

Qualitative content analysis: Components influencing the city structure imageability

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Original Research

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Abstract:

Aims: The structure of the city, as one of the main components of the city, which has a significant impact on the citizens' understanding of the city as a whole and it provided imageability of the city. The process of forming people's mental image of the city structure is formed following how they interact with the surrounding environment. This study explores the components influencing the imageability of city structures, emphasizing the interplay between physical, functional, and semantic dimensions in shaping citizens' mental images of urban environments. As cities expand, the complexity of urban structures grows, making it challenging to maintain coherence and legibility.

Methodology: The current research method is "descriptive-analytical", the research is "fundamental" in terms of nature, and its approach is "qualitative" with an inductive approach, examining 145 scientific texts (articles, books, and theses) from 1940 to 2024 to identify key factors affecting urban structure imageability. the present research is in three stages (ready creation, organization and reporting). The selection of texts was done with targeted sampling and manual coding.

Findings: The findings reveal that urban structure imageability is shaped by three primary dimensions: physical (e.g., spatial connectivity, landmarks), functional (e.g., movement patterns, activity centers), and semantic (e.g., cultural, historical meanings). The study highlights the importance of legibility, coherence, and complexity in creating a clear mental image of the city, which in turn influences citizens' behavior and spatial cognition.

Conclusion: A conceptual model is proposed, integrating these dimensions to enhance urban design and planning practices. The research underscores the need for a balanced approach that considers both the objective physical structure and the subjective mental perceptions of citizens, offering valuable insights for creating more legible and imageable urban environments, and what is important in evaluating the visualization of the urban structure is the relationship between the elements, not the coherence of each element alone.

Keywords: City structure; Perception; Mental image; Imageability; Legibility

1. Introduction

Due to the enlargement of cities and the impossibility of controlling all its components within the framework of the focused and conscious activity of urban design and planning, the use of the concept of main structure and construction is inevitable [1].

According to existing theories, the main factors of structure It consists of main communication axes, major open spaces, major activity centers, main city elements and public buildings [2, 3].

The main structure of the city is one of the main pillars of the city, which has a significant impact and an important

role in the citizens' evaluation and understanding of the city. It can be said that by considering and examining the urban structure simultaneously, it is possible to achieve opposite goals such as stability and change, cohesion and diversity, control and freedom. In this case, the structure of the city creates an opportunity for all urban functions and types of human communication to be placed in a coherent network, interwoven and close to each other, in order to establish a strong link and connection between the most important and main elements and urban spaces. The clarity and readability of the structure is a privilege for the city, because it will seek to organize the main identity of the city (especially in connection with its old context) [4]. Paying attention to

the mental image and citizens perception of this structure, which displays the whole city like the bones and skeleton of a body, is one of the topics that can be analyzed from all dimensions, including physical, visual, semantic, social, economic, and ... and influence the behavior of citizens. recognition this structure will be an important step in the direction of identifying a Systematic framework for the legible and imageable city with a coherent structure. Paying attention to the issue of perception of the city structure, not only the physical connection and connection of activities in the space is considered; Rather, it will lead to a clear understanding of the city's structure and, as a result, help to create legibility, the formation of a sense of direction and integration (structural unification) of the city's structure. Despite the special importance of a clear and coherent structure, in the past years, urban master plans, along with encouraging less compact growth and by imposing zoning regulations and separating the main urban functions, have caused further disintegration of the structure of cities. In this research, we seek to present a conceptual model of the components and relationships of the elements of the city structure in order to imageability the structure.

2. Methodology

The current research method is “descriptive-analytical”, the type of research is “fundamental” in terms of nature, and its approach is “qualitative” on the subject of city structure imageability. The unit of analysis is scientific-research texts (articles and books, theses) in the field of imageability, perception, mental image, urban structure, which are indexed in international and national reliable databases. The method of data analysis is based on qualitative content analysis with an inductive method. As a result, among the selected works, the themes and content of the texts (sentences, paragraphs, tables and forms in each text) were examined and the research results were obtained through the extraction of categories and their classification. In this research, the

classification the categories include similar and congruent items, and secondly, it was in such a way that first, very detailed and small concepts and themes were removed so as not to lead to incomplete and contradictory content. In accordance with the general structure of qualitative content analysis, the present research is in three stages (ready creation, organization and reporting) [5]. The selection of texts was monitored by purposeful sampling and manual search. All references and information were manually coded and summarizing the methods, the results and the literature of the subject has been examined, so that variables such as the quality of journals and magazines, the date of publication, the indexed database, the degree of credibility and the accuracy of the texts, and an effort was made to select the most reliable sources from among the published sources and works. The sample started by searching for articles published in scientific databases that are not limited to specific disciplines. Then by searching key words such as urban structure, imageability, mental image, configuration, legibility and a combination of these words, related texts were collected and in order to select carefully, key points and abstracts of 375 articles and books and Theses found were studied for initial screening. Reference lists of selected articles were also reviewed to discover additional relevant research. The selection criteria and the selection process of the texts required publications or full text descriptions, publication in English and persian and the time period from 1940 to 2023 AD. On the other hand, there was no limitation for the scale and place of publication. After the final screening, 145 articles, books and theses were reviewed for qualitative content analysis (figure 1). In short, the qualitative content analysis of the current research was organized in three stages 1. A series of written works on the urban structure imageability was collected through international and national scientific databases (number of 345 articles, 6 books and 21 theses); 2. Among the collected sources, 145 items were selected for full evaluation. 3. Specifying the

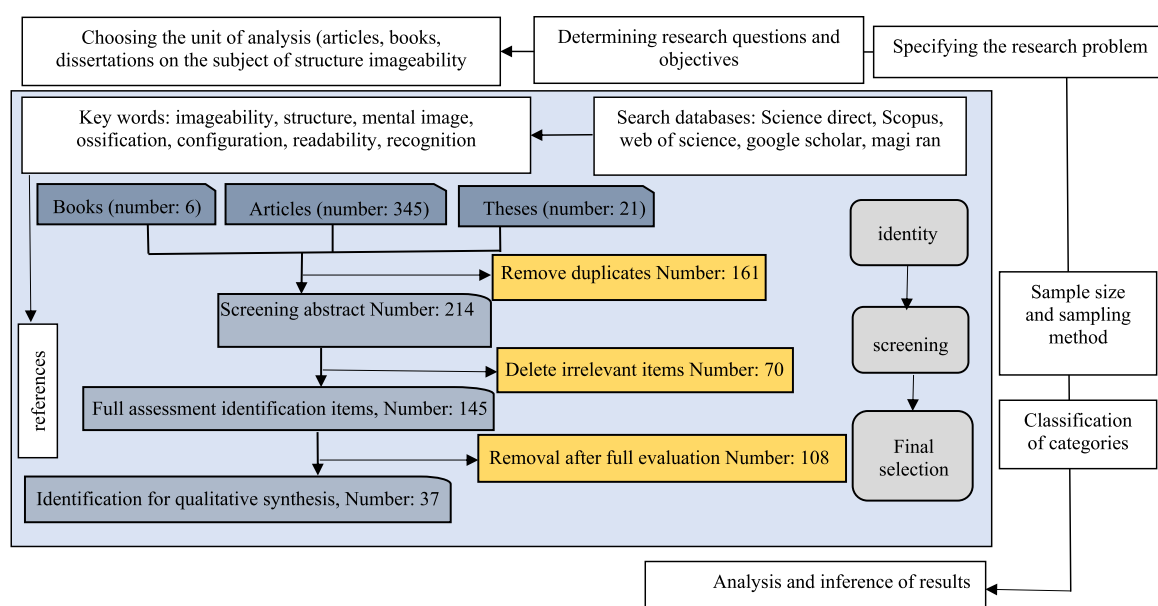


Figure 1. The process of doing research (source: author, 2022).

scope of urban structure imageability topics in the selected sources and classifying major categories along with their in-depth analysis, which is a kind of innovation and expansion of the knowledge boundaries of the structure imageability. It is considered a city; it was done in the third stage. At the end, a theoretical model is obtained based on qualitative studies.

3. Research literature

3.1 Environmental perception process

The mental image of a person is the result of the interaction between a person and the environment and the mentality that he has from the spatial links in the environment, and this mental image is a part of the process of perception of the environment by a person. The perception process of the urban environment plays a fundamental role in drawing and storing a person's mental image of the surrounding environment. [6] The environment appears in two types, geographical and behavioral. Geographical environment in the form of objective reality and behavioral environment is human experience. [7] The first layer of an urban environment is the physical layer, where buildings and complex topological relationships appear. The second layer is the historical layer, where physical metamorphosis and historical evolution are reflected. And the third layer is a layer, including different aspects (religious, individual, social) of the cultural experience of people from the environment. [8] In fact, people introduce themselves to the physical environment as a place from social environments. An environment includes a set of behavior stations that are next to each other and have common points with each other. [9, 10] So Perception can be described as a process in which sensory input is transformed into meaningful experiences and interpretations. As a result of the influence of internal and external factors and the selection of all environmental information through human cognitive experience, perception is combined with interpretations. Despite the conscious nature of

perception, the perception process of the environment is influenced by the person's background and his unconscious mental factors. [11–13] The mental evaluation process from perception to action can be seen below (figure 2).

3.2 Mental image

A mental image is a brief data that people, groups, organizations and societies create and use in their minds to observe, understand and represent the perceived phenomenon in the real world. [14] A mental image is A Picture-like representation of perceived phenomena in the human mind. [11] Image and mental image is a valued schema in a person's mind from an urban view that many physiological, individual, social and value factors play an important role in the formation of this mental image. Lynch considers the mental image of the environment to be the result of two main factors: firstly, his memories and experience, relationships and expectations, which provide a perceptual set of connections between the person and the landscape, and secondly, the three-dimensional knowledge received from the perspective that creates the mental image as a schema. It forms a diagram. [15] Appleyard believes that the creation of a mental image is rooted in the needs, experiences, and intellectual and mental capacities of people. [16]

the image of the city is a combination of cognitive and emotional elements. The first one includes features to recognize and identify the city. [17, 18] and emotional elements express the attitude and feelings of a person towards the urban space, which is created through past experiences related to the place, its residents, and related objects and organizations. [17] Emotional conflict and reminiscence of collective memories can have a great effect on strengthening the image of a city and cause it to be strengthened. [19] It can consider a set of map-image or map-perception of a city; a set that people have extracted of physical existence of a city, this extracted image is the image of city. [20]

Mental images are dynamic in nature due to the changing nature of existing cognitive and emotional elements, as not

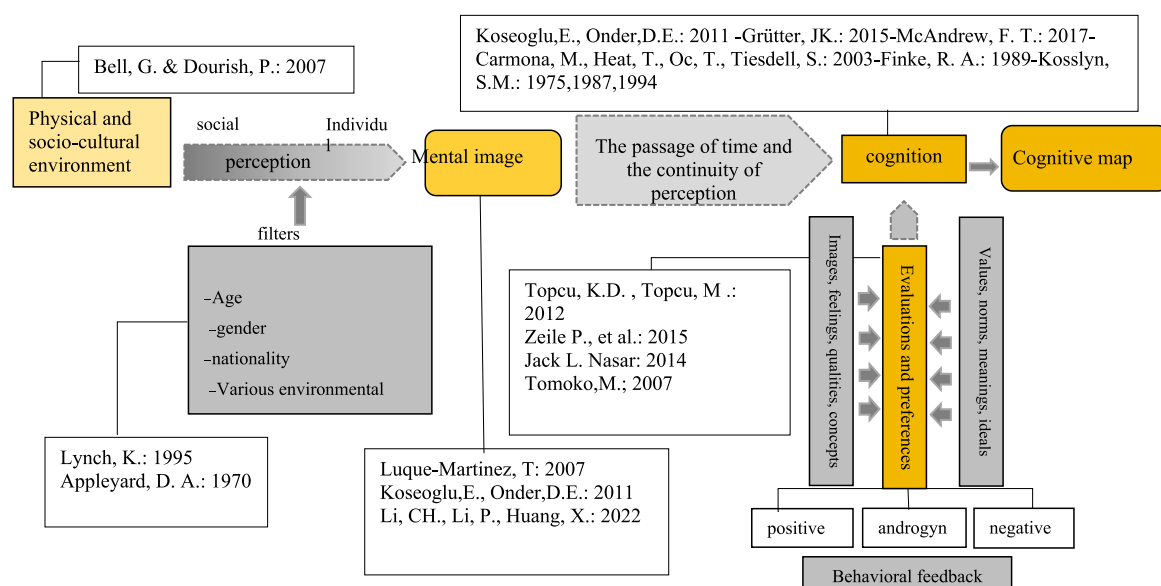


Figure 2. The mental evaluation process from perception to action (source: author, 2022).

only the elements themselves but also the relationships between these elements are changing. [18] This mental image of the environment is the sum of the values and qualities that emerge in the human mind from the environment, which mostly does not overlap with the existing realities, so a person behaves based on this image and not based on reality. [11]

According to what was said, the mental image cannot be obtained in a precise and holistic way, and only by continuous interaction with the environment and repetition and strengthening of these mental images, a spatial knowledge of the environment is created, and the structure of this knowledge is formed through specific steps. Different forms are formed. First, symbolic knowledge is formed as characteristics with discrete knowledge of environmental characteristics, the spatial relationship between which has not yet been established. After that, in the evaluation phase of spatial knowledge, more complex sequential structures are formed, that is, path knowledge, which remembers the signs experienced along the path. At this phase, their complex spatial relationships have not yet been revealed. In the continuation of the interaction with the environment, a surveying knowledge is formed, which enables them to locate and infer directions and distances. (figure 3) [21]

The formation of all these stages in the human mind and the understanding of the relationships in the space that causes the formation of spatial knowledge can be considered as a factor to recognize the structure of the environment, which creates a clearer understanding of the environment, which is imageability.

3.3 imageability

Image of the city is real manifestation of the lifestyle and insight of its inhabitants. In a way that throughout history, geographical factors, has never had such a decisive impact on the way people's life and their insights. This image is the foundation of any interaction of the individual with the environment. [20]

In order to perceive any space by users, it is very important to read it as a setting and then have related images of the space in the mind, load meanings for it, evaluate the space and finally act with these evaluations (cognitive behaviors). These concepts explain the important stages of imagining the urban space and this process is a mental process due to the correspondence with the cultural and social setting of each person. [18] High comprehensibility and imageability means that a person can easily recognize the general structure of the environment based on what he sees in the en-

vironment. In general, people who live in a more intelligible neighborhood can map routes more accurately than people who live in a less intelligible area. [22] importance of paths or streets is widely recognized in imageability both in terms of their function in enabling mobility and as experienced public spaces. [23] Lynch (1960) stated that an environment with high imageability and broad mental image consists of three components: identity, structure and meaning. Identity refers to the differentiation or legibility of environmental elements. Structure is the way that environmental elements are organized and related to each other, and the degree of comprehensibility of this structure is related to the meanings of messages and other collections that connect environmental elements with people. [24] The structure is one of the two main variables to explain imageability based on the characteristics caused by the space, these two variables are: 1. The complexity of the spatial plan and 2. The salience of the landmarks. Spatial plan complexity (structure and relationships) describes two-dimensional information about a space, while landmark salience (legibility and differentiation) refers to three-dimensional information about a space. [11] Appleyard also considers clarity, usability and social concept to be the key features of buildings imageability. He states that the form of buildings is more memorable when: there is more movement around it, it has a clear contrast with the form of the buildings around it and the adjacent landscape, the size and scale of the building is large, the height and width of the building, having a special shape, lighting, texture and color, strong materials quality, large legible landmarks. [25] It can be said that the imageability of an environment and the elements in that environment depend on the degree of power of representation of perceptual features (identity or readability and structure or coherence), semantic features and complexity (sufficiency, variety of information and perceptual meanings) can have different levels. The complexity of the information and also the design of the environment is one of the most important factors in the environment imageability. The characteristics of coherence, legibility, and complexity are directly related to the dimensions of Lynch's structure and identity, and mystery to its semantic dimension. Another aspect affecting imageability are the emotional aspects that affect the clarity of the image of the environment in people's minds, safer and relaxing spaces are more imageable. On the other and, the lack of clear perception of the space reduces the feeling of control over the environment and thus reduces the feeling of spontaneity. [26] (Table 1)

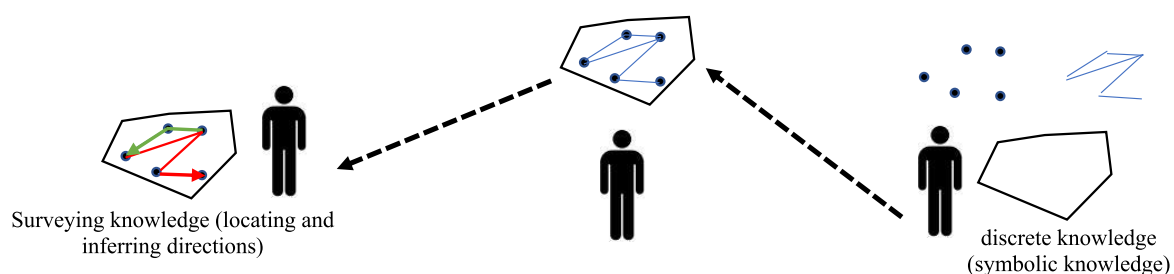


Figure 3. Stages of spatial knowledge formation (source: author, 2022).

Table 1. Features of imageability of space from the point of view of different Theorist (source: author, 2022).

Theorist	Year	Features of imageability of space
Lynch	1960	Identity (character recognition and legibility), structure (connection and relationship between elements), meaning [15]
Appleyard	1969	Clarity, usability and social meaning [25]
Kaplan	1982	Coherence (structural relationship of environmental landmarks), mystery (the meaning of a certain level of perceptual deprivation of environmental information), legibility, complexity (sufficiency, variety and lack of environmental signs) [27]
Rapoport	1990	Physical or perceptual Attributes and social or Associational Attributes [28]
Passini	1992	Spatial differentiation , Spatial correspondence [29]
Silva	2004	The degree of power of representation of perceptual features (identity or legibility and structure or coherence), semantic features and complexity (sufficiency, variety of information and perceptual meanings), Complexity in information and environment plan, spatial connectivity [24]
Long	2007	High comprehensibility (general access at the city fabric and high local access, high total integration) [30]
Kim	2010	Visibility (clarity), marking ability, existence of different uses and different physical shapes, high cognitive accessibility (recognizable buildings and landmarks), feeling of satisfaction and pride, being in consecutive sequences. [31]
Koseoglu, Onder	2011	The complexity of the spatial arrangement (structure and relationships), the salience of landmarks (legibility and differentiation) [11]
Topcu, k&m	2012	Having a feeling of satisfaction with the space strengthens the mental image and creates a sense of place [17]
Gabriele Filomenaa, Judith A. Verstegeena, Ed Manleyb	2019	Centrality measures consented to detect main nodes from the street network, as well as major paths, nods, landmark, edge [32]
Shaked Gilboa, Eugene D. Jaffe Donata Vianelli Alberto Pastore, Ram Herstein	2015	Security, private services and municipal services, Historical places and cultural activities, [33]
Conner R. Bruns, Brent C. Chamberlain	2019	Landmark's locations, Landmark Configuration unique configuration, [34]
Denis Sheynikhovich*, Angelo Arleo	2010	Landmarks and geometric [35]
Mahbubur Meenar Nader Afzalan, Amir Hajrasouliha	2019	Scale, eye level, details, accuracy/timeliness, and sensory/movement Age [36]
Yu Ye	2019	Building frontage, greenery, sky view, pedestrian space, motorization, and diversity [37]
Sophia J Gowers	2022	Movement as being intrinsic to their meaning, meaning making and movement, edge or bounds, position and meaning [38]

3.4 Structure

Structure is a set of rules that justify relationships and situations; The concept of construction (a meaningful essence of the arrangement, decoration and arrangement of the components of a dynamic system that has been formed and evolved over the time) this characteristic includes even the smallest components (size and scale) and their relationships and functioning. [39, 40] The type, style, order and form of the components of different phenomena lead to the phenomenon called structure. [9]

The two structural aspects of the city include constituent elements and fixed relationships that connect the structural elements to each other. Therefore, the structure of the city, in addition to the main elements and public buildings, open spaces, activities and main axis lines, includes the way these elements are related to each other in order to be compatible with the total shape of the setting. [41–43]

Therefore, it can be said, the essential elements of the urban spatial structure include: poles(connect intermediate spaces, spatial bridges between different neighborhoods), centers(regulators that have organizational structure rules that are arranged around them), boundary (socio-economic boundaries). [44] Based on this, the main structure of urban spaces can be determine based on 4 main criteria: location and morphology, different and varied applications, connection points, attraction potentials (Gravity points). [9, 45]

Now, this urban structure with all its constituent elements and factors as a phenomenon that forms a meaningful nature of relations and components of a dynamic system is directly related to the concept of city imageability through the organization of the citizens' mental map. Structure as a concept has been formed against the complexity and mental disturbance of citizens for perception of the city and an effort to simplify its understanding. [46] A huge number of Theorist consider structure to be a subjective and not an objective issue. As Lévi-Strauss believes: structures should be searched in the patterns that the human mind imposes on reality. [47] From the study of the existing approaches to the structure, it can be seen that all the interpretations refers to three types, the approach with physical tendencies and the creation of a whole unit among the physical elements and components and paying attention to the shape and morphological aspects, functional approaches with emphasis on Paying attention to the functions and functional relationships between components and mental and semantic approaches with emphasis on searching for meanings among components and discovering hidden relationships between urban elements.

Physical structure is following principles and each principle plays a special role in the formation of physical structure. Multiple principles of physical structure include hierarchy, proportionality, preferred patterns, continuity, repetition, proximity, order, and limitation. Different levels of the skeleton (body) include the physical structure of particles, blocks, super blocks, parts and their internal and external relationships in the environment. [9] The functional dimension is representative of the direction, like the users of urban functions and the relationships and interactions between them, the form and functional dimension cannot be consid-

ered separately. [48] The city structure is an opportunity to integrate and entanglement urban functions and all kinds of human communication to establish a strong connection between the most important and main elements and urban spaces. Therefore, changes in the urban structure, such as the spatial distribution of activities, lead to changes in people's movement patterns. [49] the most important aspects of urban spatial structure is the morphological dimension and its functional dimensions, which morphological dimension shows the size and spatial distribution of inner-city centers, and functional dimensions that show the connections between different centers. [45]

The meanings hidden in the physical and functional relationships that formed in the mind of the citizens define the meaning of the structure. In a structured space, a person knows where he is and different directions have meaning for him. [50] The structure is made by the human mind, which then spreads over the shape of the city. The structure is a mental thing that is compiled from human perceptual frameworks to the environment, and based on this, it should be searched in mental maps. [39]

4. Discussion

According to the detailed study of the results of the articles, the main fields affecting the imageability of the city structure have been identified and in a final summary, a new conceptual model of the factors affecting the imageability of the city structure has been presented, different approaches to the issue of urban structure can be divided into three categories: physical-oriented, semantic-oriented, and functional-oriented. As can be seen in the table of the evolution of approaches, in study the issue of structure, functional and semantic issues have gradually replaced physical issues over time. (Table 2)

Based on the research, the perception of the city's structure occurs on three levels, the first is the perception of the structure as the reality of the physical environment and a form independent of its observer, and the second as a completely subjective category that is Perceived by the observer and is independent of the physical form of the structure, and the third is like A phenomenon or an event in the exchange between the physical and tangible characteristics of the environment on the one hand and the semantic patterns and codes and mental abilities of the observer on the other hand. One of the most important issues raised in the mutual disconnection between the perceived objectivity of the structure and the mental image of people as the mentality of the structure can be the failure of this configuration to respond to human needs, where a person for the first time with a body without soul and meaning and empty of content, and this causes an incomplete or weak image of the city's structure for him. The configuration of the city is where the objective appearance of the structure takes place, the configuration of the city causes continuity in the physical form of the city, and on a macro scale it can cause the coherence of the shape of the city. The stability of this part of the structure in the viewer's mind can clearly link the visual values and all the urban manifestations and components of the city's appearance visually. Now, if this body is formed based on

Table 2. Evolution of approaches in the study of urban structure over time (source: author, 2022).

Approach	Theorist	Year	Concepts investigated in relation to city structure
Physical	Comillo Sitte	1889	Spaces with unique character, enhancing the appearance of large buildings [51]
Physical	Edmond Bacon	1949	The communication network that connects the main buildings and unity as a whole [51]
Semantic	Alison Smithson	1956	Identity through structure [51]
Semantic	Kevin Lynch	1960	Mental order to perceive the whole, the structure is one of the city imageability laws [52]
Physical	Thomas Gordon Cullen	1961	Pedestrian movement and continuity in the city structure [51]
Functional	Doxiadis	1966	Relationship between space forces, functions and configuration [51]
Semantic	Appleyard	1969	Methods of structuring the city, mental patterns of urban structure [25]
Semantic	Rappaport	1982	Structure in terms of cultural characteristics, culture is the organizing factor, the organization of concepts [51]
Semantic	Cristopher Alexander	2004	Behavior detection factors: major activity centers, urban elements, access network [51]
Functional	Sigfried Giedion	2004	Super structures and group structure, large-scale foundation responding to various needs and purposes [51]
Semantic	Arthur E. Stamps	2005	Using expert panels to assess coherence, legibility and complexity [52]
Functional	Yanbing Tang	2007	How to distribute the population based on the distribution of services and land use and the income level and its impact on the urban structure [53]
Physical	Nikos A. Salingaros	2010	Principles and rules of urban form integration: pairing, diversity, boundary [54]
Semantic	Itzhak Omer and Bin Jiang	2010	Considering the role of spatially differentiated spatial elements, reducing the gap between structural image and Lynch image [55]
Semantic	Emine Koseoglu	2011	The complexity of the spatial arrangement to describe the two-dimensional information of a space and the suitability of signs to refer to the three-dimensional information [11]
Functional	Burger M and Meijers E	2012	The most important aspects of urban spatial structure, morphological dimension, operational dimensions (commuting or shopping trips for practical aspects [45])
Physical	Cristopher Alexander	2013	The idea of a growing whole, growth arising from structure [51]
Functional	Martin Tomko	2013	The study of functional relationships provides the possibility of making the most complete image of the city [56]
Semantic	Jack L. Nasar	2014	Perception of the environment and cognition of the environment and behavior in the environment and the effect of individual differences of people in the perception of the environment [57]
Semantic	Chen Zhong	2014	Changes in the spatial structure of cities according to the pattern of human activity [44]
Functional	Anzhelika Antipova	2018	Internal city structure models, urban structure models, spatial structure models [49]
Physical	Tong Huali, Shi Peiji, Luo Jun, Liu Xiaoxiao	2020	The Structure and Pattern of Urban Agglomeration [58]

the person's desire and mental image of what she expects and what is imprinted in her mind, this urban image will strengthen the relationships, interactions and performance of the city structure. Mental image, activity, physical form are the main elements of urban structure. By placing the concept of mental image instead of meaning, which is the most influential factor in shaping the structure of a city, factors such as memory, symbolism, legibility and visibility, sensory experiences, perception and psychological connection give a city a special value. [59]

The main purpose of this study is to present the components that affect the imageability of the city structure. By studying this topic, we can understand how people form the structure of the city in their minds and how the elements of this structure are more imageable. The conceptual framework is based on the following three arguments: First, the main skeleton of the city consists of physical elements (discrete elements) and the topological relationships of these elements, which are perceived by humans as cognitive representations and mental images in their minds. Second, the structure of the city, which is the result of the interaction between the physical and semantic dimensions (relationships between components), naturally affects the mental image and imageability of the city. Third, personal experiences and individual and personality characteristics of people are effective on a person's knowledge of the environment. In the process of perception, the environment, after facing the physical dimension of the environment (objectivity), man mixes the available information with his desires, prejudices and thoughts, which are influenced by the social and cultural environment of the individual, and forms the initial mental image of the environment. The social characteristics of the environment refer to the different meanings that are created from the relationship between the person and the environment. In fact, in relation to the environment and shaping it and linking it with the meanings in his mind, he makes a kind of decoding and creates a mental schema and acts according to it. This process is a process that can make the environment attractive and readable. It happens if there is a meaningful connection between the social characteristics and the meanings in the person's mind. This primary mental image in the continuity and passage of time creates awareness of the environment and this point is the point where people can draw a cognitive map based on their imageability of the environment. In fact, people perceive the environment in three parts: physical, functional and semantic. imageability of the environment means perception the discrete elements of the environment and establishing the relationship between them and giving meaning to these relationships according to the social and cultural setting in which each person lives. This is why the imageability of an environment may be different according to the number of people, because even in the same cultural, social and economic conditions, people can have a different understanding of the environment according to their individual characteristics. On the other hand, many theorists consider the structure of the environment to be the most important part of people's understanding of the environment, which is the result of understanding the relationships that have a

structure and pattern. As Long defines spatial cognition as knowledge and internal or cognitive representations of the structure, entities, and relationships of space. And as Siegel and White (1975) define environmental learning based on path structures that are subsequently placed in primary anchors and cue points. [60] On the other hand, relying on the theories stated in the literature, we understand that each person needs to understand the structures in the city in order to have a clear image of the city. The urban structure is a collection of the main body and figure of the city under the title of configuration and the relationships between the elements of this configuration. As Long states, overall structure is effective on the development of environmental knowledge. [30] On the other hand, this structure is formed through continuous interaction with the environment. The similarity between the process of perception, which leads to knowledge through a structured and hierarchical process, and having a visible mental image of the city structure, which itself consists of a coherent hierarchy, proves a meaningful relationship between the imageability of the city structure and environmental knowledge. (Table 3)

Based on what was presented in the conceptual model, the overt and hidden codes of the texts in three areas indicated how to strengthen urban imageability, firstly, the physical and topological characteristics that refer to the objective aspect of the structure, and on the other hand, the aspect of imageability that mentioned The structurality of the components of urban environments, which led to the extraction of concepts such as structuredness, adherence (physical), integration, hierarchy, coherence and complexity, and secondly, the semantic characteristics that Checks the influence of social-individual characteristics and personal experiences of people in understanding the environment. In this section, based on the codes extracted from the texts, categories such as memorable, identity, satisfaction with the environment, continuity, readability, and sequence were extracted. In a way, these categories refer to the connection of visual values and urban manifestations and components of the urban image in terms of visual and mental perspective of the citizens, which are also effective on the stability and stability of the city structure. If we consider the structure as a framework of rules and the way elements and components are connected, the comprehensibility of the city is also done through the organization of the image of the citizens based on the structure of the relationships between the components of the elements understood in their minds. Therefore, the relationship between structure and imageability is not limited only to the function that structure has in the clarity of the mental image. Rather, different theorists basically consider the structure as a subjective and not an objective issue existing in the external world. Therefore, based on the emotional-cognitive, behavioral and semantic functions of the mental images of the citizens, this mental image can be used as a valuable criterion in determining the structure of the city, or on the contrary, in a dialectical relationship, the structure of the city can be used to clarify the mental images or visualize the city. Therefore, what is important in evaluating the visualization of the urban structure is the relationship between the elements, not the coherence of

Table 3. Concepts and categories extracted from qualitative content analysis (source: author, 2022).

Categories	Concepts	Codes
Structuredness	Spatial connectivity	Creating network structures
	Adherence	Paying attention to spatial ossification and non-local relational characteristics
		The formation of simple patterns, a kind of schematic structure for deciding on the choice of location and orientation
	Sequence	Recognizing structured and patterned relationships Check the access pattern
Complexity	Complexity in plan and context	Attention to complex topological structures and relationships
		Physical spatial form
		The relationship between mass and space
Legibility	Place differentiation	Considering the features of the for Naturalness
		Using personal and social experiences
	Imageability	Cultural and historical continuity
		The formation of the symbolic network of urban signs
		Characteristics of physical elements such as the color or shape of the building, width,...
		The existence of connections between the internal and the external structure
		Abstract labeling of environmental elements and main directions
		The formation of a person's inner mental model of objective reality
Paying attention to the Path structures in the main anchor and marking points		
Accessibility	Visual access (visibility)	Presence of physical symptoms
	Physical access (Permeability)	Note the access pattern
		Physical spatial form
Identity	Sense of Place	Environmental experiences and the formation of behavioral index patterns
		The formation of social relations
		Creating citizenship identity
		The existence of implicit meanings derived from physical form
		Body formation with a reflection of historical evolution
		Creating a cultural experience from the environment
		The effect of human identity on the perception of place
	Repetition of certain patterns of events	
	Identification	naturalness
		Existence of an index body form
		Attention to historical and symbolic importance
The formation of social bonds		
Memorable	Encryption	Considering the perceptual capacities of people
		Implicit meanings in the body
		Encoding environmental information in the mind in a symbolic or visual way
		Creating environmental meaning with the experience of moving in space and mixing it with the experience of everyday life
	Associating meanings and remembering	Using people's perceptive capacities
		Implicit meanings in the body
		Cultural and historical continuity
		Attention to environmental experiences
		The formation of social relations
		Attention to historical and cultural values

Continued on next page

Table 3. Concepts and categories extracted from qualitative content analysis (source: author, 2022). (Continued)

Satisfaction	Emotional satisfaction	Experience beautiful environments
		Understanding the built environment based on “biases”
		The formation of a mental image under the influence of collective and individual values
Communicability	Walkability	Diversity in access
		Development of footpath
	The relationship between the whole and the parts	Knowing the route is dependent on access to the immediate the neighborhood
		The presence of relational elements (the connection of each space with another)
Coherence	Connection	People tend to distinguish buildings based on overall accessibility to the neighborhood
		Development of connections to facilitate movement
		The existence of connection and connection of the space body
	Spatial configuration	Linking mass and space
		The existence of pair connections rather than single elements or connections
		Connecting spaces through articulation
Integrity	The unity of mass and space	The effect of depth and distance on spatial cognition
		Identify spatial relationships
	Hierarchy from private to public spaces	Relationship between mass and space, examination of physical form
		There is a natural way to order things
		Creating awareness of certain places in the
Continuity	The connection between the components of space	Hierarchical structure of place memory
		The relationship between spatial ossification and mental structure
	Strengthening the main axis	Check the access pattern
		Creating a network of centers
		Create an interactive link through the axis
		Organization of the substructure order of fabric
Hierarchy	Spatial contrast	Studying the movement pattern simultaneously and in time at the tissue level
		Establishing strong correlation between integration and movement
	Existence of boundaries and territories	Designing the access model, examining the relationship between mass and space
		Gaining hierarchical configuration knowledge
Unity	Structural relationship between physical-spatial elements	Adhering to the hierarchy in linking spaces
		People are aware of certain places in the city that are hierarchically distinct
		The existence of a network structure of centers
	Visual unity	Note the access pattern
		Proper positioning of components
		Understanding the complexity of the setting
		The relationship between mass and space
		The existence of continuity between centers

each element alone, for example, the connection of the passages alone cannot determine the coherence of the form and structure. Therefore, based on the presented conceptual model of the categories extracted from the analysis of the hidden and obvious content of the texts, the imageability of the urban structure is the result of the realization of each of these categories for the elements as well as their relationship in different structural situations, and this framework and criteria are the most important achievement in this research. In total, the model extracted from the content analysis is presented in (figure 4).

5. Conclusions

The relationship between structure and mental image is not limited to the function that structure has in the clarity of mental maps. Rather, the structure is basically a subjective

matter and not objective and existing in the outside world, and the structures should be searched in the mental patterns of the people. Based on what comes from the literature of environmental perception, imageability and the structure and configuration of the city, the structure is a mental matter that shapes the frameworks of human perception of the environment and for this reason it plays an essential role in the mental representations of people. The imageability of the structure and the ease of forming a mental image of it from various aspects are important. The role of the city planner in improving and relative clarity of people’s mental map of the city’s structure is to influence the mental image created of it by emphasizing the configuration of the city as the existing objectivity of the city’s structure. The structural connection between the elements and physical components of the city fabric creates a purposeful

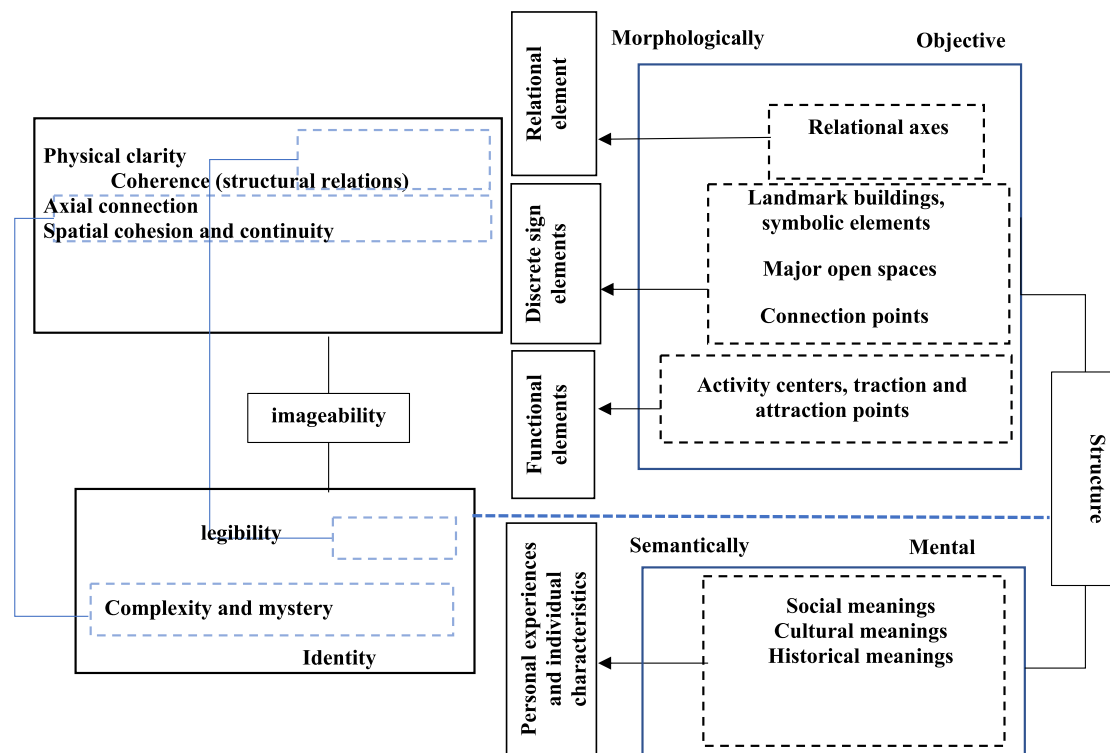


Figure 4. Components Influencing The City Structure Imageability (source: author, 2022).

combination of components at different scales, which displays an integrated whole with a hierarchy of elements, main and secondary centers and their organizing forces. The structurality resulting from this integrating and then the connection and relationships between different parts of the structure through the indicators and their hierarchical sequence and the creation of a symbolic network in the fabric leads to the perception of the structure as a whole. The lack of continuity in the structure of the city and the absence of a hierarchy of landmarks in different local and strategic scales causes the mental confusion of citizens in perception a continuous structure of the city and not understanding the right direction for their movement and choosing their path. People tend to perceive the fabric in a combination of order and complexity that It is attractive and stimulating for them. The existence of absolute order with its geometric pattern, although it provides a clear spatial design, but it reduces imageability and reminder in people, and such a structure is forgotten over time, or is not effective in Strengthening people's mental image of the city structure.

One of the general and basic principles in imageability the structure of the city is legibility, which has a deep relationship with the arrangement and location of key elements in the structure. The legibility of the environment is characterized by environmental elements that reveal themselves with a degree of power in their structural, identity and semantic features. The legibility of places and parts of the structure is created through the creation of place distinction, visibility and imageability. Legibility is a product of the realization of other principles such as structuredness, evocativeness, identification and relationship ability in the structure of the city.

The structure of the city is actually a physical form that is image able by the meaning among its components for the citizens. The structure of the city is affected both by physical factors such as physical signs, walls, the physical form of the environment and urban fabric, the way spaces are connected and connected with each other, and influenced by the current meaning among these components, which is created by social factors such as society's culture and historical continuities and associated meanings in people's minds. The dimensions of interest in the studies of the main structure of the city can be considered in three physical, functional and conceptual (meaning) dimensions. In fact, the connection between the physical and functional components and elements of the city and the interaction between the activities and the urban form forces the citizens to behave and move in this structure, which can create different meanings for it. In addition to the body and function, these meanings are also derived from the identity and culture of the people of that city. The important point in this is the coordination and interrelation between the functions of this structure and its body as a vehicle for the occurrence of behaviors that in harmony with the culture and beliefs of the people of that city express the main characteristics of the city and represent its citizens. In general, the ability to imagine the structure depends on the presence or absence of one or a number of principles such as complexity, legibility, memorability, continuity, structured, communication, etc. The realization of these principles depends on both the physical environment and the personal and social characteristics of people in the environment.

The most innovative aspect of the present research is the examination of the relationship between objectivity and

subjectivity of the city structure and the way of perceiving the structure, which leads to a deeper qualitative analysis of the existing texts on the visualization of the structure compared to other similar domestic and foreign researches. Therefore, the results of the research can provide valuable opportunities for expanding the foundations and boundaries of the knowledge of visualizing the urban structure. In addition, researchers and urban designers can use this article as a potential reference and starting point to overcome the current conditions and also to conduct complementary research in the future.

Authors contributions

Authors have contributed equally in preparing and writing the manuscript.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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