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Syntactic Legibility of Image Elements: Eskişehir Case

İmaj Ögelerinin Sentaktik Okunabilirliği: Eskişehir Örneği

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ABSTRACT

This study aims to measure the image perception and spatial legibility of Eskisehir city and to discuss the relationship between image elements and spatial legibility through comparative analysis. Methodologically, the study consists of three stages. (1) A questionnaire was prepared in line with Lynch, Nasar, and Rapoport's approaches to image and urban space perception. This questionnaire was applied to a group of 60 consisting of ordinary people and experts in the form of mutual interviews, and an image map of the city was created as a result of the answers received. (2) An axial map of the city was drawn and integration, connectivity, intelligibility, and synergy parameters were analysed at an urban scale with the axial analysis method using space syntax methodology. (3) Image elements were discussed comparatively in the context of determining numerical parameters. As a result, the perception of the path parameter was the highest; the landmark and node parameters were close to one another and came second, and the district parameter was the last. The study proposes a different methodological approach in order to categorise the image elements in detail, allowing each element to be evaluated numerically, and to discuss on which parameter the perception of the image element is numerically more important.

Keywords: *Eskisehir; legibility; image; intelligibility; perception analysis; space syntax.*

ÖZ

Bu çalışmada, Eskişehir'in imaj algısını ve sentaktik olarak okunabilirliğini ölçmek, imaj ögeleri ve sayısal okunabilirlik arasındaki ilişkiyi karşılaştırmalı analizlerle tartışmak amaçlanmıştır. Metodolojik olarak çalışma üç aşamadan oluşmaktadır. İlk olarak Lynch, Nasar ve Rapoport'un imaj ve kentsel mekân algısına yönelik yaklaşımları konseptinde bir anket hazırlanmış ve bu anket karşılıklı görüşme şeklinde halk ve uzmanlardan oluşan 60 kişilik bir gruba uygulanarak alınan cevaplar doğrultusunda kentin imaj haritası oluşturulmuştur. İkinci aşamada kentin aks haritası çizilmiş ve mekân sentaks metodolojisi kullanılarak aksiyel analiz yöntemiyle bütünleşme, bağlılık, anlaşılabilirlik ve sinerji parametreleri kentsel ölçekte analiz edilmiştir. Son aşamada ise imaj ögeleri, belirlenen sayısal parametreler bağlamında karşılaştırmalı olarak tartışılmıştır. Sonuç olarak, ilk sırada yol parametresinin algısı en yüksektir, nirengi ve düğüm noktası parametreleri yakın seviyede ve ikinci sıradadır, bölge parametresi ise son sıradadır. Çalışma, imaj ögelerini hem detayda kategorize ederek her bir ögenin sayısal olarak değerlendirilmesine imkân vermesi açısından hem de imaj ögesinin algısının sayısal olarak hangi parametrede daha öncelikli olduğunu tartışabilmek adına farklı bir metodolojik yaklaşım ortaya koymaktadır.

Anahtar sözcükler: *Eskişehir; okunabilirlik; imge; anlaşılabilirlik; algı analizi; mekan sentaks.*

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Introduction

Urban spaces are common scenes that constitute the common memory of those living in the city, are experienced by people, take part in the developmental process of the city under the influence of many political, economic, social, and historical events that have occurred over time, and form the memory of the city (Castells, 1983). The relationship of the users of the space to the physical environment, their understanding and interpretation of the space, and their behaviour within this physical environment play an important role in the shaping of urban spaces (Erdönmez & Akı, 2005; p 69). In this context, urban spaces, which are the main concern of urban design, are defined as multidimensional places where human-environment interaction takes place, which is liveable and perceivable, are shaped together with social characteristics and form the image and identity of cities (Bilsel et al., 1999; p. 61).

Appleyard states that 3 factors are effective in the perception and comprehension of the city. These are used, how the physical environment is shaped, and the interpretation of our past individual experiences (Appleyard, 1970). Lynch, states that images are formed by mentally perceiving the urban space where people spend their daily lives, experience, and perform their actions, and the elements that form the space (Lynch, 1960). In this context, Southworth argues that the formation and development of urban image occur in two different ways. While the image of the city is sometimes formed spontaneously in the process, it can also be formed by the influence of different actors such as architects, city planners, landscape architects, businesses, and institutions, in accordance with the demands of the people (Southworth, 1985, p. 53).

People are in a mutual interaction with the environment not only with physical properties but also psychological properties too. Space is central to the experience of urban design and has a perceptual presence of its own (Topcu & Topcu, 2012, p. 574, Isaacs, 2000). In the *'space to place'* transformation process, perceiving any space by users, reading it as a text, then having some images in the brain related to this space, loading meanings to it, evaluating the space and finally act with these evaluations *(cognitive behaviours)* is considerably important (Rapoport, 1977).

The act of perceiving is the process of gaining information about the environment in which emotional input transforms into meaningful experiences and interpretations (Koseoglu & Onder, 2011, p. 1192; Sartain et al., 1958). The image of a city, which is formed as a result of the mutual relationship between people and environment and the act of perception, is defined as the impressions the individual has of the urban environment, together with the past and present experiences, concerning the point or area where this relationship becomes concrete (Ocakçı, 2016, p. 192). The fact that the perception of the environment depends on subjective interpretations, i.e. user characteristics as well as objective characteristics, causes the cognitive maps formed as a result of the act of perception to be different for each individual (Golledge, 1997; Kim & Fesenmaier, 2015, p. 8).

Background

Lynch defined a good city image as high legibility places where paths, districts, landmarks, nodes and edges are perceived as a whole and easily described in people's minds in relation to these elements. Paths are mobility networks that connect or separate districts, make transportation continuous, and provide circulation through such means as streets, pedestrian roads, canals and railways. Districts are medium or large-scale parts of the city the physical boundaries of which people can shape their minds and feel that they are entering the area where they are. They form a whole within themselves and have similar physical characteristics and functions. Edges are structural or naturally occurring linear elements such as coasts, rivers, railways, walls, streams and mountain ranges that divide the continuity between two districts and are not used as transportation axes. The nodes are the strategic points of the city such as intersections, bus terminals, stations and street corners serving as meeting, transfer and dispersal areas that are heavily used and where the roads intersect, and people pass from one part of the city to another. Landmarks are the dominant places or structures within the silhouette that create contrast by virtue of their distinction from the urban texture with physical features such as colour, texture and scale, which have remarkable characteristics and can be easily recognised and defined. Lynch stated that these elements that constituted the image of the city were important places in making a place meaningful and ensuring the legibility and intelligibility of the city. Maps related to the image of a city were created with the cognitive maps drawn with these five image elements (Lynch, 1960). Nasar, on the other hand, stated in his study that places where people felt strong emotions gained more place in human perception and this situation increased the imageability of the city. He devised a 5-point Likert scale based on likes and dislikes and measured the urban perception with the evaluative map of the elements that formed the city image. With the evaluative maps created by Nasar, interventions can be made, and the appearance of a city can be improved by revealing the good and bad aspects of the city's change over time and determining the problematic areas of the city. This situation enables the formation of more meaningful and liveable places in urban space (Nasar, 1990, p. 41). Rapoport explains the process where elements in the urban environment are transformed into images in the mind as a cognitive process, environmental perception, environmental cognition, and environmental evaluation. The individual envisages in his mind the environment he perceives and then transforms it into mental maps through cognitive schemas (Rapoport, 1977).

When these approaches are evaluated, it can be said that cognitive maps have been developed by different researchers and created using different tools such as questionnaires, sketch drawings, interviews, etc. They are important in that they show how the city is perceived by the users as a result of the experience of the city with short- or long-term use and reflect the concretised form of the perception regarding the physical environment. Cognitive maps facilitate the obtainment of information about the appearance of the city by enabling the concretisation, in the human mind, of the perception of the elements that make up the urban space and the spatial relations that these elements form by coming together.

In perception studies conducted today, in addition to traditional, subjective analysis approaches, new measuring instruments have been developed with the innovations brought by technology. Methods such as Geographic Information System (GIS), Space Syntax, Big Data Analysis, Image Analysis and Fractal Analysis began to be used in urban design research by integrating them into subjective methods and urban space started to be handled with numerical approaches (Tang, Liang, & Yu, 2018). These developments caused the studies on the perception of urban space to change direction. In this context, when studies on the perception of urban space and image analysis in the literature are examined, it is seen that Morello and Ratti examined Lynch's urban image analysis with 3-D isovite maps and reinterpreted the visual elements defined by Lynch (Morello & Ratti, 2009). Meenar et al. evaluated the effects of virtual maps (Google Earth, Google Map and Google Street View) on people's perception of space through Lynch's image elements (Meenar, Afzalan, & Hajrasouliha, 2019, p. 2). Erçevik Sönmez and Erinsel Önder interpreted the effects of GPS-based navigation tools through urban image and perception (Erçevik Sönmez and Erinsel Önder, 2019, p 111). Tomko and Winter (2013) made a computational analysis on five different elements of Lynch to provide support for those who experienced the city and made some suggestions (Tomko & Winter, 2013, p. 185–186). Paul i Agusti et al. (2019) used the questionnaire/survey and mapping method as a subjective approach in the first step in evaluating 2 different urban spaces for Lleida (Spain), and in the second step, utilised the Heart Rate Variation (HRV) method as an objective approach. Thus, they ensured that the perception of the city was measured both subjectively and objectively and compared these two methods. As a result of the comparison, they found significant differences between how people perceived and represented urban space through mental maps and the fluctuations in Root Mean Square of Successive Differences (RMSSD) monitored using an objective measuring instrument (HRV) (Paul i Agusti et al. (2019). Filomena et al. made a comparison between Lynch's method of analysis and 'Geographic Information System', which is a numerical approach, and compared the consistency levels of the two methods (Filomena, Verstegen, & Manley, 2019, p. 15).

In addition to all these approaches, Space Syntax methodology is also used numerically as a method in urban perception studies. The relationship between the external space and social phenomena is the driving force of Space Syntax, a set of theories and techniques 'for the representation, quantification, and interpretation of spatial configuration in buildings and settlements' (Hillier, Hanson, & Graham, 1987, p. 363). In this perspective, the street layout and the configuration of space have a strong impact on the development of mental representations (Kim & Penn, 2004). The association between street configuration and cognitive mapping is not unprecedented. Kim and Penn (2004, p. 20) found that "space syntax of spatial configuration in genuine environments and spatial cognitive of intellectual maps in spatial cognition are firmly related". Long et al. used the Space Syntax method to determine the relationship between spatial configurations and cognitive representations in two different cities in China (Long, et al., 2007, p. 129, 03–05). Jiang stated in his study that axial maps had great similarities with perceptual maps and that both of them could be used to predict human behaviour at urban and architectural scales (Jiang, 1998). Dalton and Bafna, on the other hand, interpreted Lynch's image elements with the concept of 'legibility' and 'intelligibility' in Space Syntax methodology comparatively and argued that the Space Syntax approach provided strong evidence in terms of the concepts of 'legibility' and 'intelligibility' on a perceptual basis (Dalton & Bafna, 2003). Marcus et al. discussed the cognitive competencies for a sustainable city with the Space Syntax approach through spatial perception (Marcus, Giusti, & Barthel, 2016). Gohari examined the relationship between Lynch elements and Space Syntax parameters in his study. They found that the node and road parameters are in close relationship with the axial maps (Gohari, 2019, p. 146–151). In addition, Agael and Özer comparatively examined the Lynch approach and space syntax theory in the concept of human perception and the built environment. As a result, they emphasised that the interpretation of mental maps and axial analysis together helps to understand the human perception in the physical and social environment more strongly (Agael & Özer, 2017, p.159, 173).

Many different approaches to measuring the perception of urban space are mentioned above. With reference to these approaches, the study was designed with the aim of subjectively measuring the perception of a city through the concept of Kevin Lynch's analysis and discussing the numerically syntactic intelligibility of this perceived urban structure via the space syntax approach. In this context, the city of Eskişehir was determined as the sample area.

Methodology

We see from the studies that during the past 60 years, scientific research on the perception of space has evolved into a direction that uses technological tools with the advancement of technology. In this framework, a method has been designed regarding the perception of space to discuss the relationship between an analysis method determined by the approaches that we can define in the subjective dimension and an analysis method that emerged with technological developments. The designed method consists of three stages. The first stage, as a subjective analysis, was determined according to the concept of perception analysis (signs, landmarks, borders, paths, and regions) introduced by Kevin Lynch, with the influence of the approaches of Nasar and Rapaport. In the second stage. the dimension of reading and perceiving the spatial setup through numerical measurements was conducted according to the concept of Space Syntax analysis (Intelligibility, local and global integration, synergy, connectivity) proposed by Bill Hillier. In the third stage, what kind of results the results of the Lynch analysis could yield separately in terms of the Space syntax analysis were planned to be discussed in detail with comparative spatial analyses.

At this stage, different expressions of the data obtained from each analysis approach emerge as an important constraint. For example, the Lynch analysis measures the perception of the city over five basic parameters, as can be understood from the theoretical framework. These parameters are defined as landmarks, nodes, districts, edges and paths. In this context, two of the five parameters (landmarks and nodes) appear as point data, two of them (paths and edges) are linear data and districts are spatial data. Space syntax analysis, on the other hand, interprets the city through linear data expressing open spaces between buildings in a certain region and through statistical relations between these data. In this study, some limitations were determined in order to make comparative analyses between these two approaches. These limitations are as follows: In order to interpret the data obtained in Lynch analysis spatially in the Space syntax analysis, a regional area was defined within a radius of 300 meters (5 minutes walking distance) by accepting the punctuated landmarks and nodes as the Centre. Another limitation is that spaces such as rivers, railways, etc., that cannot be measured linearly even if they are in people's perception were ignored. In other words, the edge parameter in Lynch analysis was ignored in space syntax analysis.

In the findings section of the study, in the first stage, the image map of the city was created with perception analysis within the framework of Lynch's parameters (landmarks, nodes, districts, paths and edges). In the second step, an axial map of the city was drawn based on the parameters that were calculated using the Space Syntax methodology (Integration, Global and Local, Connectivity, Intelligibility and Synergy). In the last stage, the items that were created in the image map were categorised separately and tested with Space Syntax parameters. This stage is also where the originality of this study lies.

In this study, the city of Eskisehir in Turkey was selected as the sample area. The reason why this city was chosen as the sample area is that the city has exhibited an exemplary development in recent years with the innovative approaches that local governments have adopted to respond to the wishes and needs of the citizens, and it has an important role in urban design applications. When the city of Eskişehir is evaluated within the historical process, it is seen that it began to develop with the establishment of the railway line and the station building. In addition to the increasing agricultural activities in the city after the 1930s, the industrial sector also developed and various factories were established. In the subsequent periods, it transformed into an industrial city (Çelen Öztürk, 2016, p. 862–865). Besides its identity as an industrial city, it also enjoys the identity of a "student city" because it hosts 3 different universities. The banks of the Porsuk Stream, which runs through the city, has become a focal point for both urban residents and tourists, and the city centre has developed around these banks. The settlements on the banks of the Porsuk Stream include important districts and meeting points of the city. In addition to this, there are various recreation and festival areas, museums, parks, and social and cultural areas in the city.

Findings

Perception Analysis

In order to measure the perception of the city via the selected sample area, Rapoport and Nasar's approach was used to evaluate the perception of urban space in addition to the 5 basic elements (districts, paths, edges, landmarks and nodes) proposed by Lynch (1960) that have been applied in many studies to make the city legible and intelligible. It was asked to rank, according to their importance, the places that were the most memorable, the most comfortable, the most inviting and had the highest character based on the 5 elements that Lynch proposed

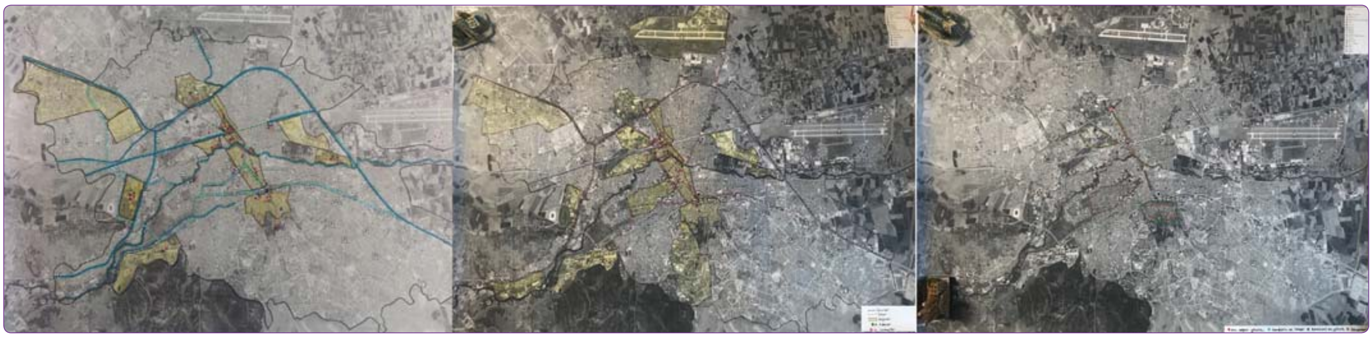

Figure 1. Maps synthesised with the data obtained as a result of the survey study.

regarding urban image and Rapoport and Nasar's approach to addressing urban space. In this context, comprehensive place names were included for each question asked in the questionnaire, and the questions were prepared in multiple-choice form.

The survey and interview stages were conducted according to a sample size determined as a result of statistical power analysis. Statistical power analysis is an analysis that contains answers to questions such as how much statistical power a study has and what sample size is needed in the study (Ellis, 2010, p. 56). In order to perform statistical power analysis, it is necessary to take into account the parameters of significance level (α), effect size (ES), statistical power (1-β) and sample size (n). Statistical power analysis explains the relationship between these four parameters. For any statistical model, this relationship is expressed as a function of each of the other three (Cohen, 1988, p. 4). In this study, a research sample was constructed on the basis of two groups, namely experts and the public. The sample size was statistically calculated using the power analysis method. When the significance level (α) was kept at 0.05 by taking the effect size as 80%, it was concluded that a total of 58 samples, at a rate of ½ in the form of 19–39, and with a statistical power of 0.80 (1-β) would be significant. In this context, analyses were made on a sample size of 60 people, 20 of whom were experts and 40 of whom were laypeople.

Of the 60 selected people, 40 were from the people randomly selected from important points throughout the city. The aim here was to measure the different views and perceptions of people from different gender, age and occupation groups who lived in different parts of the city and had been living in Eskişehir for at least 5 years. Ten people were selected from the knowledgeable and competent faculty members working at the Faculty of Architecture and Design at Eskişehir Technical University. The aim here was to obtain opinions from different people who were experts in their fields. The other 10 people were people who worked in Eskişehir Tepebaşı municipality and who were experts in their fields, such as architects and city planners. The purpose of including these people in the survey was to determine the perceptions of different people working in administrative units other than the public about different image elements of the city.

The questionnaires were administered simultaneously in the form of face-to-face interviews. The data obtained through the studies conducted dimensions were categorised under major and minor according to their importance through Lynch's image analysis elements. While the major elements were determined based on the answers stated most frequently, the minor elements were interpreted as less perceived elements than the major ones. The answers given to the survey questions in the interviews were simultaneously processed on a scaled city map. In the next stage, combined maps were created by the authors by simultaneously processing the obtained answers on the maps (Figure 1). The data obtained as a result of the survey and interviews were transferred to a digital map for the analyses to be conducted to understand the relationship between image elements and spatial structure employing the mapping technique used in studies such as Jiao et al. (2017, p. 77) and Meenar et al. (2019, p. 3–5), which were mentioned in the background section of the study, as well as employing ArcGIS (ArcMap 10.4) software, and a visual image map of the city was created (Figure 2).

As a result of the image analysis, 51 image elements in 5 categories were determined as major and minor. Major and minor landmarks obtained according to the perception analysis were indicated to be the most memorable, comfortable and inviting places with the highest character. It was seen that these items were generally located in the old and new market areas. These regions appeared to be the places that the city dwellers called the centre of Eskisehir and defined it as a commercial district.

While Kanatlı Shopping Centre and The Train Station were places of high memorability and character for the citizens according to perception analysis, Kentpark and Sazova parks were inviting places especially preferred by tourists. It was observed that while the downtown

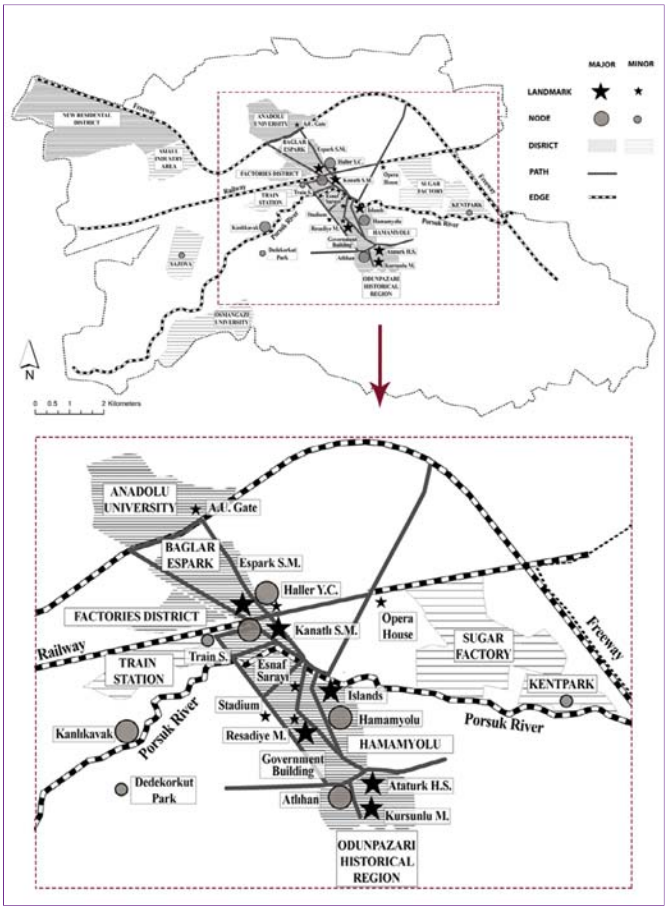

Figure 2. Image map of Eskisehir city.

area, Anadolu University Campus, Kentpark and Sazova Park were the most preferred areas by the city dwellers, the Sugar Factory and Factories District remained in the perception of the city dwellers from past to present and had high memorability. It was also observed that these regions were areas where people felt comfortable and relaxed. As a result of the analysis, it was observed that these paths, which were the most common in the perception of the city dwellers, were especially intertwined with landmarks and nodes. The elements perceived as edges in the city were "The Porsuk Stream, Train Station, and E-90 freeway". The Porsuk Stream divides the city into two as north and south. However, the bridges over the stream allow access between the two parts especially in the city centre, in the market area, and the edge effect is thus eliminated even if a little (Figure 3).

It was observed that the landmarks, nodes, districts, paths, and edges determined through Lynch's method for the data obtained as a result of perception analysis and the perception of the city dwellers were similar to those specified in the approach proposed by Nasar and Rapoport and supported each other. Many of the elements they perceived in the city were similar. Therefore, they were evaluated within the framework of Lynch's five image elements in the study.

Space Syntax Analysis

Space syntax theory was first proposed by Hillier and Hanson in the book "Social Logic of Space" and is generally considered an effective and veritable theory, and methodological analytical tool, to examine how space impacts human development, by measuring spatial configuration (Hillier and Hanson, 1984). The theory of space syntax is founded on the hypothesis of the "Social Logic of Space", which introduces a general hypothesis of how individuals identify with space in built environments, and the effects of these spaces on perception, social behaviour and relationships. Space syntax is generally considered a significant hypothesis and analytical tool in examining how space impacts human development by measuring spatial configuration (Hillier and Hanson, 1984). In space syntax studies, the basic methodology is to partition space by the scale and human visual ability (Agael & Özer, 2017, p. 14). Space syntax has also become a computer language to describe the spatial pattern of urban space. Urban space can be partitioned into two categories from the perspective of human movement: blocked space, and free space. Blocked space is comprised of spatial obstacles such as buildings, and within this space, people cannot move freely. On the other hand, free

Figure 3. Important elements of the city: a - Kanatlı Shopping Mall; b – Espark Shopping Mall; c – Hamamyolu; d – Porsuk Islands.

space is the part of urban space where people can in fact engage in uninhibited movement. Space Syntax focuses on the links and syntaxes of space; it measures the patterns, connections and permutations of spaces that cannot be measured through simple Euclidean geometry (Hillier and Hanson, 1984).

The space syntax approach emerges as an important tool and method in many subjects and researches related to the city and space. Visual graph analysis, angular segment analysis and axial analysis methods are basically the methods used. In this study, the axial analysis method was implemented since it was built on the syntactic intelligibility of the space syntax approach. Certain parameters need to be measured in order to interpret the spatial intelligibility in the axial analysis method. These parameters are Intelligibility, Synergy, Integration (Local and global) and Connectivity. To briefly mention these parameters.

Hillier improves a metric for *intelligibility* by connecting a local measure of spatial configuration with a global measure. It is characterised as the level of correlation between the connectivity and integration values of the axial lines in spatial configuration (Kim, 1999; Kim 2001; Zhang, et al., 2013, p. 82-2). In line with the results obtained, the high values of intelligibility can be interpreted to mean that spatial order is more intelligible and easily predictable by the users. If the value is low, it can be said that the spaces in the area are disconnected from each other and difficult to define. On the basis of these inferences, comments and suggestions about the structure and values of urban elements can be offered depending on whether the city is intelligible or not (Bafna, 2003; Hillier, 1999; Hillier and Hanson, 1984; Kubat, 1997; Penn, 2003, p. 52). The concept of *synergy* is defined as a second-second order measure value resulting from correlation just like the intelligibility parameter. It is obtained as a result of the correlation of general integration (Rn) and local integration (R3) parameters, on a local urban scale. The synergy value measures the degree of an area or space within the urban system and to what extent it is related to this system. A high value here refers to a highly intelligible system (Önder & Gigi, 2010, p 261, Hillier, 1996). *Integration* is an indicator of how easily a person can reach a particular street axis and it is a measure of accessibility. Many studies have shown that high-access streets attract higher activity in urban areas (Hillier, 1996; Hillier and Hanson, 1984; Penn et al., 1998). On the other hand, the literature on spatial cognition indicates that people's cognitive maps are developed through movement. Movement in the city gives the individual an idea of the global and local relationships of physical elements including the urban environment (Haq, 2002; Heft, 1983; Ozbil Torun et al., 2020, p. 86). Naturally, some areas in the city will attract more movement due to their high accessibility. As a result of this analysis, it can be determined how disconnected or integrated space is on a local or global scale. If people tend to use certain paths (i.e., high integration, high connectivity) more often than other paths, it can be assumed that certain physical elements such as landmarks and nodes on these paths will be clearly reflected in their cognition (Long et al., 2007, p. 129-05). Connectivity values measure the number of immediate neighbours that are directly linked to space connectivity is a static local measure.

In this context, the axial map of the city was drawn by using ArcGIS (Arcmap 14.01) program in order to calculate the determined analyses. Calculations were made on this axis map with the axial analysis method using Deptmap X ver.030 program (Varoudis, 2012). Although the angular segment analysis method is more commonly used than axial analysis in Space Syntax studies today, the axial analysis technique was preferred in this study for the calculation of the intelligibility parameter. As a result of the analyses, Global integration (Rn), Local integration (R3), Connectivity, Intelligibility, and Synergy parameters were calculated (Figure 4) (Table 1).

In this context, numerical results were obtained by using the integration, intelligibility, and synergy parameters in the numerical evaluation of the study.

Based on the outcomes of the analysis, the area around the Porsuk Stream, the CBD (Central Business District), and the main arteries of the city (Figure 2) stand out as the places with the highest integration value (Figure 4). It is observed that this value decreases as one goes towards the periphery of the city. The integration value decreases especially in new residential areas, and the relationship with the city centre gradually weakens.

Table 1. Space syntax parameters calculated for the whole city of Eskisehir

	Number of Axial lines	Integration Global	Integration Local R3	Connectivity	Intelligibility	Synergy
Whole City	10900	Min.: 0.3876	Min. :0.3333	Min. :1.000	0.26	0.52
		Max. :1.3053	Max. :4.2924	Max. :54.000		
		Mean: 0.7785	Mean: 1.9361	Mean: 4.012		

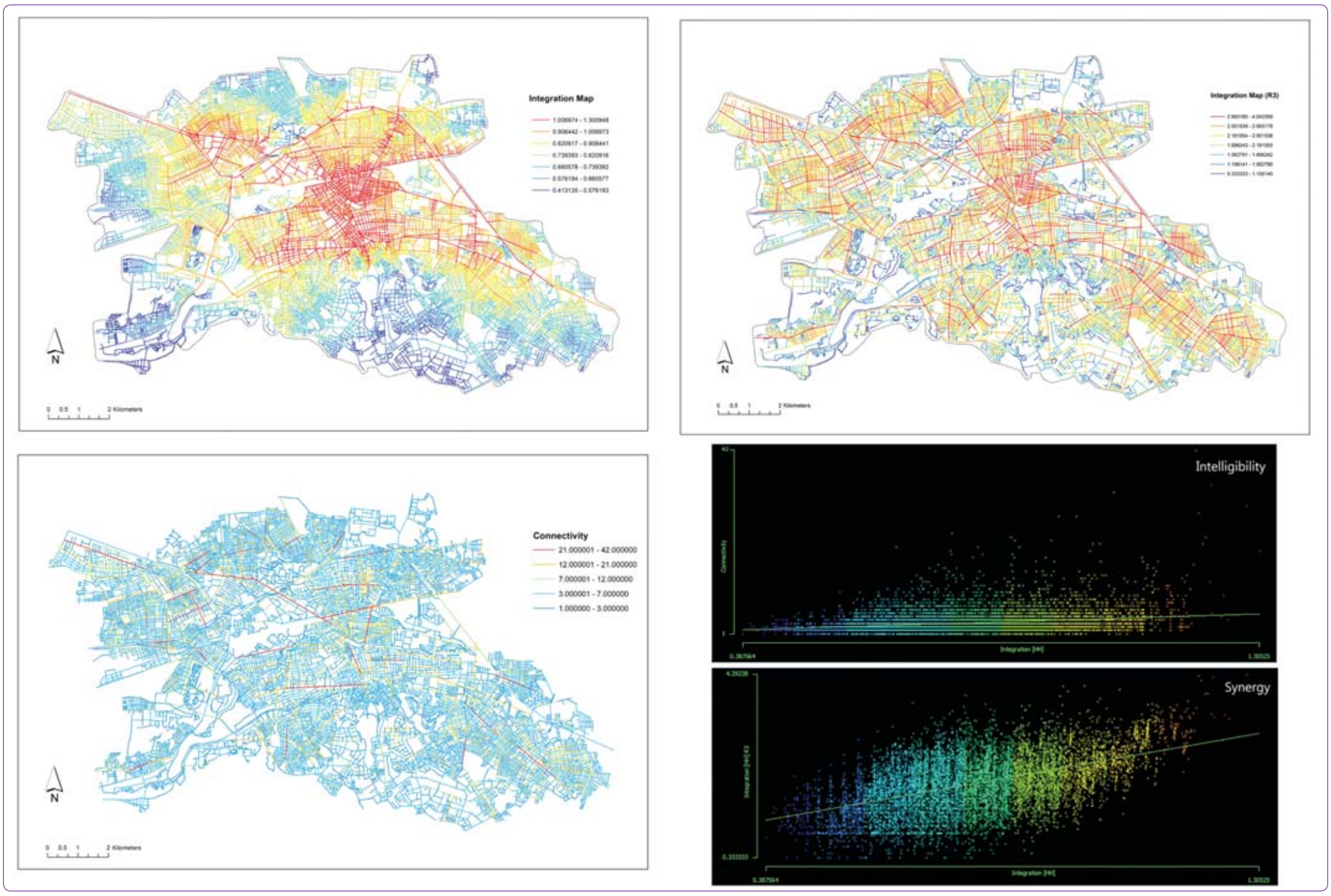

Figure 4. Integration map (Rn, R3), Connectivity map, Intelligibility graph, Synergy Graph of the city.

The fact that areas such as factories district and the train station in the city centre have the perception of edge and are not accessible for public use can be regarded as the reason for the weakening of the city centre's relations with the other areas.

Discussion – Comparative Spatial Analysis

The two basic analyses (perception analysis and space syntax analysis) performed as specified in the methodology part of the study are discussed comparatively in this section. To put it in more detail, the paths, nodes, districts, and landmarks obtained from the perception analysis were categorised separately and evaluated with Space Syntax via the parameters of integration (global and local), intelligibility, and synergy. Here, measurements made with space syntax parameters provide the opportunity to analyse separately the nodes, landmarks, paths, and districts in the perception analysis. However, the areas designated as edges cannot be measured with the Space Syntax parameters, since they are elements that cannot be separated numerically in the spatial setup. Therefore, syntactical measurement of the edges was not part of this study. Consequently, separate numerical evaluations were made for the perceived places regarding the 4 parameters and 48 image elements obtained in the perception analysis.

A Comparative Analysis in Terms of the Relationship between Landmarks and Space Syntax

When the perception analysis was evaluated in terms of landmark elements, it was understood that a total of 12 different landmarks, 6 major and 6 minor, were perceived. Space syntax analysis yields healthy results in the context of specific area size. Landmark elements are elements that are perceived as points. It should be stated that calculations were made in a circular area of 300 meters in radius so that each landmark element would be at its centre. The size of this area was considered to be the walking distance of the landmark. Then, the axes within the boundaries of this 300-meter radius circle were determined as the analysis data for each landmark. The landmark-space syntax relationship is interpreted over these axis lines. The evaluation was made according to the degrees of integration (global), integration (local), synergy, and intelligibility within the boundaries of the area defined for each item (Figure 5).

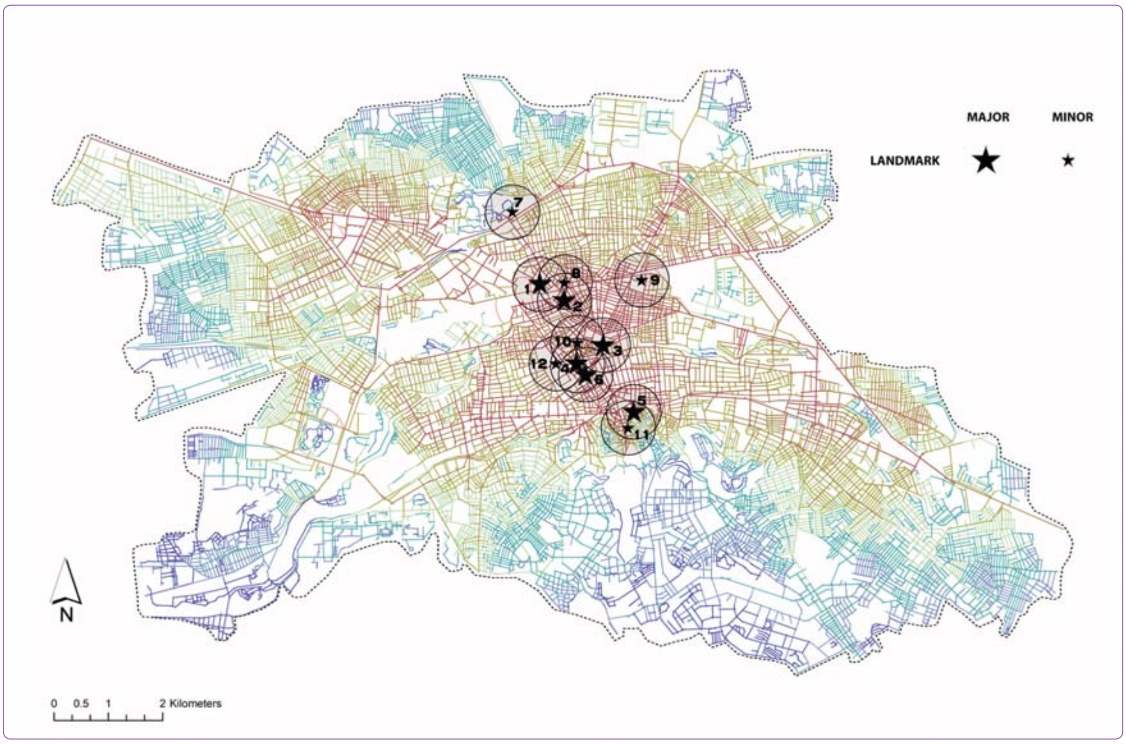

Figure 5. Eskisehir city, major and minor landmarks.

- When the landmarks were examined according to the whole city average, it was seen that the global integration value of "Anadolu University Gate (7)", one of the minor landmarks, and the local integration value of "Kursunlu Mosque (6)", one of the major landmarks, were below the city average. When the intelligibility and synergy values of all the perceived landmarks were examined, it was noticed that all of them were above the city average.
- When the global integration values of the perceived landmarks were investigated, it was seen that Kanatlı Shopping Centre (2), one of the major landmarks, had the highest value, and when the local integration values were examined, the Opera house (9), one of the minor landmarks, had the highest value. On the other hand, Porsuk Islands (3), one of the major landmarks, had the highest value in terms of intelligibility, and the Resadiye Mosque (11), one of the minor landmarks, had the highest value in terms of synergy values (Table 2).
- It can be stated that the landmarks designated as major in the image map were mostly located in areas with high integration value, as can be followed from the map in Figure 5. However, the detailed analyses indicate that not only physical space fabric at the points where these elements were located but also the visual and functional features could make a difference in the perception of individuals. In this case, while the major-minor distinction could be made in perception analysis, the same distinction could not be made in Space Syntax analysis.

Comparative Analysis in Terms of the Relationship between Nodes and Space Syntax

When the perception analysis was evaluated in terms of nodes, a total of 9 different nodes were perceived, 5 as major and 4 as minor. Likewise, node elements were perceived as points, as in landmarks. At this point, calculations were made in a circular area with a radius of 300 meters, centring each point node element. This area size was taken to be the walking distance of the node area. Then, the axes within the boundaries of this 300-meter radius circle were determined as the analysis data for each node. The node-space syntax relationship is interpreted over these axis lines. Evaluations were made according to the degrees of integration (Global), integration (local), synergy, and intelligibility within the boundaries of the area defined for each element (Figure 6).

- When the nodes were examined according to the whole city average, based on the minor nodes, the global integration value of "Sazova Park (6)" and the local integration value of "Kentpark (7)" were below the whole city average. When the intelligibility and synergy values of all perceived nodes were examined, it was seen that all of them were above the city average (Table 3).

Table 2. Evaluation of the perceived landmarks in terms of numerical parameters

	Number of Axial lines	Integration Global (Mean Value)	Integration Local R3 (Mean Value)	Connectivity	Intelligibility	Synergy
MAJOR						
(1) Espark Shopping Mall	119	1.0351	2.4563	5.5868	0,40	0.65
(2) Kanatlı Shopping Mall	131	1.0688	2.5371	5.8939	0.48	0.81
(3) Porsuk Islands	147	1.0463	2.5289	6.0472	0.58	0.88
(4) Government Building	103	1.0291	2.4190	5.3894	0.57	0.93
(5) Ataturk High School	271	0.9113	2.0576	4.8309	0.46	0.79
(6) Kursunlu Mosque	345	0.8465	1.8770	4.2370	0.40	0.70
MINOR						
(7) Anadolu University Gate	126	0.7669	1.6257	3.5197	0.42	0.73
(8) Haller Youth Center	123	1.0646	2.5501	6.0564	0.37	0.71
(9) Opera House	106	1.0466	2.5660	6.3925	0.49	0.81
(10) Esnaf Sarayı	135	1.0373	2.4710	5.9118	0.58	0.88
(11) Resadiye Mosque	112	1.0291	2.4190	5.3894	0.57	0.93
(12) Stadium	96	1.0076	2.4330	5.7113	0.50	0.87
Whole City Landmark	10900	Min. : 0.3876 Max. :1.3053 Mean : 0.7785	Min. :0.3333 Max. :4.2924 Mean: 1.9361	Min. :1.000 Max. :54.000 Mean: 4.012	0.26	0.52

- An examination of the global integration values of the perceived nodes revealed that Espark Shopping Mall (1), one of the major landmark elements, had the highest value, whereas in terms of the local integration values, Hamamyolu (5), also one of the major nodes, had the highest value. Based on the intelligibility values, Kent Park (7), one of the minor nodes, had the highest value, and considering the synergy values, Hamamyolu (5), one of the major nodes, had the highest value (Table 3).

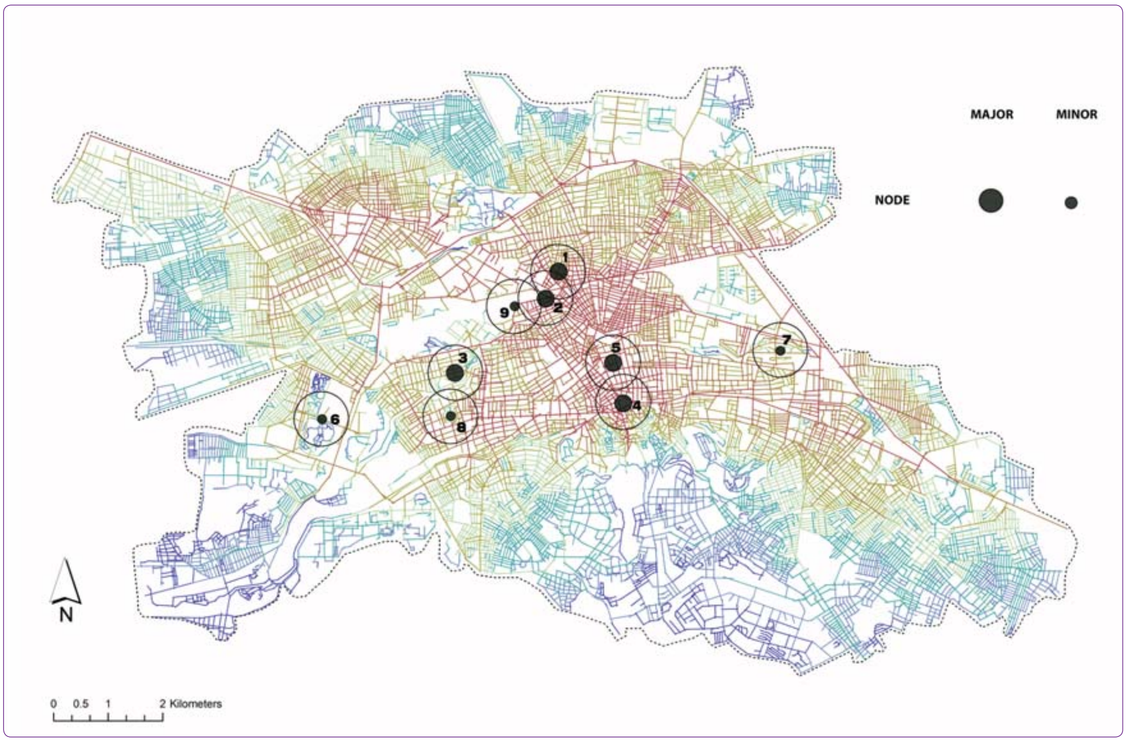

Figure 6. Eskisehir city, major and minor nodes.

Table 3. Evaluation of the perceived nodes in terms of numerical parameters

	Number of Axial lines	Integration Global (Mean Value)	Integration Local R3 (Mean Value)	Connectivity	Intelligibility	Synergy
MAJOR						
(1) Espark Shopping Mall	119	1.0351	2.4563	5.5868	0,40	0.65
(2)Kanatlı Shopping Mall	131	1.0688	2.5371	5.8939	0.48	0,81
(3) Kanlıkavak Park	144	0.8395	1.9120	3.9449	0.40	0.79
(4) Atlıhan	337	0.8674	1.9313	4.3817	0.42	0.73
(5) Hamamyolu	105	1.0608	2.6062	6.2359	0.60	0.93
MINOR						
(6) Sazova Park	168	0.7000	1.4410	3.1420	0.54	0.77
(7) Kentpark	116	0.8700	1.77552	3.5897	0.57	0.84
(8) Dedekorkut Park	139	0.8886	1.99590	4.2429	0.56	0.85
(9) Train Station	91	1.0219	2.1415	4.9557	0.48	0.86
Whole City	10900	Min. : 0.3876 Max. :1.3053 Mean : 0.7785	Min. :0.3333 Max. :4.2924 Mean: 1.9361	Min. :1.000 Max. :54.000 Mean: 4.012	0.26	0.52

- The nodes designated as major in the image map were mostly found to be located in areas with high integration value. Minor image elements can be said to occupy less space in user perception, even though they had high values in space syntax analysis. The reason for this could be that they were areas that were isolated from their surroundings and therefore not integrated with them.

A Comparative Analysis in Terms of the Relationship between Districts and Space Syntax

Based on the perception analysis evaluation made in terms of districts, a total of 12 different districts were perceived, 6 as major and 6 as minor. Since the districts represented an area size, a separate spatial definition was not made. Likewise, evaluations were made according

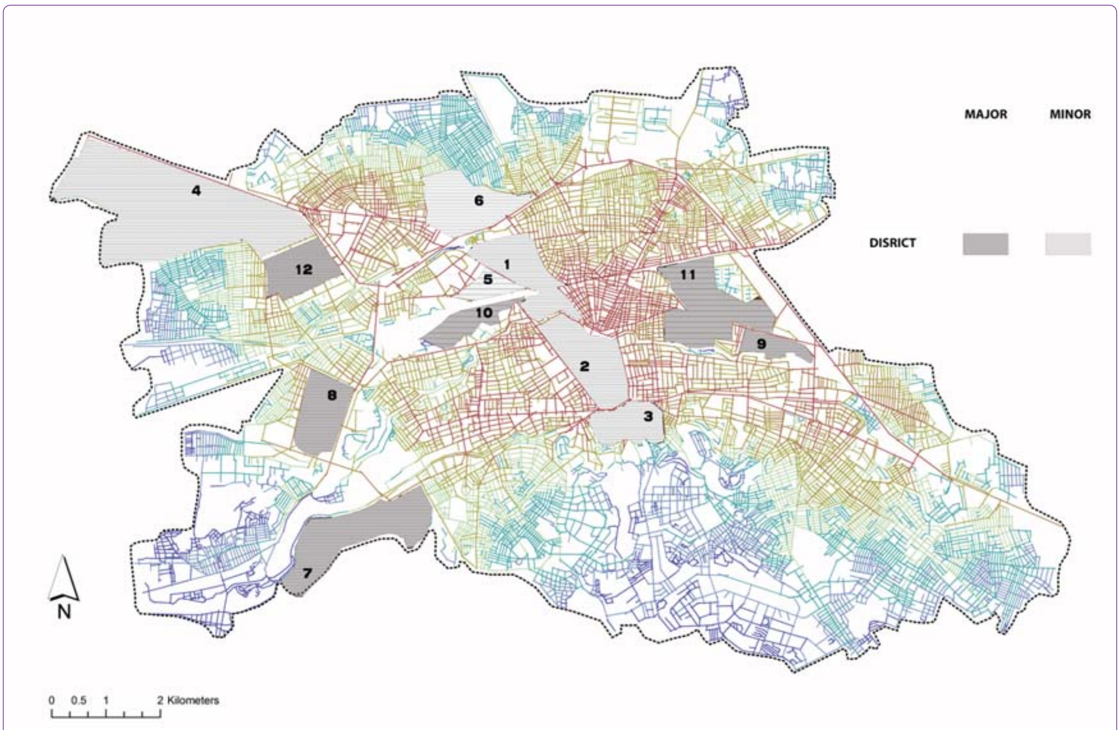

Figure 7. Eskisehir city, major and minor districts.

Table 4. Evaluation of the perceived districts in terms of numerical parameters

	Number of Axial lines	Integration Global (Mean Value)	Integration Local R3 (Mean Value)	Connectivity	Intelligibility	Synergy
MAJOR						
(1) Baglar-Espark District	129	1.0596	2.4228	5.4153	0.43	0.80
(2) Hamamyolu	148	1.0324	2.4433	5.2080	0.61	0.91
(3) Odunpazarı Historical District	323	0.8438	1.8578	3.9969	0.38	0.67
(4) New Residental District	332	0.7636	2.1257	4.4534	0.32	0.58
(5) Factories District	20	0.9293	1.4121	3.0526	0.75	0.91
(5) Anadolu University	202	0.7449	1.3614	2.8670	0.43	0.63
MINOR						
(7) Osmangazi University	150	0.6622	1.4296	2.8411	0.35	0.67
(8) Sazova Park	232	0.6496	1.3643	2.9099	0.32	0.52
(9) Kentpark	62	0.8345	1.5936	3.1587	0.47	0.84
(10) Train Station	18	0.8146	1.3593	2.7538	0.54	0.77
(11) Sugar Factory	64	0.9293	1.4122	3.0526	0.75	0.92
(12) Small Industry Area	345	0.8655	2.3062	4.4959	0.35	0.61
Whole City	10900	Min. : 0.3876 Max. :1.3053 Mean : 0.7785	Min. :0.3333 Max. :4.2924 Mean: 1.9361	Min. :1.000 Max. :54.000 Mean: 4.012	0.26	0.52

to integration (Global), integration (Local), syntactic intelligibility and synergy values for each district area using the determined parameters (Figure 7).

- When the districts were examined according to the whole city average, it was seen that the global integration values of "New Residential District (4)" and Anadolu University (6), which were major districts, and Osmangazi University and Sazova Park, which were minor districts, were below the whole city average. Among the districts perceived as minor, only a small industry area (12) was above the city average. On the other hand, the local integration value of "Kentpark (7)" was below the whole city average. When the intelligibility and synergy values of all the perceived districts were examined, all of them were noticeably above the city average (Table 4).
- Based on the global integration values of the perceived districts, Baglar-Espark (1) district, one of the major districts, had the highest value, whereas, in terms of local integration values, Hamamyolu (2) had the highest value. Considering the intelligibility values, the Factories District (5), one of the major districts, and the train station district (10), one of the minor districts, had high values. In terms of the synergy values, the train station district (10), which was again one of the minor districts, had the highest value.
- The districts with high synergy value are perceived as minor rather than major. This is understood to have arisen from the fact that physical and visual access to these districts is limited to their semi-public character.

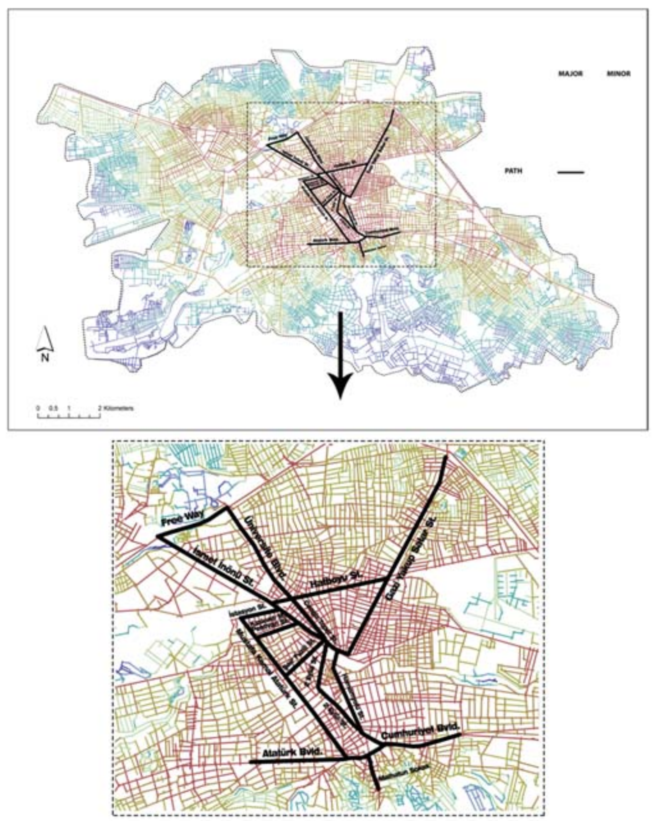

Figure 8. Eskisehir city paths.

Table 5. Evaluation of the perceived paths in terms of numerical parameters

	Integration Global (Mean Value)	Integration Local R3 (Mean Value)	Connectivity	Intelligibility	Synergy
Üniversite Boulevard	1.1353	3.3269	14.5000	-	-
Free Way	1.1550	2.5599	6.000	-	-
Atatürk Boulevard	1.1970	4,1645	36.000	-	-
Üniversite Boulevard	1.1331	3.3170	14.3333	-	-
Cumhuriyet Boulevard	1.1195	3.1528	11.000	-	-
İsmet İnönü Street	1.3053	3.8684	25.000	-	-
Hatboyu Street	1.2826	4.2923	38.000	-	-
Gazi Yakup Satar Street	1.1920	4.2674	54.0000	-	-
Cengiz Topel Street	1.1648	3.4641	18.000	-	-
İstasyon Street	1.2413	3.4136	12.000	-	-
Kızılcıklı M. Pehlivan Street	1.1175	2.8293	9.000	-	-
Şair Fuzili Street	1.1413	3.4436	14.000	-	-
Mustafa Kemal Atatürk Street	1.3053	3.8684	25.000	-	-
Hamamyolu Street	1.1252	3.4997	22.000	-	-
Malhatun Street	1.1259	3.3146	14.000	-	-
Paths	**1.1544**	**3.4182**	**17.2222**	**0.60**	**0.73**
Whole City	Min. : 0.3876	Min. :0.3333	Min. :1.000	0.26	0.52
	Max. :1.3053	Max. :4.2924	Max. :54.000		
	Mean : 0.7785	Mean: 1.9361	Mean: 4.012		

A Comparative Analysis in Terms of the Relationship between Paths and Space Syntax

An examination of the perceived paths in the city within the framework of the perception analysis made revealed that the perceived paths were not distinguished in people's minds as major and minor. In addition, although perceived paths did not represent a spatial system with boundaries such as landmarks, nodes, and districts, they still represented a connected system (Figure 8). Therefore, 15 perceived paths were interpreted as a single spatial area in the calculation of the determined parameters (Table 5).

As can be followed from Table 5, integration, intelligibility and synergy values are well above the whole city average.

Discussion

In this study, a spatial reading was performed through a methodological approach in which two different methods,

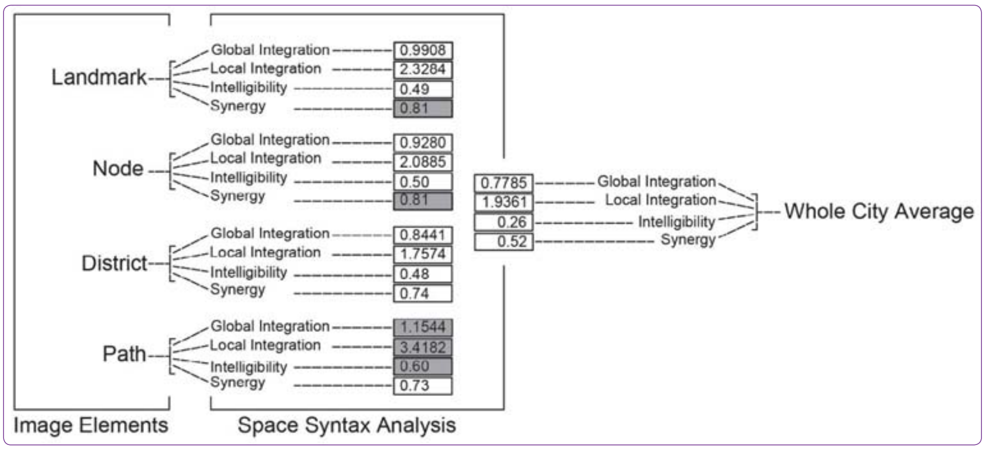

Figure 9. The relationship between image elements and space syntax parameters.

subjective and objective, were applied comparatively. When the images, districts, landmarks and paths perceived as a result of Lynch's analysis were evaluated numerically, the following Figure 9 was created.

An examination of the global integration value on an urban scale indicated that the path parameter had the highest value with an average value of 1.1544. The landmarks had second place with a value of 0.9933, and the nodes were in third place with 0.9358. The accessibility of the districts was in the last place with a 0.8441. However, a general examination of the integration levels of these four parameters revealed that they had values far above the whole city average. This proved that the spaces in people's mental perception also had high integration values. Likewise, an examination of the local integration parameter indicated that the path parameter was at the highest level with an average value of 3.4118. The image elements and nodes had average values close to each other and high levels of accessibility. The average value of the district parameter, on the other hand, was the lowest value. These results also proved that the spaces in people's mental perception had high local integration values on an urban scale. When the intelligibility parameter was examined, it was seen that the path parameter was at the most accessible level with the highest average value of 0.60. Landmarks and nodes had average values close to each other and high levels of intelligibility. The average value of the district parameter was again the lowest value. These results showed that spaces in people's mental perception also had high intelligibility values. As a result of the analysis of the synergy parameter, it was seen that the landmarks and nodes had the same average values and the highest values. Considering the paths, edges, and districts, it was seen that landmarks and nodes appeared predominantly as point image elements. This situation revealed the importance of a system with high integration both at the global and local levels within the urban system in the formation of point images.

Conclusion

In general, it is observed that the perception of the path appears to be the primary image element, followed by the elements of landmark and node, at close and significant values. Lastly, image elements perceived on the district level are perceived less. The results obtained from the space syntax parameters in this study indicate, as was suggested by Dalton and Bafna, strong evidence in terms of the concepts of "legibility" and "intelligibility" on a perceptual basis. In addition, the study presents a different methodological approach in order to categorise the image elements in detail, allowing each element to be evaluated numerically, and to discuss on which parameter the perception of the image element has priority. It is believed that this discussion, which has been conducted on image perception and spatial legibility, can be a guide for future projects regarding the design of urban space for the city of Eskisehir.

This study is important since it has used numerical approaches as an auxiliary instrument in the planning process of a city and contributed to the emergence of urban spaces that are integrated with the city residents. At the same time, the study offers a holistic methodological approach that can be used for different cities, even though it has been applied in the sample city of Eskisehir. In addition to all these, it is an important point to test image perception with visual approaches, as in this study, in numerical and technological terms, besides the intelligibility of the morphological structure of the space.

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