

Persian translation of this paper entitled:  
چگونگی شکل‌گیری الگوهای رفتاری در سازمان فضایی محلات  
«زرگنده» و «دروس» با استفاده از نرم‌افزار «اگراف»  
is also published in this issue of journal.

### Original Research Article

## The Formation of Behavior Patterns in the Spatial Organization of Neighborhoods Zargandeh and Daroos Using the Agraph Software\*

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Received: 03/08/2020 ; accepted: 23/12/2020 ; available online: 22/06/2021

### Abstract

**Problem statement:** Recognizing and examining the relationship between space, behavior and or environment and community in urban studies is always important and valuable. The main issue of behavioral studies understands the relationship between humans and their needs and the formation of behavior in the environment. In this study, two different neighborhoods based on morphological structure (Zargandeh neighborhood with irregular-organic texture and Daroos neighborhood with regular-grid texture) were studied to investigate the effects of different structure of neighborhood texture and the roles of urban planners and designers on the formation of behavioral patterns which can be affected on the formation of the desired behavioral patterns.

In the present study, the main question is about understanding the difference between the occurrence and emergence of behavioral patterns in two different irregular-organic and regular-grid textures. This research is not hypothetical and seeks to describe and analyze the relationship between behavioral patterns and these two different urban structures.

**Research objectives:** The goal of this study is detection of behavioral pattern changes in different urban textures in order to prepare a suitable planning according to the goals of urban planners and designers.

**Research method:** The above research is descriptive-analytical. Because it has adapted or compared case studies and also it is comparative due to the comparison of the outputs of the two Agraph and Depth software. Type of this research is mix-method (quantitative and qualitative).

**Conclusion:** The formation of behavioral patterns in different urban spaces of neighborhoods is due to human relations. Existence of regular pattern in the passages has been lead to the high level of access, integration and strengthens the movement patterns. Wide field of view facilitates movement and increases security. Due to proper access of the neighborhood texture, the land-use patterns have been dotted and scattered. The presence of an organic physical form has strengthened walking and increased the sense of search. Parts of the neighborhood have been separated from other parts due to low integration and the existence of multiple dead ends and reduced sense of security because of the presence of many corners, cozy and limited visibility and have become spaces with no or limited visits.

**Keywords:** *behavioral patterns, Irregular-organic texture, Regular-grid texture, urban space, Spatial Organization.*

\* This article is extracted from Navid Paknezhad's Ph.D. dissertation entitled "Explaining the effect of spatial-formal organization of urban neighborhoods on the behavioral patterns of residents (Case study of Zargandeh and Daroos neighborhoods)" which is done

under supervision of Dr. Manouchehr Tabibian and advisement of Dr. Gholamreza Latifi at Islamic Azad University, Qazvin Branch, in 2019.

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## Introduction

The formation of behavioral patterns in urban spaces and social processes in the texture of everyday life and the relationship between them from a spatial (physical) perspective is explainable by Space Syntax theory. However, to explain the relationship between behavioral patterns and space (physical), the method of space syntax is one of the proposed methods. Space syntax is the use of variables obtained from the analysis of space configuration in recognizing the patterns of different geometric elements that have been created by buildings and cities (Abbaszadegan, 2002, 66). One of the tools used to analyze the space syntax is Agraph, which has been used in this research. The main purpose of this study is physical analysis and its effect on behavioral patterns. In this regard, trying to rely on scientific and theoretical foundations based on the space syntax attempt to recognize and understand the impact of the qualities of space organization in neighborhoods on behavioral patterns. The main research question is about how the physical dimensions of the space organization relate to the formation of behavioral patterns. The present study is not hypothetical and deals with qualitative analysis.

## Methodology

This research was conducted using descriptive-analytical. Selection of two neighborhoods of Zargandeh and Daroos for study was made a comparison between the two textures, so comparative research method was used. For data collection, Bibliographical method has used and for data analysis, Agraph software has been used and the variables proposed in this research include Control value, Total depth, Mean depth, relative asymmetry, Integration value. Each of the variables mentioned is effective variable on the behavioral patterns and can be evaluated in the spatial organization of two neighborhoods. Agraph is software for drawing spatial graphics diagrams based on space syntax technique, and Agraph calculations are performed to design diagrams based on given data. Zargandeh

and Daroos neighborhoods are located in District 3 of Tehran Municipality. According to the study of historical records and aerial and satellite photos, formation of Zargandeh and Daroos neighborhoods since 1954. Although Daroos neighborhood was developed premier than Zargandeh neighborhood according to aerial photos of 1954. These two neighborhoods have the closest proximity to each other in terms of cultural, economic and geographical features and differ in terms of morphology and spatial structure, which made these two neighborhoods best for selection. Zargandeh neighborhood has an organic structure and in contrast to Daroos neighborhood has a regular and almost grid structure. According to the above research approach, the choice of these two neighborhoods provides a good basis for analyzing, measuring and comparing the effects of physical-spatial organization on the formation of behavioral patterns.

## Literature review

Several studies about evaluation and analysis of urban structure have been carried out by researchers with a space syntax approach mainly using Depth map software. Lack of analysis conducted by Agraph software is recognizable in related studies.

A common feature of studies of non-descriptive methods in urban space analysis is the use of different methods to record users' physical activities in public spaces. Another group of researches and studies have tried to model the recorded behaviors of pedestrians in urban spaces by using computer tools such as GIS and or space syntax tools such as Space Syntax Laboratories and Intelligent Space projects in the UK. These projects mainly include the collection of large statistical data in a range of public spaces from the quantity and quality of existing flow currents, analysis of the current situation in relation to computer models and attempts to predict the possible effects of proposed projects on social and economic aspects of public spaces. The methods used in most of the above studies are taken from the behavioral sciences. Behavioral setting

theory proposed by Roger Barker (1968) caused the emergence of environmental psychology field. He is the first to use scientific methods of observation in real-world psychology. Another work that can be mentioned is the method presented by Christopher Alexander. He suggests discovering patterns using in-depth observation to achieve design principles; He describes this method in his book *The Timeless Way of Building* (Alexander, 1979).

The Space Syntax Consulting Engineering Company analyzed the connections inside and outside the Olympic area (in Stanford, London, 2012) to help determine which route pedestrians, cyclists and drivers would choose, or which park and space is getting more and more popular, and the company's director, Tim Stoner, writes about production plans (these maps reveals the nature of the city of London, people move and interact in space, They share their stories and thoughts, exercise, create and innovate, therefore, a social and economic network runs in the streets and public spaces). In this regard there are some studies looking into effective parameters in the formation of human behaviors in different spatial structure (which are mostly based on the analysis of existing conditions, not new developments).

Table 1 summarizes theoretical or practical researches and their perspective of the relationship between the urban spaces physical aspect and the formation of behavioral patterns.

## Theoretical foundation

### • The theory of natural movement - the Space Syntax

The theory of space syntax was invented by Hillier and Hanson in the 1970s and presented to the world (Izadi & Sharifi, 2015). This theory, from a spatial perspective, is focused on the relationship between society and space (Hillier & Hanson, 1984). This theory, which is part of systemic theories (Vibæk, 2014), seeks to "how the spatial pattern in itself can carry information and social content" (Hillier & Hanson, 1984). Numerous observations have shown that the main traffic in the city (in any space) is not

due to the presence of the destination or origin in the same space, but due to its location in a part of the origin to destination route. It is necessary to explain that even purposeful movement (from origin to destination) must cross related lines (Abbaszadegan, 2002, 70).

Bill Hillier proposes his theory of Natural Movement, where he points to the effect of spatial configuration on pedestrian movement (the formation of socio-behavioral patterns) in the city. He states that spatial configuration alone is the most important factor in guiding pedestrian movements in the city. In this regard, local and micro-scale factors such as spatial adsorption and land use are less important (Rismanchian & Bell, 2010). The relationship between the structure of the urban network and the densities of movement along the lines can be called the basis of "Natural Movement". In this theory, the main idea is that movement has the most fundamental connection with the discussion of spatial configuration. Also, land use distribution is affected by spatial configuration due to the effect of configuration on accessibility and permeability (ibid.). This theory holds that in the complexity of the city, the relationship between the components and the constituent factors of the city plays a more important role than each component (Hillier, Pen, Hanson, Grajewski & Xu, 1993). Movement is basically an issue related to the morphology of the city and is the main product of space configuration and how it communicates between urban elements so that spatial configuration alone can be considered as the principle factor of predicting pedestrian movements. Hillier assert that first the spatial configuration guides the pattern of movement across the city, and then the space gravity and land uses are located to benefit from this movement, thus spatial configuration. It can also affect the distribution pattern of space adsorbents (Rismanchian & Bell, 2010).

The relationship between Movement, space gravity, and spatial configuration is shown in figure 1.

1. Gravity pole A affects movement, but has no effect on spatial order

Table 1. Research background and type of relationship between physical and behavioral patterns. Source: Authors.

Researcher	Year	Book / Theory	Key concepts	Type of relationship between the body and behavioral patterns		
				Direct	Indirect	Not related
Kurt Lewin	1944	Psychological Ecology	A person's feelings and behavior are a function of the tensions between things in the environment that he is aware of at all times.	×		
Roger Barker & Herbert Wright	1947	Ecological Psychology	The environment is a combination of several elements and events that make the behavior match the patterns	×		
Hannah Arendt	1958	The Human Condition	Public realm is the main factor of extraversion and political and public life	×		
Paul Zucker	1959	Town and Square from the Agora to the Village Gree	The square transforms society into a community, not just a gathering place for individuals		×	
Kevin A. Lynch	1960	A Theory of Good City Form	Formation of mental image and constituent elements of the city image from the perspective of citizens	×		
Jane Jacobs	1961	The Death and Life of Great American Cities	Pavements, strengthening and cause social interactions, social monitoring concept through design	×		
Philip Thiel	1961	People, Paths, and Purposes: Notations for a Participatory Envirotecture	Assign a large number of symbols to specific properties of the space	×		
Fritz Redl & Paul Gump	1963	The Behavior Setting: A Promising Unit for Environmental Designers	To understand people's behavior, researchers must study about where they live	×		
Edward T. Hall	1966	La Dimension cachée: The Hidden Dimension	Defining interpersonal distances and their effects on individual perception and actions		×	
Robert Sommer	1969	Personal Space: The Behavioral Basis of Design	Defining personal space and its effects on relationships and reactions		×	
Harold M Proshansky	1970	Environmental psychology: Man and his physical setting	Every physical environment is also a social environment	×		
Oscar Newman	1972	Defensible space theory	Define the spatial hierarchy	×		
Irwin Altman	1975	Human Behavior and Environment	The environment must be both impactful and flexible		×	
Amos Rapoport	1977	Human aspects of urban form	The passive position of man in relation to the environment of orienting pedestrians in the urban environment		×	
Schoggen	1979	Behavioral setting Concept Development	Environmental opportunities and Behavioral setting	×		
Allan Wicker	1979	An Introduction to Ecological Psychology	Relationships of purposeful actions of individuals and Behavioral setting	×		
William H. Whyte	1980	The Social Life of Small Urban Spaces	Emphasis on the social role of urban spaces	×		
Donald Appleyard	1981	Livable Streets	The effect of transportation and the form of the city on social interactions	×		
Romedi Passini	1984	Wayfinding in Architecture	Orienting people in the urban space and paying attention to the special needs of users	×		
Jan Gehl	1987	Life between Buildings: Using Public Space	Division of activity in urban / essential, selective, social space	×		
Jon Lang	1987	Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design	Behavioral setting / Formation of mental schema of people's perceptions of the environment / Interaction of built-in capabilities and behavior		×	

Rest of Table 1.

Ray Oldenburg	1989	The Great Good Place: Cafes, Coffee Shops, Bookstores, Bars, Hair Salons, and Other Hangouts at the Heart of a Community Ray Oldenburg	Emphasis on the public sphere as the third place of individuals	×
Clare Cooper Marcus	1990	People Places: Design Guidelines for Urban Open Space	Evaluation of residential environment and introduction of seven urban spaces	×
Francis Tibbalds	1990	Making People-Friendly Towns: Improving the Public Environment in Towns and Cities	Focus on Place and user integration	×
Ian Bentley	1990	Responsive Environments	Qualitative and quantitative suggestions for the environment	×
Carmen Hass-Klau	1999	The Pedestrian and the City	Paying attention to behavioral patterns and socio-cultural texture for design	×
Hussein Bahraini	1999	Analysis of urban space	Investigating the adaptation of space to behavioral patterns	×
Ricky Burdett & Deyan Sudjic	2008	the endless city: the urban age project	Emphasis on the study of behavior in public spaces	×
Lynne Elizabeth & Stephen A. Goldsmith	2010	What We See: Advancing the Observations of Jane Jacobs	Study of public life as a principle	×

2. The movement of M affects the pole of gravity and is affected by it, but it has no effect on the spatial order

3. Spatial order C affects the movement and polarity of gravity, but they do not interact.

Figure 1 states that while spatial configuration can affect both movement and space gravity, but the opposite is not possible. However, movement and space gravity can be affected by each other. This does not mean that most of the city-wide movement is due to spatial configuration; rather, it confirms that spatial configuration is the primary factor of creating movement, therefore without understanding it, the pattern of movement in the city cannot be studied. Natural movement is the movement resulting from the configuration of space, although it is not necessarily the most extensive movement in the city, but it is the dominant movement in the city so that without it most of the urban spaces are often empty (ibid.).

Ecological psychologists consider the real environment of human life and behavior as units that work together but at the same time independently (Wicker, 2012). The emphasis in environmental psychology has been on how human behavior,

emotions, and sense of health are affected by the physical environment. This means that human behavior is formed in interaction with other human behavior and with the environment in which it is located (Barker, 1968, 1). When people move from one place to another, their behavior changes based on that environment, and the behavior that occurs in one place may not be usable in another. Assigning behavior to place is an important fact of environmental psychology (ibid., 18). A wide range of selective activities are also performed by inviting conditions to stop (pause), sit, eat, play, and the like. In low quality streets and urban spaces, minimal activity is done and people go home quickly While in a good and completely different environment, a range of human activities are possible (Gehl, 2017, 5). In this study, to examine the effects of the environment on a local scale on behavioral patterns, the spatial organization of the two neighborhoods is considered (Fig. 2).

• **The Agraph software**

The Agraph software was developed in a doctoral dissertation study at the Oslo School of Architecture. In this study, a kind of software for space syntax analysis on a number of apartments was considered.

There is different software for analyzing Space Syntax. However, since this study required software to perform both Space Syntax calculations and graphic and editing graphs, no suitable software was found. Then the decision was made to create such real software and it was named Agraph. The Agraph program was developed in C# (Sharp). The output of all Agraph files is. AGX This program consists of a series of communication matrices (including connected or unrelated nodes) and internal distance matrices (including the shortest distances between

nodes). With simple calculations in this matrix, the space syntax parameters of these nodes are determined.

These two tools (Agraph and Depth map) are based on the theory of spatial arrangement and both examine the ossification characteristics and structure of neighborhood paths and how it affects behavioral patterns. For this purpose, at first, the access network map of the structure of the passages of the two neighborhoods is presented (Fig. 3).

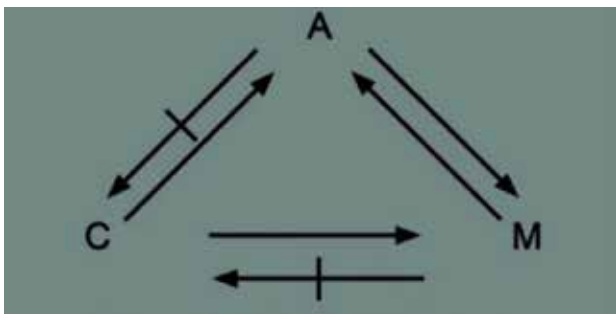


Fig. 1. Motion diagram, configuration and space absorbers. Source: Hillier et al., 1993.

### Discussion and analysis

In figure 3, perceived behavioral patterns (using survey methods) are presented in the form of a behavioral map. Here, by comparing the distribution of behavioral patterns and their diversity (three main behavioral patterns including: standing, sitting and moving), the analyzed variables are examined using the urban network analysis method. In the prepared behavioral map, the main areas of

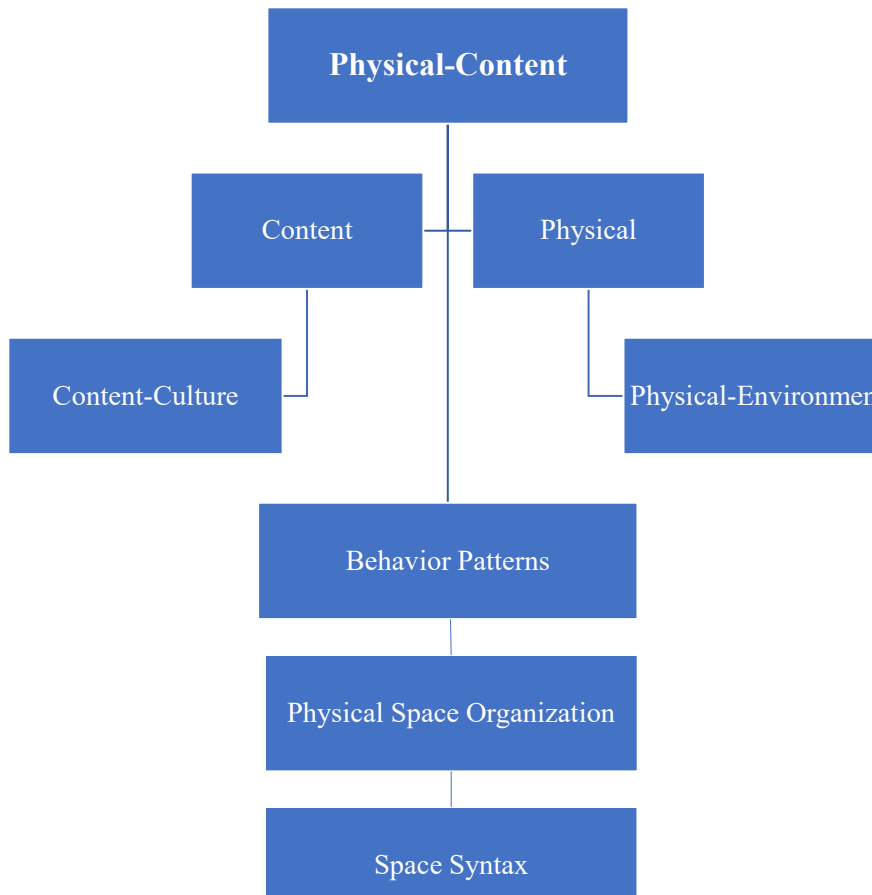


Fig. 2. Theoretical framework of research. Source: Authors.

people behavior in Zargandeh neighborhood are wider within the texture and Daneshvar and Daliri streets have frequent uses, which is why different behavioral patterns have been formed. However, in the Daroos neighborhood, there are limited and cross-sectional behavioral patterns in the parts of Hedayat Street, Hedayat Square and Rastvan Street. The access variable in Zargandeh and Daroos neighborhoods as it can be seen in behavioral map, although the texture of Daroos neighborhood in the analytical map shows that the access field is very prone and has a high permeability (Fig. 4). But in the behavioral map, this permeability has not led to the formation of behavioral patterns, and in the Zargandeh neighborhood, the central part of the texture has been emphasized, which in fact also exists and is consistent.<sup>1</sup>

Table 2 summarizes the behavioral patterns of neighborhood residents, including: positive factors that reinforce and negatively weaken the presence of

residents in the two neighborhoods and the types of activities in the neighborhood, as well as the priority of the factors that lead to behavioral patterns.

From the observations made, it can be seen that the existence of small and micro commercial uses in and around the neighborhood and the existence of rows with different uses to meet the different needs of citizens along with green spaces and local parks pave the way for the presence of different ages and strata. All above and in addition access to religious, cultural and educational spaces, all together, strengthens the presence of residents in Zargandeh neighborhood spaces. In contrast, in the Daroos neighborhood, small commercial spaces, mainly around the area and a little in the center of the neighborhood, is the reason that locals use spaces every day. Poor lighting at night, narrow width of sidewalks and passages, lack of access of some passages to each other in some areas and the existence of many actions and coziness

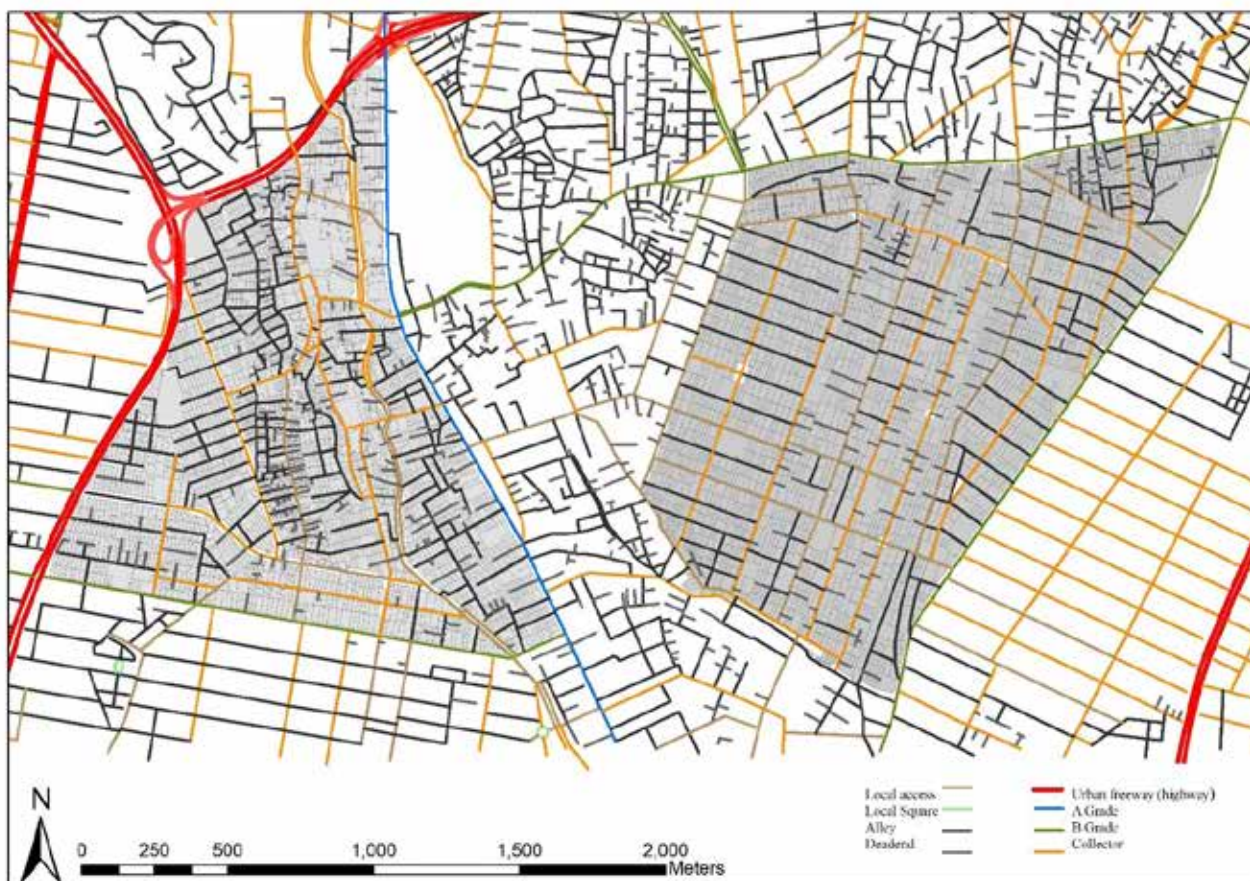


Fig. 3. Network of passages and accesses in Daroos (right image) and Zargandeh (left image) neighborhoods. Source: Authors.

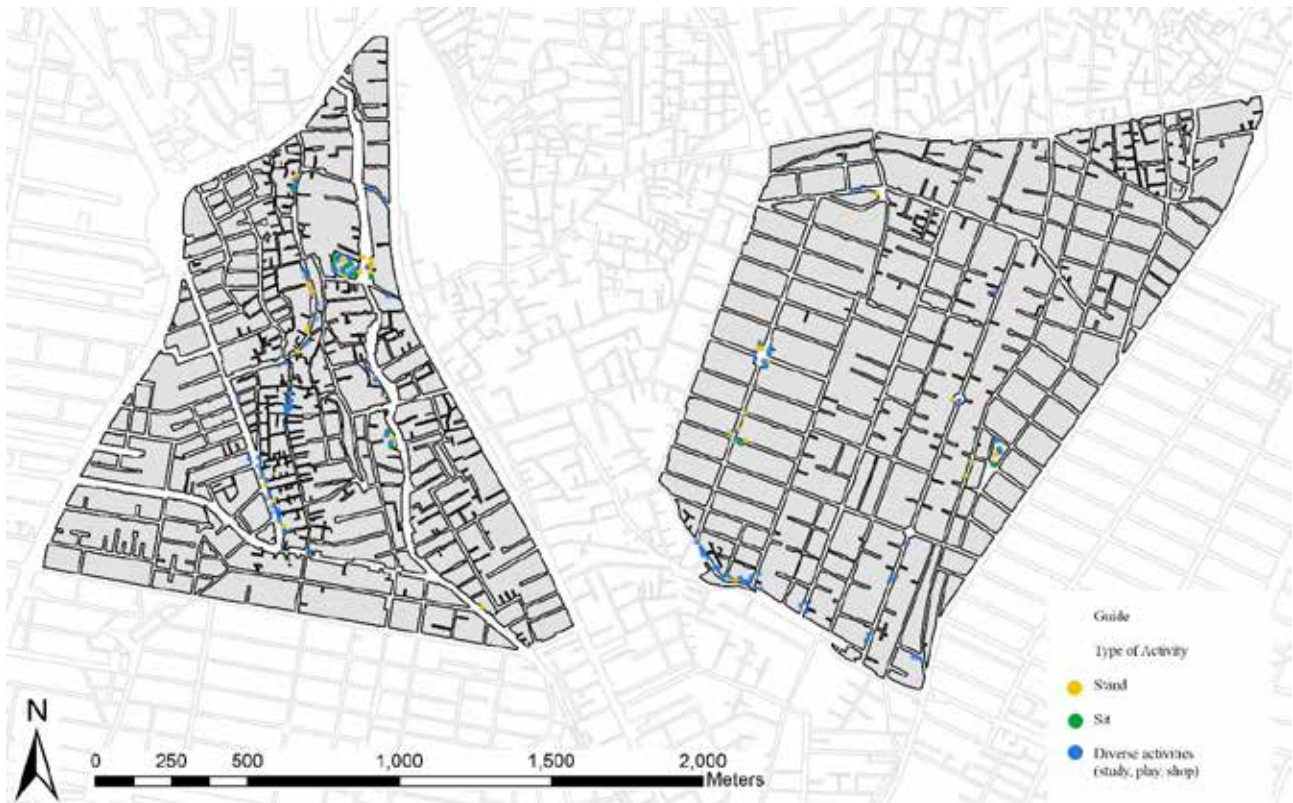


Fig. 4. Type of activity in Daroos (right) and Zargandeh (left). Source: Authors.

Table 2. Results of behavioral patterns in Zargandeh neighborhood and Daroos. Source: Authors.

Texture	Organic and natural structure Daruos neighborhood	Regular and grid structure Zargandeh neighborhood
<p>Positive factors that strengthen the presence of neighborhood residents</p> <p>Observation of the behavioral patterns of neighborhood residents</p> <p>Negative factors undermining the presence of neighborhood residents</p>	<ul style="list-style-type: none"> <li>- Existence of small commercial uses in the middle and around the neighborhood</li> <li>- Passages have different uses to meet different needs</li> <li>- Green spaces and local parks are suitable for the presence of young people and families at different times of the day</li> <li>- Access to religious, cultural, and educational spaces also reinforces more behavioral and movement patterns</li> <li>- Poor lighting at night</li> <li>- Low width of sidewalks</li> <li>- High slope of the neighborhood</li> <li>- Lack of sense of security and the existence of multiple corners and coziness</li> <li>- Lack of proper access of streets and passages to different parts of the neighborhood</li> </ul>	<ul style="list-style-type: none"> <li>- Existence of small commercial uses mainly around the neighborhood</li> <li>- Relatively active neighborhood center with uses that meet every day needs</li> <li>- Lack of Mixed-uses and meeting all local needs that lead to the formation of diverse patterns of behavior</li> <li>- Lack of recreational and entertainment uses on site</li> <li>- Narrow width of sidewalks for the formation and behavioral patterns of movement and ...</li> <li>- Poor lighting at night</li> </ul>
Types of activities available in neighborhood spaces in order of priority	<ul style="list-style-type: none"> <li>- Shopping, walking alone or with dogs, standing watching</li> <li>- Activities such as sitting, walking, getting together, going to mosques, repairing cars, playing games, withdrawing money from ATMs</li> </ul>	Shopping, walking, standing alone, two people talking and sitting, withdrawing money from ATMs
Factors that lead to behavioral patterns	Mixed land use and activities related to local daily needs	Some uses in Neighborhood



have limited the conditions for the presence of residents of Zargandeh neighborhood and the emergence of new and diverse behavioral patterns. In Daroos neighborhood, lack of recreational and entertainment uses, poor lighting at night and less penetration of micro, commercial and service uses in the middle of the neighborhood are the limiting factors for the formation of different behavioral patterns in Daroos neighborhood.

• **Integration index analysis**

The Integration index shows how many paths pass from one node to the other nodes (taking into account the shortest distance). In figure 5, whatever goes from warm (red) to cool colors decreases the integration value. The value of the integration value of each node indicates the number of access routes to that urban space the large difference between the highest and lowest Integration rates indicates that the neighborhoods have more heterogeneous characteristics. Also, nodes with a cooler color represent isolated urban spaces with spatial separation characteristics. If the physical structure does not provide the conditions for gathering, it will not be possible to form active and diverse behavioral patterns. The possibility of each event

encourages other events, and participants in one situation have the opportunity to experience and participate in other events, and a self-reinforcing process can begin. Therefore, the emphasis on the Integration index is due to the emphasis on the problem of aggregation.

The large difference between the highest and lowest Integration rates indicates that the neighborhoods have more heterogeneous characteristics. It also indicates that there are isolated points (with great depth) in the spatial structure of neighborhoods and this creates isolated and deeper spaces and causes spatial separation. Emphasizing the relationship between physical and social segregation (Fig. 6), Donald Appleyard says that neighborhoods that are physically isolated also encourage social activities in isolation (Paknezhad & Latifi, 2018). Highly Integration spaces are marked in warm color (red) on the output map, and low- Integration spaces are marked in cold (blue).

In both neighborhoods, the integration value is very high. Of course, in some parts of Daroos neighborhood, this intensity of integration is less but the average Integration for Daroos and Zargandeh neighborhoods is 0.28 and 0.23 And the difference

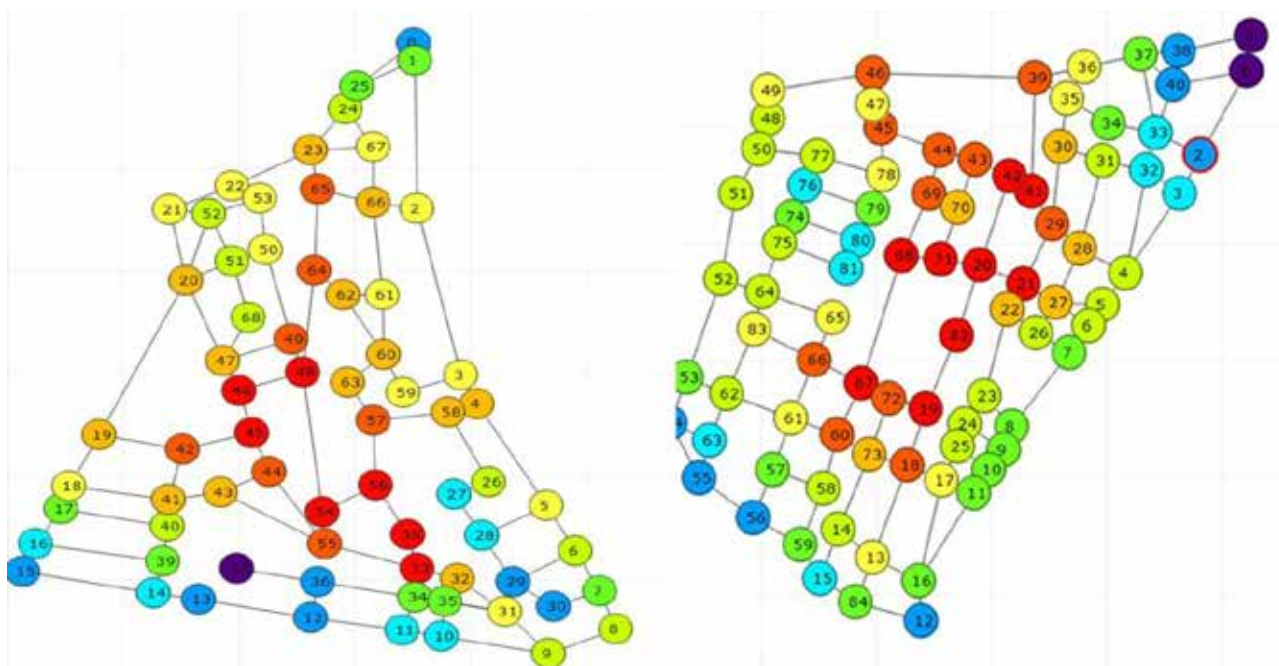


Fig. 5. Output of integration index analysis in Agraph software in Daroos (right picture) and Zargandeh (left picture). Source: Authors.

between the highest and the lowest Integration in the neighborhood of Daroos is significant and for the neighborhood of Daroos this value is 1.95 and Zargandeh 0.82 There is also spatial uniformity, especially in the Zargandeh neighborhood. The Integration ness of the two neighborhoods does not create spatial isolation in the neighborhoods and accessibility (Table 3).

By comparing the output of Integration analysis in Depth map and Agraph software, it can be seen that the desired output was consistent in the neighborhood of Daroos and both tools show the integration value to approximately the same extent in different parts of the neighborhood Of Daroos, in the study of Zargandeh neighborhood, the difference in outputs is significant and it seems that by comparing the field survey and the output of Agraph software, it can be concluded that the Integration is much more real with the field survey (Fig. 7).

The highest amount of control and in other words,

the most important spaces in the western part of the neighborhood are the paths that allow access to open streets and the possibility of selecting more urban spaces. In the neighborhood, a specific classification of the amount of control of each space can be seen in a way, the main accesses have more control and the sub-accesses and dead ends have the least control. In central parts of Zargandeh neighborhood, which is complex and organic -consists of a series of secondary accesses and deadlocks-, the level of control is extremely low. But the amount of control increases in the surrounding areas of the neighborhood, which is influenced by the organization of the surrounding neighborhoods. The control level in this neighborhood is range from 2.5 to 0.25, and the average control is 0.97. This shows slight difference to the average control in the neighborhood of with 0.99 figures. The reason was the multiplicity of deadlocks and side roads in both neighborhoods (Fig. 8).



Fig. 6. Output of integration index analysis in Depth map software in Daroos (right image) and Zargandeh (left image) neighborhoods. Source: Paknezhad & Latifi, 2018.

Table 3. Summary of Integration index analysis. Source: Paknezhad & Latifi, 2018.

Indicator	Daroos	Zargandeh
High Integrity	2.11	1.00
Low Integrity	0.16	0.18
Mean Integrity	0.28	0.23
difference	1.95	0.82

• **Analysis of control value index**

The control value of the node is equal to the number of connections that exist, so the number with the highest radar value represents the highest communication level. Less communication paths to

nodes in terms of space and physical morphology and its impact on human behavior reduce collisions and that reduces events.

The typical radius of activity for most people on foot is limited to 400 to 500 meters per turn and the fact

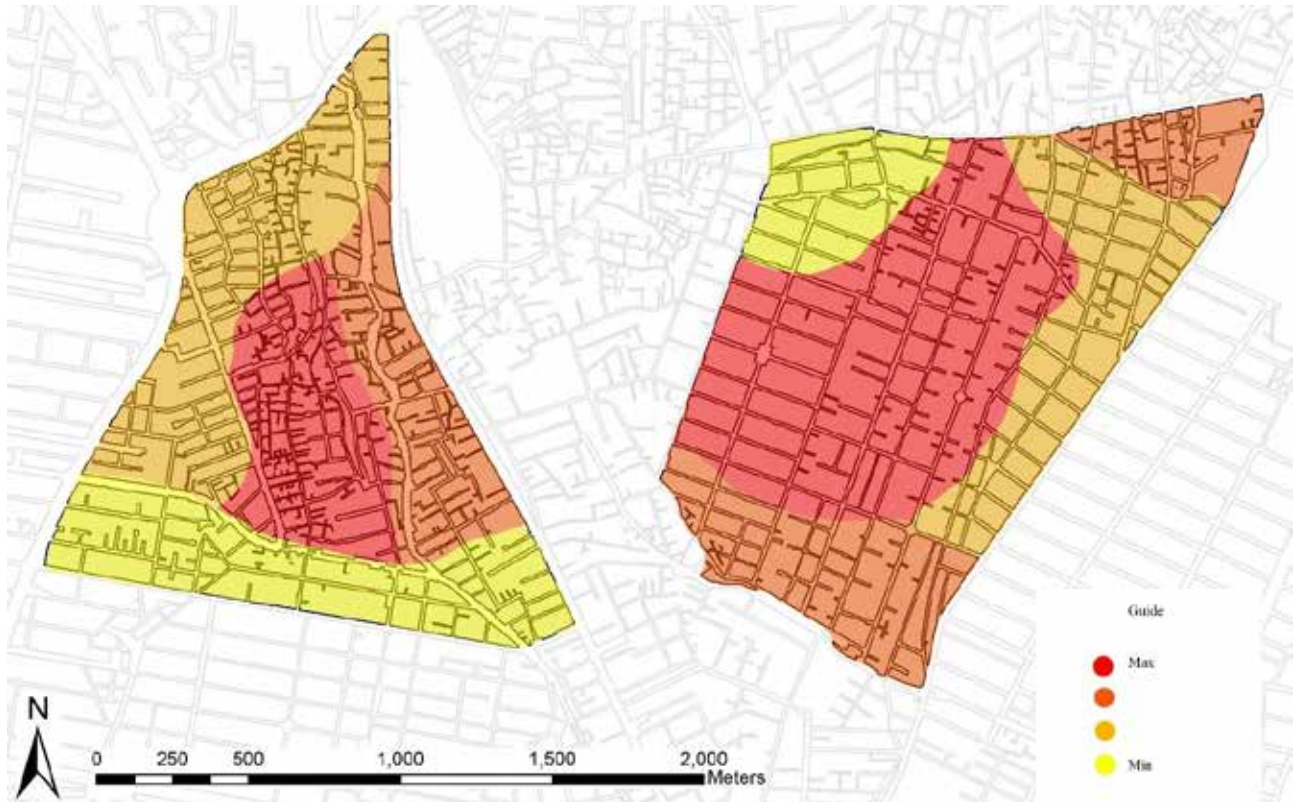


Fig. 7. Comparative analysis of integration index in Agraph and Depth map software in Daroos (right image) and Zargandeh (left image) neighborhoods. Source: Authors.

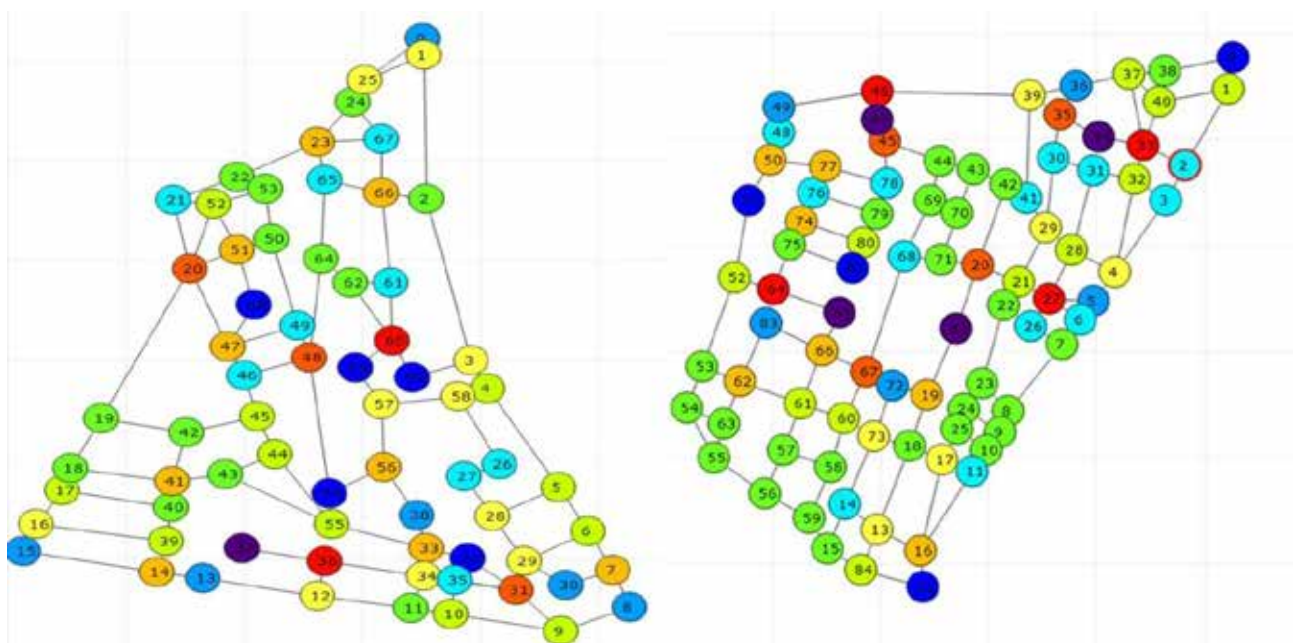


Fig. 8. Output of control index analysis in Agraph software in the areas of Daroos (right image) and Zargandeh (left image). Source: Authors.

that the possibility of seeing other people and the course of events is limited to a distance of 20 to 100 meters, Depending on what the target is, aggregation demand will change.

If it is to see people and other events from home or on a short walk, a little more than half a kilometer and also have access to the most important services on foot; Activities and functions must be collected very carefully. A slight number of small spatial functions, or a little more distance, can turn the richness of experience into poverty.

At a distance of half to one kilometer, subjects can be seen and identified depending on factors such as background, brightness, and especially whether. People face rather moving or not at a distance of about 100 meters could be recognized, and at farther distances figures can be seen as persons. This area can be called a social field of vision

Curved or interrupted paths and paths make the movement of pedestrians more interesting In addition, curved roads are usually better than straight roads to reduce wind disturbance The sidewalk network with alternative paths and small squares often has this psychological effect, which makes it naturally divided into controllable stages. People instead of thinking about the length of the way, they actually focus on moving from field to field.

It also makes it easier to create valuable spatial

contrast when parts of the path become narrow. If the width of the street is 3 meters, in contrast to it, a space with a width of 20 meters will act as a square. When we get from a small space to a large space, the quality of the experience is greatly enriched: that is, when sequence and contrast between small and large. If planning is to be done on a human scale in general, small spaces must be really small, otherwise large spaces will simply become too large (Fig. 9).

#### • Control value

In control values, the total value of 1 is assigned to each node in such a way that it is distributed among the nodes related to equality. Outputs of the analysis performed in both neighborhoods are the same.

#### • Total depth

The total depth of node n is equal to the shortest distance from node n to other nodes in the system. In other words, the total depth of node n is equal to the entire nth row (or nth column) of the distance matrix. The average access of nodes to each other in Daroos neighborhood is more than Zargandeh neighborhood and the distance between nodes is closer in Zargandeh neighborhood.

#### • Mean depth

Mean depth is the average depth (or average of the shortest distance) from node n to all other nodes. In both neighborhoods this average depth is equal and is equal in the shortest distance.

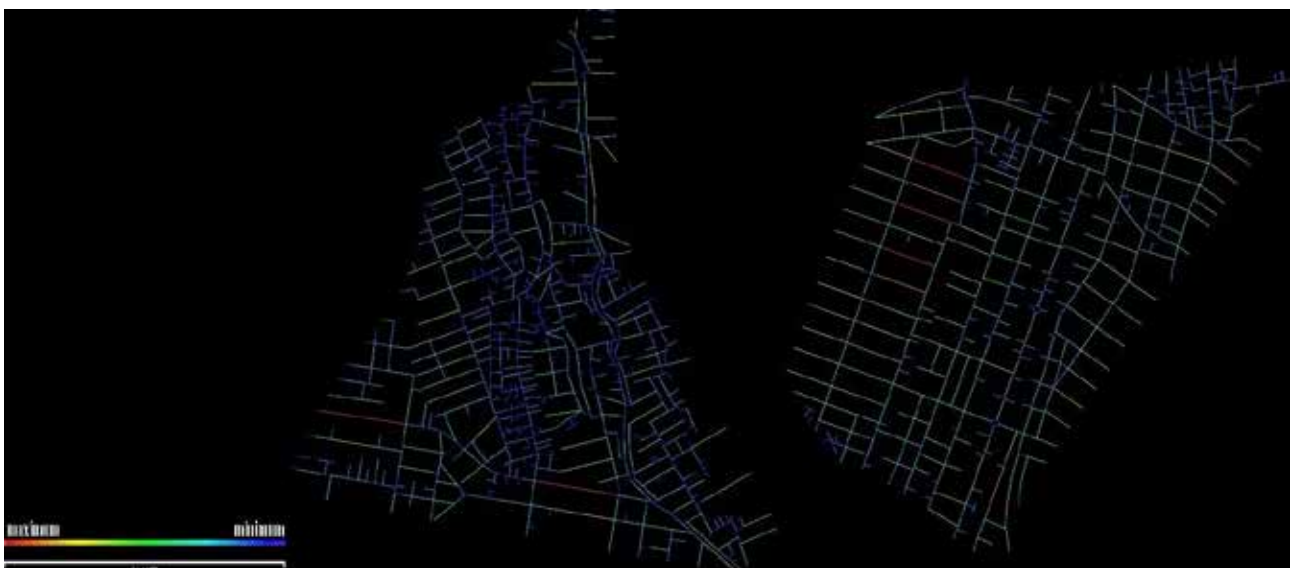


Fig. 9. Output of control index analysis in Depth map software in Daroos (right image) and Zargandeh (left image) neighborhoods. Source: Authors.

• **Entropy and relativized entropy**

Entropy and Relativized Entropy indicate node aggregation. Entropy value range from zero to one, smallest values indicating high aggregation. In both neighborhoods Entropy is equal to zero which mean high aggregation.

• **Integration value**

This indicator shows how many paths pass through one node relative to the other nodes (taking into account the shortest distance). The average Integration value in Daroos neighborhood is higher than Zargandeh neighborhood based on depth map analysis tool (Table 4).

By comparing the analytical output of the control value in Depth map and Agraph software, it can be

seen that the desired output in the neighborhood of Daroos is almost the same in both outputs. And this is also true in the map of outputs related to Zargandeh neighborhood and the outputs are not significantly different (Fig. 10). The ability to see what is happening in public can also be inviting (children are more motivated to go out and play when they see other children playing). Businessmen have always known that it is very important to be right where people are passing by and to have shop windows facing the street. The issue of short and controllable path between public and private environment is one of the inviting factors. Access to many spaces and activities through short routes can encourage their use.

Table 4. Comparison of output of indicators using Agraph software in Daroos and Zargandeh neighborhood. Source: Authors.

Indicators	Zargandeh Neighborhood					Daroos Neighborhood				
	Total Depth	Mean Depth	Relativized Entropy	Integration	Control	Total Depth	Mean Depth	Relativized Entropy	Integration	Control
<b>Min</b>	32	4	0	4	0	39	4	0	5	0
<b>Mean</b>	41	6	0	6	1	51	6	0	8	1
<b>Max</b>	55	8	0	8	1	68	8	0	11	1

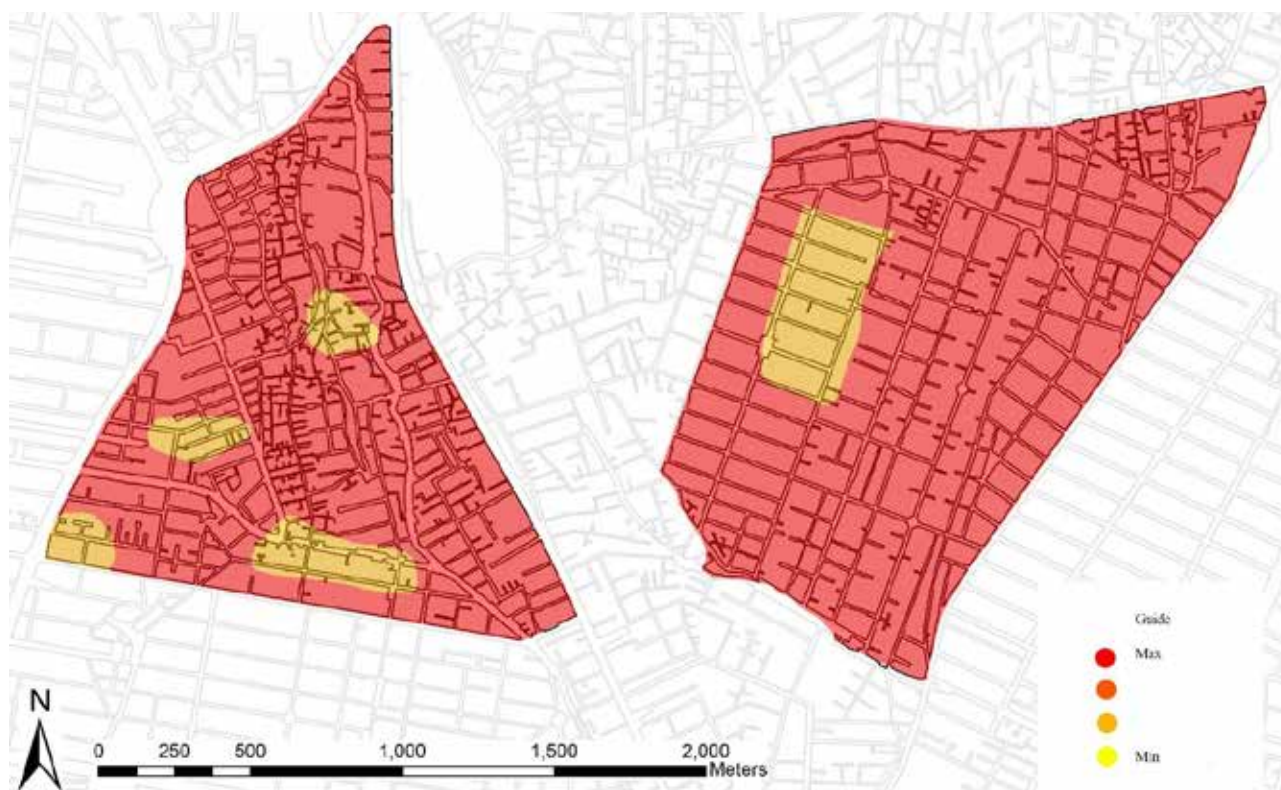


Fig. 10. Comparative analysis of control value index in Agraph and Depth map software in Daroos (right image) and Zargandeh (left image) neighborhoods. Source: Authors.

### Summary and conclusion

Due to the formation of behavior in space and its interaction with the physical environment, the importance of each component in the readability and formation of a positive space behavior is considerable. Also, the necessary arrangements and solutions for spatial design could be tailored to the psychological characteristics of individuals. Whereas people have different and diverse interests and personality traits it is not possible to speak with certainty about the same effect of the components on the spatial behavior of individuals whether or not enjoys the organization and capabilities in space. The correlation of organic structure of Zargandeh neighborhood, on average, is less than Daroos neighborhood with regular structure, and as a result, the accessibility in Daroos neighborhood is more than Zargandeh neighborhood. The study shows that the index of ggeneral depth in Daroos is higher than Zargandeh neighborhood, which indicates the possibility of faster access to different parts of the neighborhood, so it can be concluded that the regular and grid spatial structure has provided better access. But this does not develop behavioral patterns and pattern diversity, but merely enhances rider access.

Comparing the output of Agraph and depth map software in the integration index and degree of control, it can be concluded that both tools have a close analysis of the study of these two indicators in both neighborhoods. Of course, in examining the integration index in depth map software, there

is more difference with field surveys in Zargandeh than other conducted comparisons in this research.

In Daroos neighborhood, the dispersion of activity nuclei and its extent is more than Zargandeh neighborhood, and it is possible to use the applications in Daroos neighborhood in wider radii, and on a large scale, it is possible to have more access. The importance of this issue is that the promotion of daily and social activities in cities can be seen in a place that creates traffic areas and sidewalks in existing urban areas. Increasing this issue causes the emergence of more behavioral patterns in urban space. The urban analysis tools have well demonstrated the satisfactory analysis in two neighborhoods in terms of access, spatial features and uses (Table 5).

The results of this study emphasize the undeniable effect of the physical environment and the physical structure of the environment on the spatial behavior of individuals and states that the extent of the impact and formation of spatial behavior of individuals depend on the internal characteristics and personality of each person plus five senses and mental images from the structure of the environment Physical structure creates a quality in space that itself affects the spatial behavior of individuals in that space. In fact, in each environment, the formation of people’s spatial behavior is different (Table 6). This study confirms that, as in most of the researches, it was found that there is a direct relationship between physical characteristics and in fact the spatial organization of the environment and the formation of behavioral patterns are strong.

Table 5. Summary of output matching analysis in Agraph and Depth map tools with observations. Source: Authors.

Compliance rate	Comparison of integration output in Agraph and Depth map software	Comparison of integration output in Depth map and Observation	Comparison of integration output in Agraph and Observation	Comparison of Control output in Agraph and Depth map software	Comparison of Control output in Depth map and Observation	Comparison of Control output in Agraph and Observation
Zargandeh	High	High	High	High	High	High
Daroos	High	High	High	High	High	High

Table 6. Conclusions from the output of the tools used in the research. Source: Authors.

Neighborhood	Type	Conclusions from space syntax analysis	Conclusions from local observations and surveys
Daroos	Regular-grid	<p>- Existence of regular behavioral pattern in passages has caused and the level of access and integrity has been high as a result, access is facilitated to enhance pedestrian and movement patterns. Wide field of view provides the conditions for moving and increasing security and Land use patterns have become scattered due to the proper access due to the type of neighborhood texture.</p> <p>- This issue has limited the formation of diverse and many behavioral patterns in the whole neighborhood, except for some specific parts of the neighborhood. Proper access also facilitates the possibility of passenger traffic and encourages the use of the car along with the scattered user pattern.</p>	<p>- Conducted survey shows lack of mix uses and scattering of activities in neighborhood excluding one or two focal points has caused the pedestrian movement to be very limited to the neighborhood. With the desired conditions for the behavioral settings considered. The mental image of the citizens is mainly based on moving and not creating memories; which cause the perceptual image be formed mainly by riding.</p> <p>- Part of the daily needs of residents cause them to leave their neighborhood. Existing conditions caused social and voluntary behavior patterns in the neighborhood been unsuitable and, except in special cases, there is no general possibility of different age and social groups could use urban spaces, and the patterns are mostly person-centered and individual. Part of the daily needs of residents cause them to leave their neighborhood. Existing conditions caused social and voluntary behavior patterns in the neighborhood been unsuitable and, except in special cases, there is no general possibility of different age and social groups could use urban spaces, and the patterns are mostly person-centered and individual.</p>
	Irregular-Organic	<p>- Long passages, with heterogeneous accesses, which reduce the possibility of access to different spaces, have caused the behavioral patterns formed along streets. This structural pattern is a factor in the interaction of behavioral patterns and their reinforcement and diversity.</p> <p>- The organic texture of neighborhood has strengthened walking and increased the sense of exploration. Parts of the neighborhood have been separated from other parts due to low integration. Multiple dead ends reduced sense of security due to the presence of many corners and limited and low visibility.</p> <p>- The type of form and structure of the neighborhood has caused the pattern of local uses to be scattered and form service centers and daily uses in different parts of the neighborhood.</p>	<p>- Texture of the neighborhood has led to the formation of axes with very high performance in the middle parts, and this issue encourages resident's presence in urban spaces and results in the formation of different behavioral patterns. The existence of activities related to entertainment and recreation, religion and education encouraging the emergence of fixed and dynamic behavioral patterns. This encourages different groups and individuals use urban spaces.</p> <p>- Many of the needs of the residents in the neighborhood are met and there is no need to leave the place along with quality of public spaces and their number is another reason. There is no space for pause and sit, except for the local parks and green spaces where this is possible, and it is the pattern of use that gives rise to behavioral settings.</p>

**Endnote**

1. The division of perception of the type of activities in the two neighborhoods has been done based on the experiences of Yan Gehl (2017) in similar researches.

**References list**

- Abbaszadegan, M. (2002). Ravesh-e chideman-e faza dar farayand-e tarrahi-ye shahri [Space arrangement method in urban design process]. *Urban and Rural Management*, 9, 64-75.
- Alexander, Ch. (1979). *The Timeless Way of Building*. NY: Oxford University Press.
- Barker, R. G. (1968). *Ecological Psychology: Concepts and*

*Methods for Studying the Environment of Human Behavior*. Stanford, CA: Stanford University Press.

- Gehl, J. (1987). *Life between Buildings: Using Public Space* (J. Koch, Trans.). Washington: Island Press.
- Gehl, J. (2017). *Life between Buildings: Using Public Space* [in Persian] (A. Akbari, F. Karamian & N. Mehrabi, Trans.). Tehren: Parham Naghsh.
- Hillier, B. & Hanson, J. (1984). *The Social Logic of Space*. Cambridge: Cambridge University Press.
- Hillier, B.; Penn, A., Hanson, J., Grajewski, T. & Xu, J. (1993). Natural movement: or configuration and attraction in urban pedestrian movement. *Environment and Planning*, 20(1), 29-66.

- Izadi, M. & Sharifi, A. (2015). Evaluating Carl Frish's design on spatial structure configuration concerning old contexture in Hamadan (using space syntax technique). *Bagh-e Nazar*, 12(35), 15-26.
- Lynch, K. A. (1960). *A Theory of Good City Form*. Cambridge, MA: The MIT Press.
- Paknezhad, N. & Latifi, G. (2018). Recognition and analysis of the formation of the physical form of the Zargandeh & Daroos neighborhoods. *Journals of Urban and Regional Development Planning*, 3(5), 29-53.
- Rismanchian, O. & Bell, S. (2010). The application of space syntax in studying the structure of the cities. *Honar-Ha-Ye-Ziba: Memary Va Shahrsazi*, 2(43), 49-56.
- Vibæk, K. S. (2014). *Architectural System Structures: Integrating Design Complexity in Industrialised Construction*. Oxford: Taylor & Francis.
- Wicker, A. W. (2012). Perspectives on behavior settings: With illustrations from Allison's ethnography of a Japanese hostess club. *Environment and Behavior*, 44(4), 474-492.

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**HOW TO CITE THIS ARTICLE**

Paknezhad, N., Tabibian, M. & Latifi, Gh. (2021). The Formation of Behavior Patterns in the Spatial Organization of Neighborhoods Zargandeh and Daroos Using the Agraph Software. *Bagh-e Nazar*, 18(97), 49-64.

DOI: 10.22034/BAGH.2020.242285.4622

URL: [http://www.bagh-sj.com/article\\_130954\\_en.html](http://www.bagh-sj.com/article_130954_en.html)

