

Original Research Article

Quantitative Explanation and Evaluation of the Qualitative Factors of Public Spaces Using the Space Syntax Method (Case Study: Ferdows Garden in Tehran)

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Received: 23/02/2023 ;

accepted: 25/06/2023 ;

available online: 23/10/2023

Abstract

Problem statement: To increase the efficiency of the social function of the public space, urban researchers have listed many features in various conceptual models. It seems that these qualitative characteristics can be categorized under the configuration of space to converge the concepts and to evaluate them quantitatively.

Research objective: There is a cause-and-effect relationship between the qualitative factors that influence the ability of a space to shape public urban life. These factors can be evaluated through quantitative and qualitative methods. This research tries to put the necessary factors that increase the quality of the space in a more comprehensive category and evaluate them through the integration of the above methods.

Research method: The present study is applied research in terms of purpose. It used a descriptive-analytical method. First, qualitative variables effective in constructing and forming public spaces were identified and categorized by reviewing the literature. The factor of accessibility was identified as a common factor that all theoreticians have emphasized. This factor was considered to be the basis of using the space syntax method. The space syntax evaluated the qualitative characteristics of the space at the macro level. Then the results were discussed using logical reasoning.

Conclusion: The findings of the research showed that the analysis of spatial qualities can be defined in a two-step process: first, in an initial evaluation, the public space is analyzed at the macro level through axial maps based on the level of accessibility and mobility, which is the basis and foundation of spatial qualities. In the second stage, to measure how the space is experienced by the users, a micro-scale investigation should be done on the site by referring to analytical techniques such as questionnaires, mapping, surveys, etc.

Keywords: *Public space, Space syntax, Sociability of space, Spatial configuration, Ferdows Garden.*

Introduction

Social relations are formed through urban spaces

(Tonkiss, 2006). There is no way to detach social relations from spatial relations and there is an interrelationship between these two, so contemplating about one of them leads to missing

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a necessary part of an image (Elden, 2009 as cited in Baghernejad Hamzehkolaei, Haghir & Khaghani, 2023). Indeed, most human interactions have been characterized by urban interactions since the 18th century (Frouzandeh & Mansouri, 2019). According to Lefebvre, social relations are not real except in and through space (Harvey, 2008). He argues that social relations are a social reality, which forms space (Beauregard, 2011 as cited in Baghernejad Hamzehkolaei, 2023). Therefore, social relations are spatial relations; one of them without the other cannot be examined (Harvey, 2008). The spaces in which strangers meet and social relations are formed are called public arena of the city. The term “public”, when used as an adjective, refers to both people and the space. On the one hand, it refers to the people in a country and, on the other hand, it refers to space accessible and used by a large number of people and contrasts private space. According to (Lim, 2014), the spaces in which “people with different origins and lives can come together under no obvious government control, commercial or private interests, or superiority of one group over another” (Douglass, Chong & Ling, 2002 as cited in Lim, 2014) are civil spaces. Researchers consider three general features of public space: 1. being free, 2. lack of time limitations in accessing the space, and 3. the possibility of using all social groups from space without considering gender, age, race, and other factors (Magalhaes & Trigo, 2017 as cited in Pourahmad, Ziari, Hataminejad & Rezaeinia, 2018). They believe that these features contribute to social interactions among people and civil life and citizenship. Urban public spaces underlie and form the experiences of social interactions and create social and civil spaces for people (Barati & Khademi, 2018). There are different studies on factors affecting the quality of public spaces. Researchers have considered characteristics such as continuity, confinement, personality, ease of mobility, legibility, diversity, and adaptability as necessary features for a public space. These spatial qualities can be examined using quantitative and

qualitative methods and techniques. Some studies have qualitatively investigated the space using methods such as taking photos, questionnaires, observation, and visual maps, and some others used numerical analyses. One of the quantitative methods with high validity is the space syntax method.

The space syntax method was developed by Hillier and Hanson in 1984 in London. Hillier believed that spatial and social forms are closely related and that spatial configuration can define many social patterns by itself, such as the distribution of land use, mobility, crimes, location of immigrants, and so on (Hillier, 2007). With an emphasis on morphological analysis and using the Depth map program, this method forms maps based on the mobility of pedestrians and evaluates the space quality using factors such as mean depth, connectivity, integration, and choice. It seems that there is a causal relationship between the qualitative factors affecting the ability and capacity of a space in forming urban public life. This study hypothesized that there is a significant relationship between qualitative factors and indices of the space syntax theory. Therefore, it sought to identify these relations and organize them in a relationship model and find answers to these questions: 1. Is there a relationship between the creation of a quality public space and quantitative indices of the space syntax theory? 2. What does the identification of the possible relationship contribute to the body of the existing literature?

Research Background

The discussions on common concerns about rational and critical arguments in public space date back to the 18th century (Madanipour, 2003). Durand, one of the revolutionary architects of the 18th century, believed that the purpose of architecture was to achieve specific benefits for the public, their happiness, and human survival (Collins, 1998). Ledoux's designs of the ideal city focused more on schools, workshops, public baths, and public buildings rather than temples (ibid.). In tracing the historical context of this issue, Habermas refers to

the French word “Le Public” in the 17th century, which referred to speakers, audiences, and critics of art and literature. This culture was formed and extended from the bourgeoisie to public cafes and coffee houses. He believed that the halls, theaters, and cafes in 18th century in London were official spaces of a public realm since opinions could be exchanged, and communication, beyond formal transactions of life, could be developed (Habermas, 1974; Habermas, 1989 as cited in Tonkiss, 2006). In any form of dialogue or conversation through which people gather to make a community, a part of the public realm is formed or created. Here, people as citizens are involved in public interests and benefits (Habermas, 2005 as cited in Rabiee, Alikhani & Gholami, 2012) and discuss public issues on their common concerns in a logical and non-obligatory form (Bourne, 2017). According to Habermas, the public realm is a part of social life in which public thoughts are made (Habermas, 2005; Yazdkhasti, Adlipoor, & Sepehri as cited in Ghezelsoufi & Doostmohammadi, 2018).

The space related to the public realm is called public space. Indeed, public space is the physical appearance of the public realm (BanderAbad, Moradi, Kavoshnia & Aali, 2015), which finds no meaning without individuals (Madanipour, 2003; Ashrafi, Pourahmad, Rahnemaie & Rafieian, 2014). Habermas defines public space as any space where individuals can express themselves and their opinions, participate in public life (Sohrabi, 2016) and is accessible to anyone (Habermas, 2013). The public space is a place for the presence of different people and groups, the formation or emergence of various social networks, and an arena for impersonal communication, as well as simultaneous presence and coexistence. That is a place where different actors attend in a common place (Madanipour, 2003). Hannah Arendt names the space in which actions and words, agents, and events are considered subjects to be judged as the common space. She believed that this space is a space of “being and appearing simultaneously” (Babo & Silva, 2015).

She argues that the public space is a “public realm of emergence”, where “everything is observed and heard in the public”. Arendt developed the public space into a world of common actions, the world of between “self”, where one can relate and separate at the same time (Joseph, 1993).

The tasks of the public space are a means for communication, a place to face, and manage and coordinate-free citizens (Wolfgang, as cited in Rafieian & Seifaei, 2005). These spaces, either bars, clubs, and communities or churches are special spaces for social interactions and essential for the everyday ways of being together in[between] the public (Tonkiss, 2006). They are means of access to meeting places or places to roam, gatherings to be visible, to display, and places to protest (ibid.). In urban design and planning and architecture, the public space has different characteristics. After 30 years of working on the observation and study of public spaces, PPS (Project for public space) introduced the factors of public space: comfort and space image, uses and activities, access and linkage, and sociability. (Ravazzoli & Torricelli, 2017) relying on the theoretical and analytical issues provided by Jan Gehl (1987), Kevin Lynch (1960), Jacobs (1961), and William H. Whyte (1980), introduced 5 main indicators for the examination of public spaces and urban mobility: availability, accessibility, urban design, activities and functions, perception. Hannah Arendt considers a safe and secure place as a necessary precondition to attract people to the neighborhoods of the city for life, work, and activity (Arendt et al., 2008, as cited in Zarabadi, Habib, & Takalou, 2015). Zarabadi et al (2015) examined different studies of Chiarradia (2009), Bentley et al. (2008), Lynch (as cited in Lang, 2002), and Arendt (2008) on a model to design safe public spaces, and found five factors affecting safety and security of public spaces in the neighborhoods of the city: physical factors, functional factors, mobility and accessibility, perception-meaning, and urban management. (Salehi Mava, Khatami & Ranjbar, 2022) argue

about the event-oriented capability of urban public spaces as a tool to attract capital, economic growth, and increase urban vitality, and considers 5 factors of accessibility, spatial connection, spatial facilities, inclusiveness, and security to be effective on the formation and durability of events.

In their study, (Razzaghi & Khoshghadam, 2016) provided a list of indicators affecting the environmental quality from the theorists' points of view from 1961 to 2003. Almost all theorists mentioned the factor of accessibility in their studies. Lynch (1981), Appleyard & Jacobs (1987), Greene (1992), Congress for new urbanism (1993), The challenge of urban design: A review of the national seminar (1996), Punter & Carmona (1997), Smith, Nelischer & Perkins (1997), Urban Taskforce headed by Richard Rogers (1999), Carmona (2003), and PPS (2003) clearly and explicitly mentioned the role of accessibility. Jacobs (1961), Bentley (1985), Goodey (1993), and Haughton & Hunter (1994) also pointed out the factor of permeability that is the result of accessibility. Trancik (1986), Coleman (1987), London planning advisory committee (1993), and Nelessen (1994) emphasized pedestrians' mobility. Finally, Violich (1983), Southworth (1989), Tibbalds (1988, 1990, 1992), and the Department of the Environment, transport & the Regions (2000) discussed the role of eligibility of place. Since it is not possible to read a place and evaluate its clarity without moving in there, then this class of studies also pointed out the role of accessibility through mediation. Thus, it seems that the factors of accessibility and mobility are the most effective in the formation of public spaces. Indeed, the primary ideal of public space is based on equality in access (Tonkiss, 2006). Urban mobility leads to the integration of urban and social layers, such as the formation of continuity in urban mosaics or the creation of a correlation between intertwined urban structures. In this case, urban activities or nodes are considered a superposition of focal points of the city (Stipicic, 2016). Isaac Joseph uses the concept of affordance of public space and expands it

in the form of freedom of circulation and movement. He believes that it makes the city accessible to the passerby or residents, and gives affordability to the city. He also argues about another important factor, visibility, and considers it essential for providing access to various spaces (Joseph, 1993). Urban mobility produces a better and more vital public space. Providing a variety of urban mobility, including the spaces for people to walk, ride, sit, stand, wait, and communicate, determines how people decide to move in the city and surroundings, and consequently affects economic, environmental, and social sustainability (Ravazzoli & Torricelli, 2017). A method that examines the relationship between spatial form and the presence of people in society through an emphasis on mobility is the space syntax theory. From this point of view, the main structures of space form behavioral patterns (Hillier, & Hanson, 1984, as cited in Rismanchian & Bell, 2010). The examination of spatial form contributes to assessing the social efficiency of spaces as well as the variety of social actions in these spaces. This theory emphasizes that the role of each urban space and the individual characteristics of that space on a micro level (such as form, shape, color, and texture) is of less importance compared to its role in combination with other elements of the city and its characteristics on a macro level and the whole urban system (Hillier, Penn, Hanson, Grajewski, & Xu, 1993, as cited in Rismanchian & Bell, 2010). The general theme of this theory is to divide the elements of the space into its components and then analyze it as a network of relations in the form of maps and pictures (Çamur, Roshani & Pirouzi, 2017). The indicators of this method, i.e., mean depth, connectivity, integration, and choice, were used in the present study.

Theoretical Foundations

The present study hypothesized that the examination of accessibility evaluates the possibility of the formation and grounds of the features of a public space, which were investigated in the literature.

To examine accessibility, the space syntax method was used in this study. In this method, the spatial relations are shown in a graph in which each space is shown with a node, and the relation between the spaces is shown with a line.

• Mean Depth

Depth is the smallest spatial step taken from one node to other nodes in the graph. The spatial step in an axial map is the redirection of one line to another or the nodes left behind in passing one node to another node in the graph (Rismanchian & Bell, 2010). The lower the depth is, the closer the relationship between the node and other nodes is; it is more accessible. A greater depth indicates that the space is more isolated. Increased accessibility leads to increased presence of people, and increased natural surveillance, resulting in an increased sense of security. Natural surveillance leads to reduced crimes, and the sense of spatial security provides the grounds for pedestrian orientation and feeling comfortable in space. These factors influence the formation of an appropriate image of a dynamic and lively space.

• Connectivity

Connectivity refers to the number of nodes that are directly connected to a node; in other words, the distance between them is just one spatial step (ibid.). Connectivity is the most illustrative parameter in morphological analyses. Spatial Connectivity refers to the extent of connection with other spaces and thus is directly related to accessibility. The spaces with higher connections are considered more central. Increased spatial connection leads to the increased presence of users and provides the grounds for the formation of various uses, economic prosperity, and sociability, resulting in the formation of social identity.

• Integration

It is the average mean depth that is traveled to reach all the nodes in the system from one node. The integration value of a line or space is the average number of lines that can be reached from one line to all other lines in the entire system. Logically, the

smaller the average mean depth is, the desired node has a close relationship with other nodes, and as a result, that node is more accessible. These passages have more connectivity. The higher the average depth is, the more isolated the space is (ibid.). The integration of a node is related to the extent the node is used or the extent of foot traffic. So, this factor is considered as the potential of movement (Raford, & Ragland, 2003; Penn, 2003; Hillier, 1996 as cited in Bahrainy & Taghabon, 2012). The integrated spaces lead to increased spatial permeability, and increase flexibility; and since they are more accessible, they are effective in increasing the readability and participation of users.

• Choice

If space is more likely to be used in traveling the shortest routes between two possible spaces in the entire urban system, it is more likely to be selected. The more accessible a space is, the more likely it is to be used in the shortest existing routes between two possible spaces in the entire urban system and be selected by the users (Rismanchian & Bell, 2010). An increase in the number of choices leads to an increase in the value of the space, growth in security, mounting the possibility of the formation of attractive spaces, and spatial continuity.

The space syntax method is based on spatial arrangement. In the first step, the spatial configuration forms the natural movement of people in spaces, and then, places organize themselves around the natural movements to be used as the places of people's presence (Hillier, 2007). It is not clear how places should be organized and to what extent they are successful in producing a public space. However, accessibility, mobility, and pedestrian orientation are the required conditions to form other spatial qualities, which have been mentioned in the existing literature for a good public space.

Research Method

The present study is applied research in terms of purpose. It used a descriptive-analytical method.

The library research method was used to collect, summarize, classify, and categorize data related to the theoretical views and relevant literature. To achieve the goals of the study, the variables to evaluate the environmental qualities of public spaces were selected from the existing literature. A review of the records showed that there was no comprehensive model or a coherent system to evaluate the environmental quality of public spaces. However, there was a common indicator, i.e., accessibility and mobility in the space. The research question was whether it is possible to establish a relationship between the spatial qualities to provide a more comprehensive evaluation of indicators. To this end, the space syntax method was used. In this method, the physical structure of the city is examined based on the shape specifications of the space and the axial map, and the results are presented in mathematical and graphical parameters. The reason to use this method was that it focuses on the movement and presence of individuals in space. Then, a real case, i.e., Ferdows Garden of Tehran, was selected to assess the hypothesis. The case was analyzed using the space syntax via the Depthmap program. The input was the urban network maps and the output was visual maps. Therefore, a qualitative phenomenon was evaluated quantitatively (Hillier, 2007). Finally, the visual maps and tables of results were discussed and examined using logical reasoning (Fig. 1).

Ferdows Garden is an urban historical space in Tehran, known as one of the liveliest urban spaces in Tehran (Lak & Jalalian, 2022). The garden is a valuable historical mansion, which dates back to the reign of the Qajar dynasty in the district of Shemiran

in old neighborhoods of the garden. With an area of about 20000 m², the garden is known as an urban space attracting individuals, and as a social-cultural hangout in District 1 and even in the city of Tehran in both urban and suburban levels (ibid.). Relying on the documents, Ferdows Garden includes 3 parts: the main garden (outer which is called Birooni), the internal garden (which is called Andarooni), and the Ghalamestan garden. What is now known as Ferdows Garden is only a part of the vast and historical garden that has changed over time (Jayhani & Mansori, 2012) (Figs. 2&3).

Findings

The literature shows that various qualitative factors affect the ability and capability of a space to form public life in a city. These factors have a lot in common and many have cause-and-effect relationships. All of these factors focus on attracting people and increasing their presence. Indeed, all qualitative factors find meaning in the presence and attendance of users. Users attend in the space if they can have accessibility and mobility in space. To answer the question of the present study, Ferdows Garden of Tehran was selected as the case study. First, the urban map as the input was taken in the Depthmap program, and the program divided all urban spaces into convex spaces (Rismanchian & Bell, 2010). In reading the maps, the warmer colors indicated that the indicator was higher and the colder colors indicated that the indicator was lower.

• Mean Depth

Fig. 5 shows the streets with the lowest depths. These streets were passages that has the highest integration. The mean depth graph showed little dispersion.

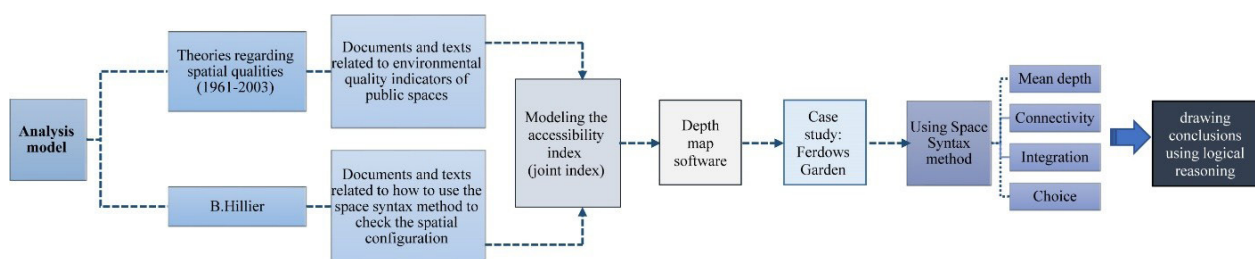


Fig. 1. Research process diagram. Source: Author.



Fig. 2. Left: Ferdows Garden area and its related gardens based on matching the old streets with the current streets. Source: Jayhani & Mansori, 2012.

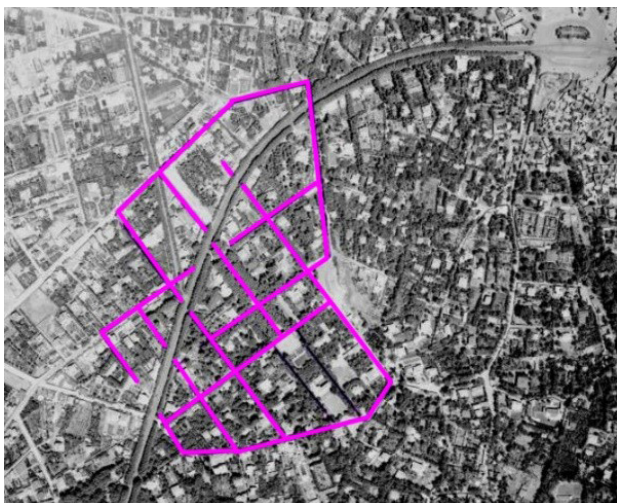


Fig. 3. Right: Marking the traces of original garden streets in the context existing in 1335. Source: Jayhani & Mansori, 2012.



Fig. 4. Converting the city map into a map of convex spaces and then forming an axial map. Source: Author.

• Connectivity

Streets 46, 32, 42, 37, and 39 had the highest rate of connectivity. Valiasr Street (numbers 39, 42,

and 46) had the highest rates of connectivity. The connectivity graph showed lower jumps. In other words, Tousi Street (left from the old garden) and Valiasr Street (the most important historical and north-south route of Tehran) had the highest rates of connectivity compared to other passages and the rest of the roads have a steadier connectivity. The length of the abovementioned streets has increased the connectivity and contact level in the passages (Fig. 6).

• Integration

Investigations show that out of the 5 passages that have been chosen the most, 4 passages 32, 37, 58, and 42 have shown the highest rate of integration. The integration graph showed the lowest rate of dispersion and jump, indicating that all passages had almost homogeneous (Fig. 7).

• Choice

Graphs showed that streets 32, 38, 37, 58, and 43 had the highest rates of choice. These streets are the original passages known as the old streets of the garden, including Ferdows Garden, Ghalamestan Garden, and Andarooni Garden. Indeed, these passages are used as the shortest ways in the entire urban system since they are connected to other passages of the urban network. The difference between the highest and the lowest values of choice was high and the graph had sudden jumps. The jumps showed that the main streets left from the old garden have a much higher rate of selection than other streets (Fig. 8).

Discussion

Various techniques and indicators have been suggested to evaluate and measure the quality of urban spaces. These indicators are almost determined and certain. However, different theorists have investigated them in different models. The gap in these concepts and ideas is due to differences in field, scale, context, and time framework (Kamp et al., 2003; Adams, 2014 as cited in Razzaghi & Khoshghadam, 2016). The present study showed that a large group of these important factors and

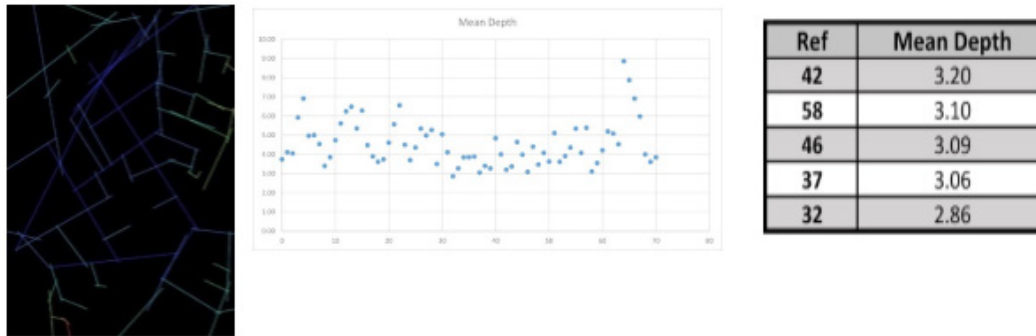


Fig. 5. From left to right, linear map, graph, and table of mean depth. Source: Author.

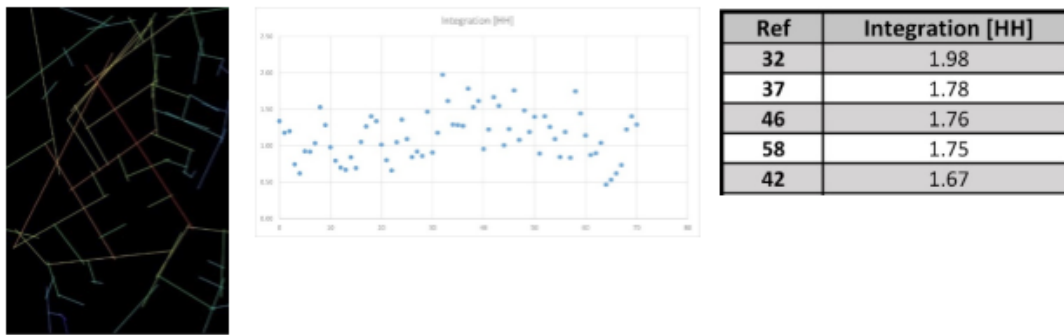


Fig. 6. From left to right, linear map, graph, and table of connectivity. Source: Author.

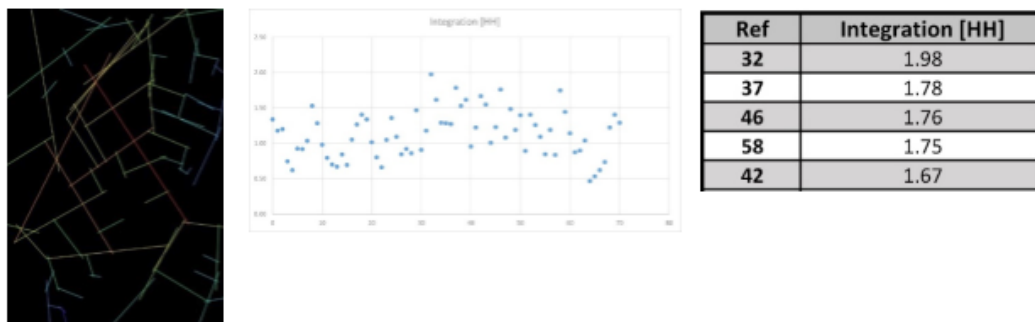


Fig. 7. From left to right, linear map, graph, and table of integration. Source: Author.

indicators to evaluate the quality of public spaces can be put under the title of shape characteristics of space in the form of a larger classification, and they can be examined using the space syntax method. The study hypothesized that many qualitative characteristics considered to form a dynamic public space can be quantitatively investigated. The

selection of the public space of Ferdows Garden was important for some reasons: 1. Ferdows Garden is a public space located near Valiasr Street, an important and historical street in Iran; 2. The social groups who use it include both intellectual and common people who are looking for entertainment; 3. This space has a strong historical record in terms of physical age,

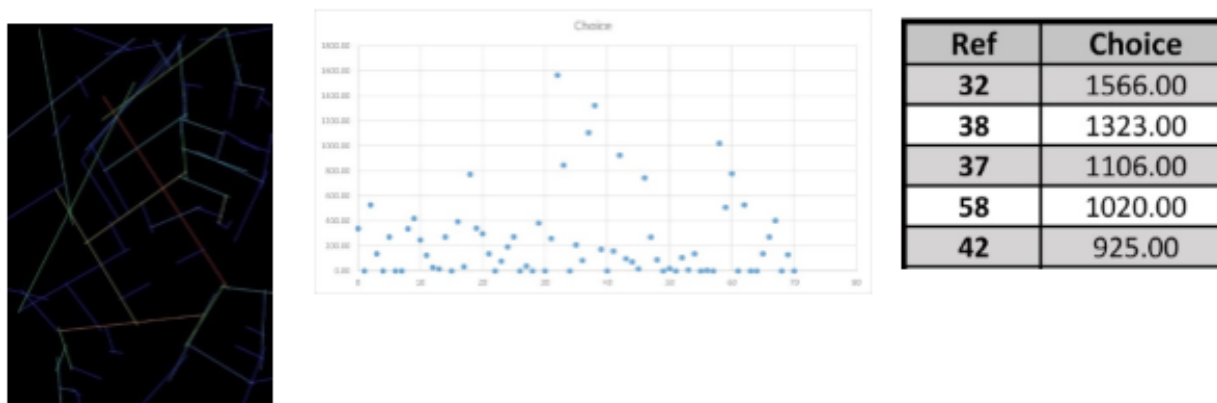


Fig. 8. From left to right, linear map, graph, and table of choice. Source: Author.

the age of using the space, and being present in it in the historical memory of citizens in Tehran (Mansouri & Atashinbar, 2014). The examination of tables and maps of the space syntax showed that the main streets of the old garden play an important role in the choice, connectivity, and integration of space (Fig.9). The streets of Bahman, Toutouchi, Delbar, and Ladan, which are the 4 passages left from the old garden, along with Valiasr Street as the main and historical road, had the highest rate of choice, connectivity, and integration, and the lowest rate of spatial mean depth. Therefore, the lower depth increases permeability, and in turn accessibility, and reduces crimes, leading to an increased sense of security in the space. Physical accessibility itself is one of the factors that provide visual accessibility and, as a result, the legibility of space. Moreover, accessibility prevents physical isolation and increases spatial connection by providing natural movement for the user. This provides the grounds for diversity in activities. Spatial variety contributes to the formation of different arenas in spatial configuration and consistency with different situations. On the other hand, spatial connections and access rings can cause spatial integration or separation, as well as provides the possibility of connecting the space with the surroundings, making spatial continuity. All of these factors result in the presence of people in the space and a reduction in social-spatial isolation. Increased presence leads to increased event orientation that finally over time will increase the possibility of being memorable and the

desire to be in the space again and again. Therefore, it seems that the extensive geometric and homogeneity of the structure left over from the old garden play an important role in inducing a sense of place in the users. The structure (shape and formal characteristics) and meaning of Ferdows Garden (Medghalchi, Ansari & Bemanian, 2014) have caused a clear line between public and private space to appear in the spatial organization. Although the entire space of Ferdows Garden emerges in the form of a public space, its place and appearance in the structure of the city are presented in the form of a semi-private (vs. public) space. With a recess from the crowded axis of Valiasr Street, this space forms a public space that is considered a private space in the heart of District 1 and next to the crowded and important Tajrish Square, and, in Lefebvre's words, has a lively and dynamic lived and experienced space (Lefebvre, 1991; Harvey, 2008). The contribution of the main streets of the garden and the historical axis of Valiasr Street in such a lively and dynamic atmosphere is not deniable. The presence of green spaces left from the old garden and waterways and the old plane trees of the neighborhood and wide sidewalks are considered prominent indicators. Lak and Jalalian (2022) showed that the nature of the space (the current garden left from the old garden), greenery, clean air, the sound of birds and water, and the beautiful landscape are the factors that have played an important role in visitors' experiences of this complex.

Considering that the indicators of space syntax

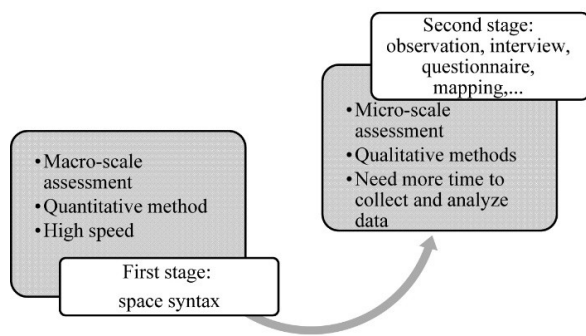


Fig. 10. Spatial quality analysis model of public space. Source: Author.

understand if there was a relationship between the factors affecting public spaces to provide a more comprehensive classification of the issue. It tried to expand and analyze the issue by examining a real case. In the research process, it was indicated that the factor of urban mobility was a factor emphasized by all theorists in this regard. This factor by itself led to the integration of urban layers, continuity, and correlation in urban structures. Mobility in the space is the result of spatial configuration. Indeed, the spatial configuration provides access and permeability in urban spaces, and then it leads to the formation of spaces attracting individuals. The study showed that using the factor of accessibility as a basis, an initial evaluation of public space can be performed based on the space syntax method. This method evaluates the space on a macro level. However, the examination of the case study indicated that it does not present a comprehensive and complete image of the environmental quality because it analyses the space based on axial maps that are two-dimensional. But the real urban spaces are three-dimensional, which are influenced by many factors present on the site. Therefore, it is suggested to evaluate a micro level in the second stage. In this stage, current real life in urban spaces can be examined by considering human factors and using existing research methods such as observation, interviews, and visual mapping. Therefore, in analyzing the sociability of public space, the quantitative and qualitative methods complement each other.

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HOW TO CITE THIS ARTICLE

Baghernejad, B. (2023). Quantitative Explanation and Evaluation of the Qualitative Factors of Public Spaces using the Spatial Syntax Method (Case study: Ferdows Garden in Tehran). *Bagh-e Nazar*, 20(125), 45-56.

DOI: 10.22034/BAGH.2023.387019.5341

URL: https://www.bagh-sj.com/article_178204.html?lang=en

