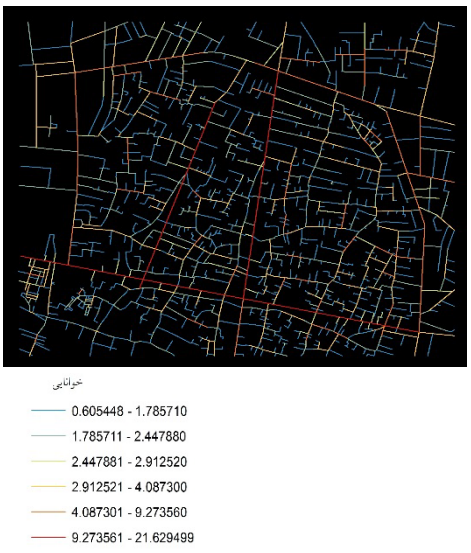
Integration is the most important factor in spatial layout. In other words, to the extent that a space has a higher integration, it has more coherence with spaces and the city structure. Moreover, more integrated spaces have higher accessibility (Rismanchian & Bill, 2010). In contrast to the integration component is the depth component. The space depth shows the amount of isolation and separation. Actually, deep spaces have lower integrations. To analyze spatial configuration of the Oudlajan neighborhood, the Pamenar axis, Mostafa Khomeini and Panzdah Khordad which were the results of building street in the historical neighborhood of Oudlajan, are were integrated than the other points (environmental axis has also a proper situation in this respect). In the other words, mentioned axis had more integrity with the set and had more accessibility. In the more integrated axis and points, due to less depth and more accessibility, the possibility of the presence of individuals was more. Also, this presence made the possibility of occurrence of social interactions among citizens more. By looking more at the analysis of the depth and integration maps of Oudjalan neighborhood, other results could also be achieved including that the most integrated points were in the convergence place of the streets. Also, most of the internal axis of the tissue had a low integration due to the separation from the main axis of the neighborhood and more depth. This separation could result in the creation of isolated spaces that usually had lower security (insecurity with local origin) in relation to other points and decreased the possibility of occurrence of social interactions. Connectivity is of the other components of the space syntax and shows the number of accesses to the required space (Long, Baran, & Moore, 2007). Having analyzed the connectivity map of the Oudlajan neighborhood, it was concluded that the axis of Panzdah Khordad, Mostafa Khomeini, and Pamenar had the most amount of the connectivity component, respectively and in the other classes were surrounded streets and some local short allies. This issue showed that the mentioned axis formed the main framework of the neighborhood and due to higher connection with other points, it was used more than other points by citizens showing high penetrability of these sections.

Moreover, this presence can have results such as being more secure (by assuming internal insecurity of the neighborhood). In other words, according to the connectivity and depth components, some of the internal axis of the neighborhood that had more depth and was predicted to have less penetrability and traffic, according to the Hillier view, had lower security and they had low possibility of having social interaction. According to the available experimental literature, the presence of individuals makes the possibility of social interactions more (a spectrum of looking to talking between individuals can be placed in the social interaction subset) (Daneshpour & Charkhchian, 2007).

Another index that has been discussed in this research was the complementary component of intelligibility which was achieved by the statistical correlation between “general integration” and “connectivity”

(Hillier & Jlienne, 1984; Long, Baran, & Moore, 2011; Tiangxiang, Dony & Shoubing, 2014). From the analysis of the intelligibility map of the Oudlajan neighborhood, it was concluded that the axis of Panzdah Khordad, Mostafa Khomeini, and Pamenar and environmental axis of the neighborhood had the most amount of value. Also, results showed the intelligibility signs of many internal axis of the tissue.

Table 1. Finding of Connectivity, Integration, Depth and Intelligibility(Indicator) of the Oudlajan Neighborhood

The Amount of		Neighborhood Status Based on Analysis	Indicator
0	Min		Connectivity
2.21	Average		
24	Max		
0.1	Min		Integration
0.6	Average		
1.16	Max		
1	Min		Depth
14.98	Average		
28.64	Max		
			Intelligibility

6.3. Criticizing Methods and Discussion about the Role of Cognitive- Spatial Findings on the Space Sociability

In an urban artificial environment, the city spatial configuration and spatial cognition that citizens achieve from spatial configuration of the city, affect their social behaviors. So, comparative comparison of the city spatial configuration and spatial cognition of the citizens were used as a combinatorial method in the measurement of the citizens' sociability. For this comparative comparison and with the purpose of responding to the questions about the sociability of Oudlajan neighborhood and relying on the pooling of the maps, in the first stage the cognitive map of local residents on the spatial configuration maps of the neighborhood and in the second stage, the cognitive map of non-local users were adapted on the spatial configuration maps of the neighborhood (Table 2).

Having comparatively compared the cognitive and spatial configuration maps of the neighborhood, it can be concluded that there were differences between the qualitative data of analyzing cognitive maps and quantitative data of investigating the spatial configuration maps. In other words, cumulative spaces welcomed by the residents were relatively different from beds that were presented (predicted) through computer modelling (that is through the space syntax method) as the possible places of the individuals' presence and having social interactions which may be due to the fact that software analysis had analyzed available axis of the neighborhood (there are mathematical relations between them) which were two-dimensional and could not recognize 3D elements (like signs). Moreover, in these methods, the space users were not taken into account. With a more look at the analysis and comparing quantitative and qualitative data, following results were obtained:

In comparing the spatial cognition of local residents and connectivity map, it was observed that the main axis (3 axis of the main framework) in the two maps were lap on each other so that, in the cognitive map in addition to the main axis, environmental axis were also of adequate acceptability among residents in order to have social interactions. Moreover, in the cognitive map of the residents (from the social interaction aspect) several internal tissue axis had a high degree of importance (75-100%). But, the spatial configuration map was weak in recognition of these parts and these axis were shown with a less amount of connectivity. In other words, in the spatial cognition of the residents (in relation to computer modelling), the number of nodes and paths that could be effective in the attraction of individuals and as a result could provide social interactions, were more. But in the cognitive map which was drawn by non-local residents, cognitive and spatial configuration maps had more adaptation. Results of comparing cognitive maps and integration map of the Oudlajan neighborhood showed that in a relatively large part of the internal axis of the neighborhood, low integration and movement prediction and less presence of residents could be observed, although some of these axis in the cognitive maps of the residents had the most coefficient from the social interaction aspect. The depth component also (that shows separation of the neighborhood parts from the whole set) was achieved by comparing configuration maps and cognitive maps that the amount of depth component in the main (and small extensions to the main axis) and environmental axis had the least amount which was a believable result because these axis after building the street were more accessible than the other parts and the possibility of attraction, presence, movement, and having social interaction of individuals was more in them due to the low isolation degree of the axis. This finding adapted to cognitive findings. Some of the internal axis as compared with the main framework, had a less amount in the depth of the neighborhood map and were more accessible. The presence of people and the possibility of occurrence of social interactions in them seems to be more. This finding was adapted more to the cognitive map of local people. Comparing the diagram of intelligibility and cognitive map of the residents, following results have been achieved:

Adaptation of the intelligibility and cognitive maps of the neighborhood showed that the main framework of the neighborhood has had a higher intelligibility from the computer modelling aspect. According to the cognition of local and non-local residents also, the possibility of the occurrence of social interactions were more in these parts so, it was observed that in spaces with higher amount of intelligibility, the possibility of occurrence of social interactions were more.

Table 2. Overlapping Cognitive Maps and Spatial Configuration Maps

Overlapping Cognitive Maps of Non-Local Users on Spatial Configuration Maps	Overlapping Cognitive Maps of Local Residents on Spatial Configuration Maps	
		Overlapping Connectivity Map and Cognitive Map
		Overlapping Integration Map and Cognitive Map
		Overlapping Depth Map and Cognitive Map
		Overlapping Intelligibility Map and Cognitive Map

7. CONCLUSION

The effects of environment on the social behavior of the citizens formed the axis of the present research. The present study was looking for the answer to this question that how spatial relations can persuade citizens to be present in the space and have social interactions? And how this process can be measured? In this research in addition to analysis of spatial configuration of the environment through quantitative parameters of space syntax, the spatial cognition of the citizens was also used to reach more pervasive results. To do so and in the qualitative part of the research, citizens participated in the measurement of sociable points of the environment. Views of the respondents overlapped, which included two groups of local residents and non-local users in the classification of three environmental elements including path, node, and sign that in their mental memory had an important role in the formation of social interactions. The product of this adaptation was the creation of two cognitive maps. In the next stage, the residents' cognitive map and spatial configuration maps were compared. Results showed that despite the commonality of cognitive map of the residents and spatial configuration map in the recognition of formation beds of social interactions, having a detailed look at the environmental elements would result from the weakness of the space syntax method in the recognition of social interaction beds. It seems that one of the reasons of this issue is the dependence of the space syntax method on the two-dimensional analysis and inattention to 3D elements including urban signs. Generally, results of the study showed that positing the space syntax method and computer modelling of this method (which is formed based on the math science) in the measurement of social concepts have been useful but not enough. In order to do somatic actions to improve social situation of urban tissues, complementary methods such as cognitive maps are needed (in the previous studies also the necessity of attention to complementary results was confirmed). In this relation, more studies are needed regarding the urban tissues and future researchers can evaluate the generalization of this subject with non-generative methods (such as electronic sight of behavioral patterns) so that respondent could have no role in the production of the information, rather his behavior is recorded, imperceptibly.

REFERENCES

- Abbaszadegan, M. (2002). The Method of Space Syntax in Urban Design Process Looking to Yazd. *Urban Management Quarterly,* 3(9), 64-75.
- Alitajer, S., Saadativaghar, P., Robati, M.B., & Heydari, A. (2018). The Effect of Spatial Configuration on the Sociability of Informal Settlements; Case Study of Hesar and Dizaj Neighborhoods in Hamedan. *Journal of Motaleate Shahri,* 7(26), 57-72.
- Asadpour, A., Faizi, M., Mozaaffar, F., & Behzadfar, M. (2015). Typology of Models and Comparative Study of Methods in Recording Mental Images and Cognitive Maps from the Environment. *Bagh-e Nazar Journal*, (12)33, 13-22.
- Bafna, S. (2003). Space Syntax: A Brief Introduction to its Logic and Analytical Techniques. *Environment and Behavior*, 35(1), 17–29.
- Burnett. (1978). *A Social History of Housing*. In David & Charles, 169–194.
- Daneshgarmoghaddam, G., Bahrainy, S.H., & Einifar, A. (2011). An Investigation on Sociability of the Spaces based on Perception of Nature in the Built Environment. *HONAR-HA-YE-ZIBA*, 3(45), 27-38.
- Daneshpour, A., & Charkhchyan, M. (2007). Public Spaces and Effective Features on Public Life. *Journal of Bagh-e Nazar*, 4(7), 19-28.
- Didehban, M., Purdeihimi, S., & Rismanchian, O. (2014). Relation between Cognitive Properties and Spatial Configuration of the Built Environment, Experience in Dezful. *Journal of Iranian Architecture Studies*, 1(4), 37-64.
- Downs, M., & Stea, D. (1973). *Cognitive Maps and Spatial Behavior: Process and Products Image and Environment*, Aldine, 8-26.
- Ghalambor Dezfuly., M., & Naghizadeh, M. (2014). Urban Design in the Context of Social Interaction Enhancement; Case Study: Street between Neighborhoods. *Hoviatshahr Journal*, 8(17), 15-24.
- Hart, R.A., & Moore, G.T. (1971). *The Development of Spatial Cognition*. Image and Environment, Aldine, 246-288.
- Harun, N.Z., Zakariya, K., Mansor, M., & Zakariya, K. (2014). Determining Attributes of Urban Plaza for Social Sustainability. *Procedia- social and Behavioral Sciences*, 153, 606–615.
- Hillier, B., & Sahbaz, O. (2008). *An Evidence Based Approach to Crime and Urban Design.* Bartlett School of Graduate Studies, University College London. Available in: www.spacesyntax.com
- Hillier, B. (1996). *Space is the Machine*. Cambridge University Press, Edition Forthcoming from www.spacesyntax.com
- Hillier, B., & Vaughan, L. (2007). *The City as one thing*. Progress in Planning, 67(3), 205-230.
- Hillier, B., & Hanson, J. (1984). *The Social Logic of Space.* Cambridge University Press, Cambridge UK.
- Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural Movement: Or, Configuration and Attraction in Urban Pedestrian Movement. *Environment and Planning B: Urban Analytics and City Science*, 20(1), 29-66.
- Imani, F., Taki, D., & Tabaeian, M. (2013). Effect of Cognitive Map in Mental Models Recreation of the Environment. *Knowledge & Research in Applied Psychology*, 13(4), 103-113.
- Jafary Bahman, M.A., & Khanian, M. (2013). Comparative Study of the Existing Condition of Kababian Neighborhood with the 2005 Comprehensive Development Plan of City of Hamadan Using SpaceSyntax Software. *Journal of Armanshahr Architecture & Urban Development*, 5(9), 285-295.
- Karami, I., & Mohamadhoseini, P. (2018). The Effect of Sociability of Public Places on Social Sustainability in Residential Complexes; Case Study: Mehr Residential Complex's in Ardabil. *Journal of Motaleate Shahri*, 7(26), 43-56.
- Kim, H.K., & Sohn, D.W. (2002). An Analysis of the Relationship between Land Use Density of Office Buildings and Urban Street Configuration; Case Studies of Two Areas in Seoul by Space Syntax Analysis. *Cities*, 19(6), 409- 418.
- Kim, Y.O. (2001). *The Role of Spatial Configuration in Spatial Cognition*. Proceedings. 3rd International Space Syntax Symposium Atlanta.
- Lay, M.C.D., Reis, A., Dreux, V., Becker, D., & Ambrosini, V. (2005). *Spatial Configuration, Spatial Behavior and Spatial Cognition: Syntactic and Perceptual Analysis of the Market Station Area in Porto Alegre*. In Proceedings from EDRA 35, Vancouver, Canada.
- Long, Y. (2007). *The Relationships between Objective and Subjective Evaluation of the Urban Environment: Space Syntax, Cognitive Maps and Urban Legibility. Dissertation*. Raleigh, North Carolina: PROQUEST LLC.

- Long, Y.K., & Baran, P. (2011). Does Intelligibility Affect Place Legibility? Understanding the Relationship between Objective and Subjective Evaluations of the Urban Environment. *Environment and Behavior*, 44(5), 616-640.
- Long, Y.K., Baran, P., & Moore, R. (2007). *The Role of Space Syntax in Spatial Cognition: Evidence from Urban China*. Proceedings, 6th International Space Syntax Symposium, İstanbul.
- Lynch, K. (1960). *The Image of the City*. London: The M.I.T. Press.
- Mohammadi, M., & Ayatollah, M.H. (2015). Effective Factors in Promoting Sociability of Cultural Buildings; Case Study: Farshchian Cultural Academy in Isfahan. *Journal of Architecture and Urban Palnning*, 8(15), 79-96.
- Mollazadeh, A., Barani-Pesyan, V., & Khosrowzadeh, M. (2011). The Application of the Space Syntax of the Valiasr St Basht City. *Journal of Urban Management*, 29, 81-90.
- Montello, D.R. (2007). *The Contribution of Space Syntax to a Comprehensive Theory of Environmental Psychology*. Proceedings, 6th International Space Syntax Symposium, İstanbul.
- Montgomery, C. (2013). *Happy City, Transforming our Lives through Urban Design.* New York: Farrar, Straus and Giroux.
- Penn, A., Hillier, B., Banister, D., & Xu, J. (1998). Configurational Modeling of Urban Movement Networks. *Environment and Planning B*, 25(1), 59–84.
- Pourjafar, M.r., Bemanian, M., Taghvaee, A.A., & Montazerolhojjah, M. (2011). An Introduction to Physical Typology of Urban Landmarks, Taken from the Citizens' Cognitive Maps; Case Study: Yazd City. *Journal of Architecture and Urban Planning*, 4(7), 129-145.
- Rezaei, N., & Hanachee, P. (2015). Oudlajan Neighborhood, an Urban Heritage between Tradition and Modernity. *Journal of Iranian Architecture Studies*, 1(7), 19-34.
- Rismanchian, O., & Bell, S. (2010). The Application of Space Syntax in Studying the Structure of the Cities. *Journal of HONAR-HA-YE-ZIBA*, 2(43), 49-56.
- Sajjadzadeh, H., Izadi, M.S., & Haghi, M.R. (2017). The Relationship between Spatial Configuration and Environmental Variables in Informal Settlements; Case Study: Hesar Neighborhood in Hamedan. *Journal of HONAR-HA-YE-ZIBA*, 21(3), 15-26.
- Seqhat al-Islami, A.A.I., & Behnamifard, M. (2012). *An Analysis of the Boundary of the Neighborhoods Using Cognitive Maps of the Residents; Case Study: Mashhad Municipality Neighborhood*. 4th Conference on Urban Planning and Management, Department of Urban Planning, Faculty of Arts and Architecture, Islamic Azad University, Mashhad.
- Shojaee, D., & Partovi, P. (2015). Analysis of Factors Affecting the Creation and Promotion of Sociability in Public Spaces in Different Scales of Tehran City; Case Studies: Two Neighborhoods and an Area in District 7 Tehran. *Bagh-e Nazar Journal*, 12(34), 93-108.
- Shokouhi, M. (2010). Haft Menbar Pathway Path of Identity Segregated from the Historic Parts of the City. *Journal of Architecture and Urban Planning*, 2(3), 57-64.
- Siadatian, S.R., & Pourjafar, M.R. (2015). Testing the Application of "Justified Plan Graph" (JPG) in Iranian-Islamic Architecture; Case Studies: Rasoolian House in Yazd and a House in Masooleh. *Naqshejahan- Basic Studies and New Technologies of Architecture and Planning*, 4(3), 27-39.
- Šiđanin, P. (2007). On Lynch's and Post-Lynchians Theories. *Architecture and Civil Engineering*, 5(1), 61-69. DOI: 10.2298/FUACE0701061S.
- Tianxiang, Y., Dong, J., & Shoubing, W. (2014). Applying and Exploring a New Modeling Approach of Functional Connectivity Regarding Ecological Network: A Case Study on the Dynamic Lines of Space Syntax. *Ecological Modelling*, 318(24), 126-137.
- Tolman, E.C. (1948). Cognitive Maps in Rats and Men. *Psychological Review*, 55(4), 189-208. http://dx.doi.org/10.1037/h0061626.
- Tversky, B. (1993). Cognitive Maps, Cognitive Collages, and Spatial Mental Models. In: Frank A.U., Campari I. Eds: Spatial Information Theory A Theoretical Basis for GIS. COSIT 1993. *Lecture Notes in Computer Science*, 716. Springer, Berlin, Heidelberg.
- Zhai, Y., & Baran, P.K. (2016). Do Configurational Attributes Matter in Context of Urban Parks? Park Pathway Configurational Attributes and Senior Walking. *Landscape and Urban Planning*, 148, 188–202.