

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE
ENGINEERING AND TECHNOLOGY

**SPATIAL COGNITION:
APPLICATION OF SPACE SYNTAX ON BEYAZIT DISTRICT, ISTANBUL**

M.Sc. THESIS

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Institute of Science and Technology

Urban Design Program

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MEKAN DİZİM YÖNTEMİNİN
BEYAZİT, İSTANBUL KAPSAMINDA UYGULANMASI**

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To my beloved parents,

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Samira Malek
(Architect)

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SPATIAL CONITION: APPLICATION OF SPACE SYNTAX ON BEYAZIT DISTRICT, ISTANBUL

SUMMARY

Designing cities depends upon how we conceived cities, in this regard focusing on the cognitive approach of urban spaces, which has an essential role in urban design, is necessary and undoubtedly determining factors that influence spatial cognition are important too. In this point of view this study preliminary illustrated the cognitive map of people about the area and spatial configuration of urban space through the case study of Beyazit area settled in the historical part of Istanbul. The aim is finding the answers of these questions:

- What is the cognitive representation of people about Beyazit area?
- Whether the syntactical properties of the area have a role in predicting the level of perceiving and memorability of the spaces or not?

This study investigated spatial cognition of Beyazit area in association with syntactical attributes of it. In order to achieve the objectives, two research studies, cognitive mapping and space syntax analyzing, were performed in this study. Research findings were obtained by investigating the results from subjective and objective perspectives respectively.

In the cognitive mapping process the technique of sketch mapping was utilized and additionally recognition task which is one of the cognitive mapping technique was done in order to underpin the results drew from analyzing the sketch maps. Also the spatial configuration of the area was analyzed through space syntax method and described syntactically by three spatial properties of integration, connectivity and intelligibility. Comparison of the findings drew from cognition and space syntax approaches enabled determination of whether the syntactical attributes of space are in association with cognitive representations or not. Overall, the results of the correlational study indicated that there is a positive association between cognitive representation and spatial configuration.

In this context this thesis directs attentions to the cognition and space syntax approaches. Every chapter draws on issues relevant to these approaches, arguments about cognition started by defining of the spatial cognition. It refers to the knowledge, which is related to the thought process; these processes of gaining knowledge include, acquisition, storage, retrieval, manipulation and use of information gathered from the environment. According to Moore (1976), Spatial cognition sometimes has being seen as a subset of *environmental cognition*, which refers to the awareness, impressions, information, images, and beliefs that people have about the environments.

Environmental cognition concerns the way we acquire, organize, store, and recall information about locations, distances, and arrangements in the physical

environment. Perception is another term, which is common in cognitive studies and is often being used instead of environmental cognition to indicate the ability of human to comprehend, interpret, and evaluate the physical world that surrounds us. As Passini (1984), stated environmental perception is more related to 'sensory information', whereas *environment cognition or recognition* is considered, as 'memory information' therefore it can be stated that cognition is more intellectual than perception. Cognitive map is another notion, which is explicated as a mental representation of the world around us resulting from experience, direct and indirect learning, and knowledge integration and processing. In reality, researchers in different fields may use different terms such as mental maps, mental image, and mental pictures, which have the same meaning as *cognitive maps*. Nonetheless many different arguments point to the mental image, all of them have common idea that mental image is a by-product of thinking and it is an important component of cognition.

Lynch's arguments about mental image points to this fact that mental image is formed in the process of perceiving environment, he named it as legibility. Lynch (1960), examined legibility of the city use of mental maps; he found that there are five physical elements (paths, landmarks, districts, nodes, edges), which have important role in creating legible place. There is variety of techniques to apprehend the cognitive map which sketch mapping is one which is developed by Lynch.

Another approach, which was utilized in this study, is space syntax. The review of the theory on space syntax and the relevant issues provides an essential starting point for the research, this session discussed about the term of spatial configuration, defined it as spatial relations taking into account other relations, further more in order to generate a field for a practical study through space syntax methodology, it investigate the explanation of syntactical properties of the urban layout.

The chapter that follows take up with exploring relation between space syntax and cognition and reviewing previous studies about this issue in order to find the common area for these two approaches; for example understanding and readability of the cities were argued by noted the term of legibility from cognition perspective and intelligibility form space syntax perspective. Finally in the last chapter the whole procedure for dealing with data collection and analyzing them was explained. The results drew from inferring the cognitive maps were inverted to the quantitative data in order to execute correlational study. The comparison of the scores obtained from cognitive mapping and space syntax analyses enabled the determination the relationship between the routes' scores from cognitive mapping and their syntactic values in the present map, which are the base research issues.

In the light of formal measures derived from space syntax, the research findings recapitulate that there is a positive correlation between spatial configuration of Beyazit urban area with the degree of memorability of spaces, and it would be possible to predict the degree of memorability of the spaces according to their syntactic values.

MEKANSAL BİLİŞİM: MEKAN DİZİM YÖNTEMİNİN BEYAZİT, İSTANBUL KAPSAMINDA UYGULANMASI

ÖZET

Kentlerin tasarımı, kentleri nasıl algıladığımıza bağlıdır. Bu bakımdan, kentsel tasarımda çok önemli rol oynayan bir konu olan kentsel mekânlara bilişsel yaklaşım üzerine odaklanılması gereklidir ve şüphesiz ki mekânsal algıyı etkileyen faktörlerin belirlenmesi de büyük önem taşımaktadır. Bu bakış açısıyla yaklaşıldığında, bu tez çalışması İstanbul Tarihi Yarımadasında Beyazıt bölgesi için kullanıcıların alana ve kentsel mekânın yapısına dair biliş haritalarını sunmakta ve Beyazıt bölgenin sentaktik değerleriyle ilişkili olarak bölgedeki mekânsal biliş konusunu irdelemektedir.

Bu tez çalışmasında belirtilen soruları cevaplandırmak amaçlandırılmış:

- Beyazıt alanında kullanıcıların mekana dair bilişsel gösterimi nedir?
- Beyazıt alanının sentaktik değerleri, alanın algılanmasıyla bir ilişkisi var mı?

Tez çalışmasının amaçlarını gerçekleştirmek üzere bilişsel haritalamadan ve mekân dizimi (space syntax) analizlerinden oluşan iki çeşit çalışma yapılmıştır. Bu çalışmaların sonuçları sırasıyla sübjektif ve objektif bakış açılarıyla değerlendirilerek sonuçlara ulaşılmıştır. Bilişsel haritalama sürecinde krokilerden (sketch map) yararlanılmıştır ve krokilerin analizinden çıkan sonuçları desteklemek amacıyla bilişsel haritalama tekniklerinden biri olan farkındalık görevi (recognition test) kullanılmıştır. Diğer taraftan, bölgenin mekânsal yapısı mekân dizimi yöntemi kullanılarak analiz edilmiş ve bütünleşme (integration), bağlılık (connectivity) ve okunabilirlik (intelligibility) nitelikleri aracılığıyla sentaktik olarak ifade edilmiştir. Biliş ve mekân dizimi yaklaşımları kullanılarak elde edilen bulguların karşılaştırılması, mekândaki sentaktik değerlerle bilişsel temsiller arasında bir ilişki olup olmadığının tespit edilmesini sağlamıştır. Sonuç olarak, yapılan korelasyonlar, bilişsel temsillerle mekânsal yapı arasında pozitif bir ilişki olduğunu göstermiştir.

Bu bağlamda, bu tez çalışması biliş ve mekân dizimi yaklaşımlarına dikkat çekmektedir ve tezdeki her bölüm bu yaklaşımlarla ilgili konulardan, biliş konusundaki mekânsal bilişin tanımını da kapsayan tartışmalardan yararlanmaktadır. Mekânsal biliş, zaman zaman, insanların çevreleri hakkındaki farkındalıkları, izlenimleri, bilgileri, görüntüleri ve inançlarını ifade eden *çevresel biliş* kavramının bir alt kümesi olarak görülmüştür.

Çevresel biliş; fiziki çevredeki konumlar, mesafeler ve düzenlerle ilgili bilgileri nasıl elde ettiğimiz, nasıl depoladığımız ve nasıl hatırladığımızla ilgilenmektedir. Algı, bilişle ilgili çalışmalarda kullanılan başka bir kavramdır ve çoğu zaman insanların kendilerini çevreleyen fiziki çevreyi anlama, yorumlama ve değerlendirme yeteneklerini ifade etmek üzere çevresel biliş kavramı yerine kullanılmaktadır.

Çevresel algı daha çok ‘duyularla edinilen bilgilerle’ (sensory information) ilişkiliyken *çevresel biliş veya algı* ‘anılarla ilgili bilgiler’(memory information) olarak kabul edilmektedir. Dolayısıyla, biliş algıdan daha düşünsel bir kavramdır. Biliş haritası ise etrafımızdaki dünyanın deneyimler, doğrudan ve dolaylı öğrenilen bilgiler ve bilgilerin bütünleştirilmesi ve işlenmesi sonucunda oluşturulan zihinsel bir temsili olarak açıklanabilen başka bir kavramdır. Farklı disiplinlerdeki araştırmacılar *biliş haritaları* yerine zihinsel harita, zihinsel imaj ve zihinsel resim gibi farklı terimler kullanmaktadır. Buna rağmen, zihinsel imajla ilgili tartışmaların tümünün ortak noktası, zihinsel imajın düşüncenin bir yan ürünü olduğu ve bilişin önemli bir bileşenini oluşturduğudur.

Kevin Lynch’in zihinsel imajlarla ilgili ortaya attığı fikirler, zihinsel imajın çevreyi algılama sürecinde ortaya konduğunu belirtmektedir; Lynch bunu okunabilirlik olarak adlandırmıştır. Lynch kentin okunabilirliğini biliş haritaları kullanarak incelemiştir ve okunabilir bir mekânı oluşturan beş fiziksel ögenin (yollar, nirengi noktaları, bölgeler, düğümler, sınırlar) olduğu sonucuna ulaşmıştır. Biliş haritalarının kavranması için çeşitli teknikler bulunmaktadır ve Lynch tarafından geliştirilen kroki çizimi de bu tekniklerden biridir.

Bu çalışmada kullanılan bir diğer yaklaşım ise mekân dizimi yöntemidir. Mekan dizimi (space syntax) yöntemi mekansal dokuları farklı ölçeklerde, binadan kentsel mekana kadar inceleme fırsatı veriyor. Mekan dizimi yaklaşımı mekânsal ve sosyal yapı arasındaki karşılıklı etkileşiminden bahsetmektedir. Mekansal özellikler matematiksel olarak çevriliyor ve bu mekanlar nasıl insanların sosyal aktivitelerini etkileyeceği belirtiliyor.

Mekân dizimi yöntemiyle ilgili teoremin ve ilgili konuların incelenmesi bu araştırma için bir başlangıç noktası teşkil etmiştir. Bu bölümde; mekânsal yapı kavramı tartışılmış, mekânsal yapı diğer ilişkiler de göz önünde bulundurularak mekânsal ilişkiler olarak tanımlanmış ve mekân dizimi yönteminden faydalanılarak uygulamaya yönelik bir çalışmanın geliştirilmesi amacıyla kentsel yapıdaki sentaktik özelliklerin tanımları incelenmiştir.

Bir sonraki bölümde ise mekân dizimi ile biliş arasındaki ilişki irdelenmiş ve bu iki yaklaşım arasındaki ortak noktaları (örneğin, kentleri ve okunabilirliklerini anlamak için bilişsel bakış açısıyla okunabilirlik (readability) ve mekân dizimi yöntemindeki okunabilirlik (legibility) kavramlarının kullanılması) bulmak amacıyla konu üzerinde daha önce yapılmış çalışmalar incelenmiştir. Son olarak, veri toplama ve analizi için izlenen yöntem açıklanmıştır.

Biliş haritalarından çıkarılan sonuçlar korelasyon yapılabilmesi için sayısal verilere dönüştürülmüştür. Bu amaçla ulaşmak için haritadan çıkarılan verileri sayısal verilere dönüştürmek üzere sıralı bir ölçek kullanılmıştır. Bunun için tüm haritada çizilmiş yollar ve mekanlar kodlama sistemiyle sayısallaştırılmış; şöyle ki tüm çizilen yollar gerçek haritadaki yollarla karşılaştırarak doğru çizilmiş olanlara üç puan, kısmen doğru çizilmişlere iki puan, yanlış çizilmişse bir puan ve hiç çizilmemişse sıfır puan verilmiştir. Doğruluk düzeyi ise yolların şekil, yön ve uzunluklarına göre belirlenmiştir. Böylece elde edilen sonuçlar üst üste konularak alandaki biliş haritası elde edilmiştir.

Bilişsel haritalama çalışmasından ve mekân dizimi yöntemiyle elde edilen skorlar karşılaştırılarak aksların bilişsel haritalardaki skorlarıyla sentaktik değerleri arasındaki ilişki tespit edilmiş ve tez çalışmasının temel araştırma sorularına yanıtlar aranmıştır. Mekân dizimi yöntemiyle yapılan analizler ışığında bu tez çalışmasında

Beyazıt kent parçasındaki mekânsal yapı ile kullanıcıların algıları arasında pozitif bir korelasyon olduğu tespit edilmiş ve mekânların sentaktik değerlerine göre hatırlanabilirlik derecesinin tahmin edilebileceği sonucuna varılmıştır.

1. INTRODUCTION

In this thesis spatial cognitive representation of respondents about the Beyazit square and the role of spatial features of this area on the people's cognition is investigated. Urban design investigations illustrate that built environment could have an important effect in human's mental health (Evans, 2003). These researches assist urban designers and planners to find and develop new and better design principles. It has been revealed through literature review that one of the effective points which has a significant role in determining the success and quality of live space is cognition of the inhabitants. People form the city in their minds according to their mental image. They perceive spaces, use spaces, reading them as texts, then create some images in their minds, evaluate the spaces based on these images and finally act according to these imaginations. Therefore, it can be stated that finding image of an urban space and understanding the environmental cognition and perception is an important aspect in designing successful environments.

According to the literature studies, many factors are involved to form the human's cognition such as cultural, physical features and demographic properties of an environment, including social groups, age and gender. However, urban studies are interdisciplinary issue, but cognitive aspect of physical environment is still focal point of their interest. Thus, this thesis examines people's spatial cognition of Beyazit area as an urban space and the aims at obtaining their cognitive maps. The other objective of this thesis was to describe the area in a syntactical way. Therefore the layout of Beyazit area is analyzed by axial map and the results of these two subjective and objective investigations used as a choice to compare them in order to reach some clues to understand the relation between Beyazit spatial features and its inhabitant's spatial cognition. To achieve this goal, some methods have been followed which will be discussed in the next part of this session, but primarily there is a need to have an idea about the notion of cognition and spatial features.

In general, spatial cognition is the human understanding and perception of geographic space; this information is got from people by asking them to draw a map

and obtaining their cognitive map and analyzing them regarding to the approach initially introduced by Kevin Lynch and in addition space syntax method is applied to get the spatial features of space. Space syntax translates these features to the mathematical based measurements. All of these methods are described in detail in the thesis. The first chapter of thesis defines concepts of cognition and what are related to it and describes the literature studies that have been done in this field and ones that are common between cognition and design fields. The second chapter explains space syntax approach, and how spatial features of an urban space can be described in this perspective that describes the spatial properties of space from space syntax approach, like integration or connectivity. After the theoretical basis researches, it continues with analytical and practical basis studies. The applied methods and techniques are described and finally it ends with the obtained result's discussions and conclusions.

1.1 Significant and Problem Statement

The aim of this study is to find the answers of these questions:

- 1- What is the spatial cognitive representation of inhabitants about the Beyazit area? And to what extent they perceive the area?
- 2- Whether the syntactical properties of the area have a role in predicting the level of perceiving and memorability of the spaces or not.

In any design process, gathering the information is the first step. Therefore, there is a need to acquire present city's image and spatial cognition of the people about the space in order to develop the design principles and to improve the city's image. Investigating the current situation of the area from perceptual and spatial aspects is the first step in designing easy-perceptible urban area. To achieve this aim, in this research cognitive mapping of area is done by providing the sketch maps which were drawn by the area's inhabitants and analyzing them according to Lynch's ideas, which this mapping method gives the opportunity of creating a common language between the designers and people, and it can be very informative.

Although each physical element of the space separately can affect the spatial cognition, the relation between various spaces can also affect the spatial cognition. Lynchian elements are used to see the relation between individual urban elements and cognitive mapping; space syntax is used to see the relation between spatial

relations and cognitive mapping. When it is argued about the relation between different spaces, the notion of spatial configuration comes to mind, which is base concept of the space syntax theory. According to the objective of this research beside the examining cognition issues and images of city, using the space syntax method was necessary. Space syntax fills the gap that were in Lynch' studies which ignores the connection between different spaces and many researches done in the filed of spaces syntax studies deal with this issue. In this respect, this thesis particularly analyzes physical layout of Beyazit area, which is one of the main historical regions of Istanbul and passed through different cultural, religious and historical layers. Thus, its layout is described by providing cognitive maps initially. Then the other aim was to understand if there is a relation between the syntactical properties with its cognition, and if it is possible to predict the spaces, which are more likely to stick in mind according to their syntactical values.

According to the previous studies and literatures, the hope is that the results of the comparison between the relation of syntactical properties and cognitive mapping of Beyazit area, confirm the previous researches, which claims that there is a positive correlation between them (Kim, 2001). Figure (1.1) indicates the general idea and framework of this study.

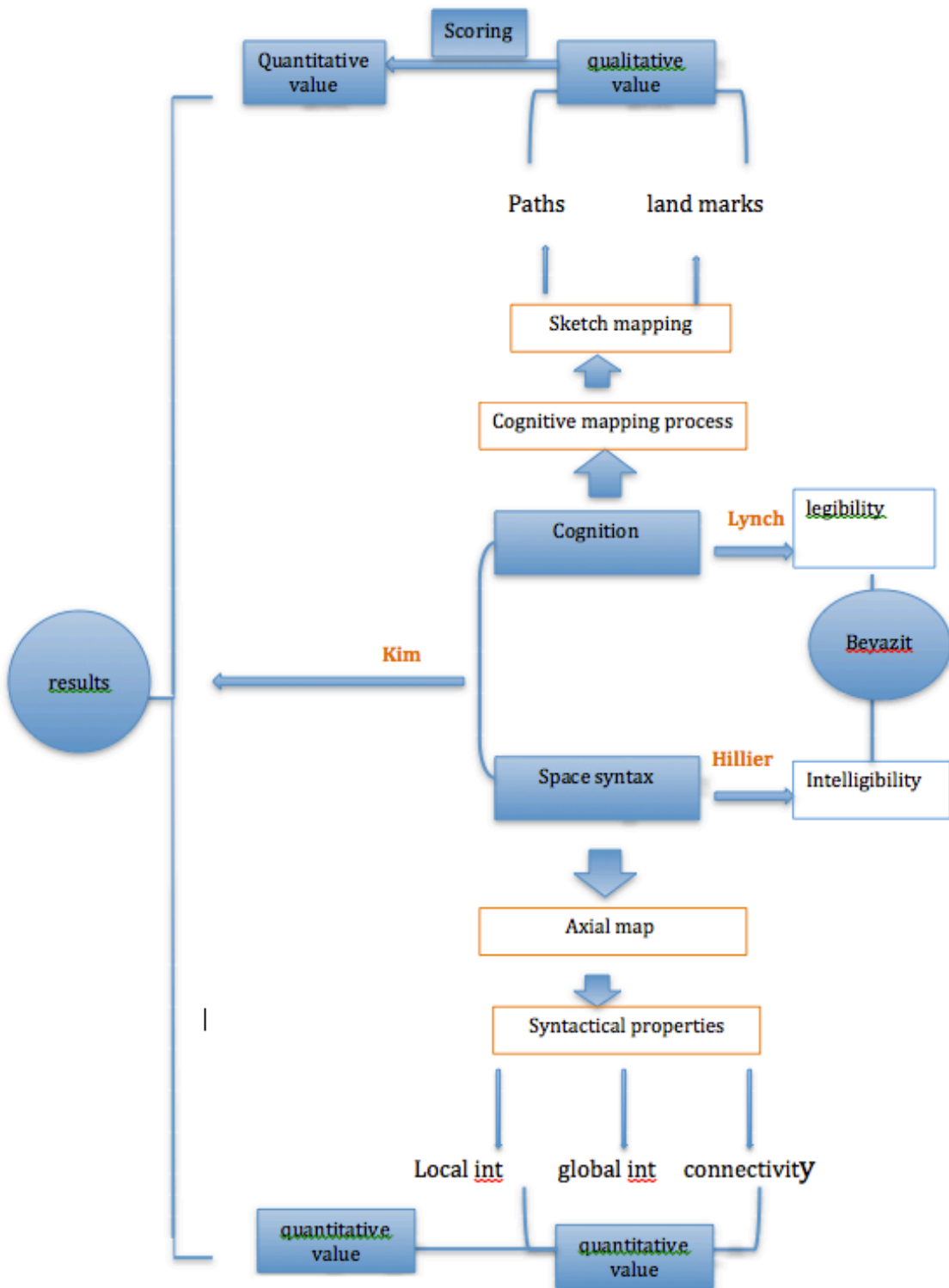


Figure 1.1 : Study's framework.

1.2 Selecting the Case Area

This research investigated quantitative and qualitative data of Beyazit area, considering its historical and locational significance.

Our cognitive map knowledge is formed in variety of ways; the most primeval form is declarative knowledge. In most cases declarative knowledge is associated with discrete objects like land mark, location places, linear objects such as Tram (Ramachandran, 2012). The nature of behavior and the activity plays an important role in how we get information about environment and our cognitive map. Therefore, Beyazit Square is selected as the case study because it is located at the heart of Istanbul and it is next to the Grand Bazaar, which is a landmark in the area it intersects with “Ordu Street” which leads to another crucial area of Istanbul, called “Sultanahmet” area. In addition to Roman and Byzantine remains, it is considered as the main campus of Istanbul University. It is also a gathering point for tourists, students and people who work in this area, so it would encompass variety of activities and social groups. This issue is important for obtaining spatial cognition, comparing and finding the differences, which appear in different social groups, because the boundaries between spaces which are in individuals’ minds and reflected in their spatial cognition, can be the products of their social differences (Tonkiss, 2003). The individuals, which participated in this practice selected randomly from different social groups since cognition can be different for different social groups. Based on one of the objectives of this thesis, which is finding the spatial cognition of Beyazit, the factor of social groups can lead us to some interesting results; therefore, Beyazit area is considered as a suitable case of study because the users are from two main groups of university students and Grand Bazaar’s tradespeople.

1.3 Methodology

In this thesis Bayazit area is selected as a case study and all the investigations applied in Beyazit by considering spatial cognition and space syntax approaches. Dealing with these two approaches, provide the opportunity of examining the case area, both with subjective and objective methods.

Applying Configurational technics, by considering the spatial cognition approach, was the initial step in order to achieve the objectives of the research. These technics

are Sketch Mapping, for obtaining the cognitive maps of the respondents about Beyazit area, and the other one is Recognition Test, which is applied in order to underpin the results drawn from the sketch Maps.

Space syntax is another method, which this study deals with it. The layout of Beyazit is described syntactically by generating the axial map of the area. Axial map provides the opportunity of analyzing the syntactical measurements of Beyazit area; means Local and Global Integration, Connectivity and the intelligibility of the case area. In order to obtain the axial map the Depth Map program is utilized. Depth map is an open source software which can implement visibility analysis and a range of configurational analysis in the scale of architecture and urban systems.

After collecting and analyzing the data by these two methods, a correlational study was performed between the results, in this regard; the qualitative values obtaining from cognitive mapping techniques were translated to the quantitative one, by using an encoding system. All of the applied procedures lead the study to achieve the stated objectives.

2. SPATIAL COGNITION AND SPACE SYNTAX

2.1 Spatial Cognition

In this chapter the literatures review about spatial cognition, different sources on cognition and their relation with physical environment have been conducted. The definitions of spatial cognition and cognitive map are given and it has been explained how to obtain a cognition map from individuals. Although there are a variety of different subjects in the fields of psychology and behavior sciences, this thesis has been focused on the architecture, urban space, human perception in the space syntax and urban design theories.

2.1.1 Definition of spatial cognition

The basic of the cognition meaning refers to the knowledge and understanding. Looking to the glossary meaning of the cognition, this is found that cognition is a general term associate with thought process, including information processing, storage of knowledge, and reasoning.

It is studied in various disciplines, such as psychology, philosophy and linguistics; however, for all of them it is referred to the processing of information. “These processes of gaining knowledge include acquisition, storage, retrieval, manipulation and use” (Montello, 2001, cited in Rafailaki, 2007: 185). Hart and Moore (1973) defined spatial cognition as “the knowledge and internal or cognitive representations of the structure, entities, and relations of space; in other words, the internalized reflection and reconstruction of space in thoughts” (p. 248). In general, spatial cognition is the human understanding and perception of geographic space.

Spatial cognition sometimes has being seen as a subset of environmental cognition, which refers to "the awareness, impressions, information, images, and beliefs that people have about the environments. It implies not only that individuals and groups have information and images about the existence of these environments and of their

constituent elements, but also that they have impression about their character, function, dynamics, and structural interrelatedness, and that they imbue them with meanings, significance, and mythical -symbolic properties" (Moore & Golledge, 1976: xii).

2.1.2 Environment perception and environmental cognition

Environmental cognition, which is the researcher, implement to show the human's ability to image and think about their surrounded world. According to the Bell et al. (2001) environmental cognition has following definition: We acquire facts and opinions about the world around us, and we remember emotional reactions to environments from experience. Presumably, we can use this mental representation of the physical environment to make plans, to understand the terrain around us, or solve problems involving an environmental context, finding a dry cleaning establishment, for example. In general, researchers refer to this ability to image and think about the spatial world as environmental cognition. (Bell et al., 2001, p. 57). Environmental cognition concerns the way we acquire, organize, store, and recall information about locations, distances, and arrangements in the physical environment. It adds a set of affective components to the cognitive components emphasized in spatial cognition. These affective components include feeling, attitude, belief, value, and other emotional characteristics (Hart & Conn, 1991).

By comparing above terms, we can understand that the environmental cognition is wider than spatial cognition, since it does not only include the human's ability to understand and reconstruct environments, but also the ability to make plans and solve problems, such as route choice and way finding.

Perception is another term, which is common in cognitive studies and is often being used instead of environmental cognition to indicate the ability of human to comprehend, interpret, and evaluate the physical world that surrounds us. Perception (from the Latin perception, percipio) is the organization, identification, and interpretation of sensory information in order to represent and understand the environment. All the perceptions involve signals in the nervous system, which in turn results from physical or chemical stimulation of the sense organs, for example, vision, involves light striking the retina of the eye. Perception is not a passive receipt of these signals, but is shaped by learning, memory, expectation and attention.

The term of perception, in general, seems to have the same meaning with cognition, but in fact there are different; it is more about the description and evaluation of the environment, for example, the perception of the environmental quality. The term has been used to describe the way in which people understand a structure and learn the environment and use mental maps to negotiate it. It involves information, experience, as well as hopes, ambitions, fears, values and various other real and imagined elements (Rapoport, 1977: 26-31). According to Downs and Stea Given, due to the varied uses of the terms, it is difficult to distinguish between perception and cognition. They believed that process of perception occurs beside the presence of an object and that results in the immediate understanding of that object by one or more of the senses. Temporally, it has strong relation with the events in the immediate surroundings and (in general) linked with immediate behavior; but in Cognition, it does not need to link with the immediate behavior and therefore, does not need to be directly related to anything occurring in the proximate environment. (Downs and Stea, 1973).

According to Passini (1984), environmental perception is more related to ‘sensory information’, whereas environment cognition or recognition is considered as ‘memory information’. In aspect of distance, there is a difference between these terms; the perceived distance is the estimated distance between two typical points which are in our sight, but cognitive distance is the distance estimated in our brain in the absence of the objects, relying more on our memory of those points location; so we can say cognition is more intellectual than perception.

2.1.3 Cognitive map

Cognitive map is a mental representation of the world around us resulting from experience, direct and indirect learning, knowledge integration, and processing. This was described by Tolman (1948), who initially used the term of cognitive map; he defined it as an internal representation that animals develop about the spatial relationships within their environment. Tolman, conducted a series of ingenious experiments in which a mouse was trained to find food by following a single roundabout pathway, he found that when the opportunity for going directly to the food is given, the animal takes it and it goes directly to the place where the food was, instead of following the original pathway. According to Tolman’s interpretation, the

animal gradually develops a “picture” of its environment that later may be used for finding the goal. This picture was called a cognitive map. He hypothesized that we construct a map-like representation within the 'black box' of the nervous system, which is then used to guide our everyday movements. Surveying another description of cognitive map, according to Altman and Chermes through these mental maps we can have an approximate idea about the city. It refers to the ability to collect, organize, store, recall, and manipulate the information about the environment.

In reality, researchers in different fields may use different terms such as mental maps, mental image, and mental pictures, which have the same meaning as cognitive maps (Downs and Stea, 1973).

2.1.4 Cognitive map process

Cognitive map is a term, which is used in many different disciplines such as psychology, social psychology, anthropology, geography, city planning urban design and architecture.

In the quotidian life we rely to our cognitive map to find our way, make decisions about geographic and spatial situations, use it to store knowledge and solve the problems related to the spaces and places. Although our cognitive map is not a real reflect of our world, it supports almost all our spatial decision-makings and behavioral needs. Cognitive and perception-based studies, which generally come up with cognitive mapping, are necessary and the first step for a better understanding and defining the urban space image. “Cognitive maps are mental constructs that encompass all the internal processes that enable people to acquire and manipulate information about the nature of their spatial environment” (Downs and Stea, 1973,p. 7). “Cognitive maps are the internal information structure that people use to represent information about everyday physical environment”

(Garling, Book, and Lindberg, 1984, p. 98). According to cognitive psychology, a mental image does not seem to be a “picture in the head”. “It differs from a picture in that it is not precise, it can be distorted, and it is segmented into meaningful pieces” (Anderson, 1995).

Also cognition map is a “compact orderly collection of knowledge which contains more information than one can generally conceive at once, thus permitting one to

anticipate, to react, and to consider next possible events” (Kaplan and Kaplan, 1982, p. 63).

As a result, when the spatial information is represented through memory, the cognitive mapping process occurs and as Golledge said, it can be used in processes like way finding and spatial behavior (Golledge, 1987).

2.1.5 Physical environment and mental representation

The physical environment became a significant subject in the field of environmental psychology’s researches, because it is a place in which human behavior occurs. All natural features of geography, climate, and man-made features, can be considered as a physical environment, which limits and facilitates the behavior, and the “resource” of the environment (Lawton, 1970, cited in Yixiang Long 2007, p 33). “This was considered as a primary, directly perceptible through the sensory organs and defined and considered in spatial and physical terms, whether built or natural, on small or large scale” (Craig, 197, cited in Bonnes, 2002, p.28). In this study the physical environment specifically refers to the man-made/built urban environment and in this environment there are symbols, and human mind always tries to make an abstract from the information that comes from its environment, in order to make it easier to keep the symbols in mind. In this point mental representation or cognitive representation, is an important subject for debate. In the psychology field, traditionally, environment behavior was important but there is also another new subject in this field, which focuses on researching the special-physical properties of environment. Spatial-physical properties of environment can form the human actions and experiences in the different levels such as intrapersonal, interpersonal to social groups (Altman, 1987). Spatial-physical property is defined as hidden dimension. (Hall, 1966, cited in Bonnes, 2002. p 29).

2.1.5.1 Cognitive representation

Cognitive representation can be described as a hypothetical internal cognitive symbol that represents external reality, or also a mental process which during this process symbols of environment are used; it is a formal system for making clear certain entities or types of information, together with them it describes how the system does this (David, 2010).

According to Stenberg (2010), mental representation is the mental imagery of things that are not currently seen or sensed by the sense organs. The mental imagery has been described in the following session. We often have images of objects and events in our mind, according to schema theory, psychological reactions to environmental events are driven by mental representations, or schemas, which are organized knowledge structures of past experiences (Bartlett et al, 1932). Environmental events are filtered through mental representations, which guide the thoughts, feelings, and behaviors (Bowlby, 1969, cited in Stupica 2012, p 78).

2.1.5.2 Mental imagery

Mental imagery is the representational theory of mind proposes that our experiences and activities are supported by mental representations (Chandrasekara et al, 2011). The exact nature of these representations is still a subject to debate but a widely received view is the mental imagery theory (Kosslyn, et al, 2005, cited in akinlofa 2013,p 239). According to the mental imagery theory there is a difference between perception and mental imagery; perceptual representations need external stimuli to react but mental imagery refers to representations that exist or persist in the absence of (or after removing) the stimuli. According to the I.West et al (1985), “Imagery involves the internal perception or representation of an object; internal representation may occur when the object is present -to play a role in identification or it may occur when the object is absent-to play a role in remembering” (P.14).

There are many views about imagery, most of them have believed that it is a by-product of thinking; also some of the researchers like Kosslyn consider imagery as an important component of cognition. Kosslyn says that the mental image information is represented “pictorially”; he demonstrated that the image contains spatial contents, which includes both metric distance of objects and relative distance of objects (cohen et al, 1985). When the objects, elements or environmental information are perceived constantly and repetitively, the mental images turn into cognition; in this situation when the environmental image is understood, taught and grouped, environmental cognition constitutes. In other words, when we perceive any space, the information, which we receive from our environment is stored in our brain as images, when this process repeats continuously; these stored data will turn into cognition.

2.1.5.3 Image in the urban design

Urban manager need to consider many dimensions that affect the city to have a better and successful design and planning; they need to know the present city's image to redesign a better image. In the urban design process, collecting information from the urban space is important, according to Martinez (2007), "both strategic city planning and city marketing, a fundamental starting point is to evaluate the image of the city itself" (p.1). "The urban image is a set of adjectival interpretations about a city spontaneously associated with a given stimulus (physical and social) that has previously unleashed in individuals a series of associations"(Martinez et al, 2007,p.1). Via a stimulus, image of an object is formed in individual's mind; they form the image through integration between chains and networks in their minds over a period of time. According to the Martinez (2007)," The great interest in the images of cities lies in the hypothesis that a certain image is a basic antecedent to establishing and better understanding a direct or indirect relationship with different target groups" (p.1). Lynch (1960), explained that environmental images are the result of a two-way process between the observer and his environment; it means that in this two-way process the environment suggests distinction and relation, and the observer selects, organizes and gives attention and meaning to what he see according to his purposes. In the other word, in this process the field of the interest of the observer is important, for example some people realize structures firstly in a square and some only the eating, drinking facilities (lynch, 1960). On the other hand, the components of cities (streets, avenues, squares etc.) cannot be denied for being important at constituting urban image and for gaining clues about that city life. in his classic work, Lynch (1960)

Cognitive maps can be defined in terms of landmarks, paths, nodes, districts and edges, and there is also some sort of relationship by which these elements are described and linked, such as connectivity, order and containment (Kuipers, et al, 2003).

2.1.5.4 Physical aspect of the city image according to lynch

According to Lynch (1960), "environmental image may be analyzed into three components, identity, structure, and meaning; it is useful to abstract these for analysis; if it is remembered that in reality they always appear together" (p.8). He

emphasis that his study is focused on the physical environment as a independent variable, so he looks for the physical qualities which are relate to the attributes of identity and structure in a mental image (lynch, 1960). According to lynch (1960), "this leads to the definition of what might be called imageability"(p.8). Kevin Lynch continues; the 'imageability' of an object depends on the quality of an object in evocating a strong mental image in any observer. There fore in the process of perceiving an environment creating a visual hypothesis and building an organized mental image is accrued (Lynch, 1960). He said that imagibility might also be called as legibility or perhaps visibility in effective sense, Kevin Lynch has a pioneering empirical work on this subject in his book named 'The Image of the City', Lynch investigates the quality of the visual environment, introducing new research procedures and new concepts such as way finding and mental maps. He examines the legibility of the city structure from the point of view of user, dwellers and their use of mental maps, pointing out the relevance of urban landmarks, and the dweller's mental image of the city (Gouveia, et. al. 2009).

Lynch (1960), in his work, investigated three American cities (Boston, Jersey City, and Los Angeles) after 1950's using surveys (direct interviews) and illustrations (asking Respondents to draw sketches of city plans or their fragments) to find out the image of these cities. Lynch separated the important and necessary elements to take the image of the city of the inhabitant; in fact, he determined the physical elements of the environment, which stick in someone's mind. He took the individual's sketch map and interviewed with inhabitants of the American cities. According to his research he found that there are five physical elements, which stick in peoples mind, these five elements have an important role in creating a legible place and they effect people's perceptions of their environment (lynch, 1960). These five elements are more 'imageable' and stick in mind more readily; these are, paths (such as streets, walkways, canals or railways), edges (such as shores, edges of development or walls that are the boundaries of areas), districts, nodes (such as junctions, squares or street corners), and landmarks (such as buildings, signs, mountains, etc) (Lynch, 1960; Zmudzinska-Nowak, 2003; Fenster, 2009).

1. Landmarks are the eternal points of references for the observers that posses some distinctive form which contrasts with background information. Examples are tall

buildings, buildings with distinctive colors or large bulk, and distinctive structures (i.e. Washington Monument in Washington D.C., Bell Tower on NCSU campus).

2. Districts are medium-sized subsections of the city that one may enter and feel “inside of”, such as a business center, campus, or residential neighborhood.

3. Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, and rail - roads.

4. Edges are linear elements not used or considered as paths by observers. They are the boundaries between two phases and are linear breaks in continuity: shores, railroad cut, edges of development, and walls.

5. Nodes are points, the strategic spots in a city into which an observer can enter, and that are the intensive foci to and from which he/she is travels. They may be primarily junctions, places of a break in transportation, a crossing or convergence of paths, or moments of shift from one structure to another. Examples are a traffic square, park, civic square, etc.

In a legible city people can move easily and are highly aware of their environment; the city of Venice is an example for ‘imageable’ city. Lynch (1960), defined legibility as “the ease with which its parts can be recognized and can be organized into a coherent pattern”. Following Lynch (1981), defined legibility of the environment as “the extent to which it facilitates the process of way-finding” (p.189).

According to these definitions, we can conclude that the accuracy of a cognitive map depends on the characteristics of a physical environment. Environmental variables, such as signs and numbers, architectural differentiation, perceptual access, and plan configuration, affect the legibility. According to Downs and Stea (1973), people’s cognitive map is more accurate and complete in the more legible environment. Cognitive maps have more regular patterns, there is a hierarchical relation between urban elements in a legible environment and people can find their destination much easier. Measuring the legibility of an environment is not easy in practice but the researchers follow two different methods to measure the degree of the legibility; one of these methods is to measure the way finding performance, which is the outcome of legibility of an environment on spatial cognition. Some studies, for example, measure the time that people need to find the destination from starting points or

interview people about their way finding process in a configuration on way finding performance. The second method is to measure the accuracy of sketch maps of a built environment or the correctness of recognizing pictures of the environment in a simulation experiment or natural setting (Evans et al, 1980). For example, Evans et al. (1984) investigated the relationships between two landmark conditions in two different grid patterns (non grid and grid) and spatial cognition in a simulation environment. They asked respondents to view a film and then let respondents put photos taken from the film in sequential order and indicate their degree of confidence in recognizing the scenes. Of course, it is better to combine these methods to achieve significant results.

2.1.5.5 Cognition task

Cognitive mapping research focuses on how individuals acquire, learn, develop, think about, and store data relating to the everyday geographic environment and on the actual knowledge that is acquired (Downs & Stea, 1973). Golledge (1987) introduces different tasks, which are related to cognition. Similarly, Lynch (1960) stated that there are several representing techniques like sketch mapping, verbal discretion, etc., to understand the individual's stored knowledge about a place.

There is a variety of techniques used by researchers in the fields of geography, psychology, urban planning, and cognitive science to collect and analyze data on how people understand and think about space. In general, the cognition knowledge can be categorized into rout knowledge and configurational knowledge; Figure 2.1 illustrates the tasks for collecting the information to understand the cognition of an environment.

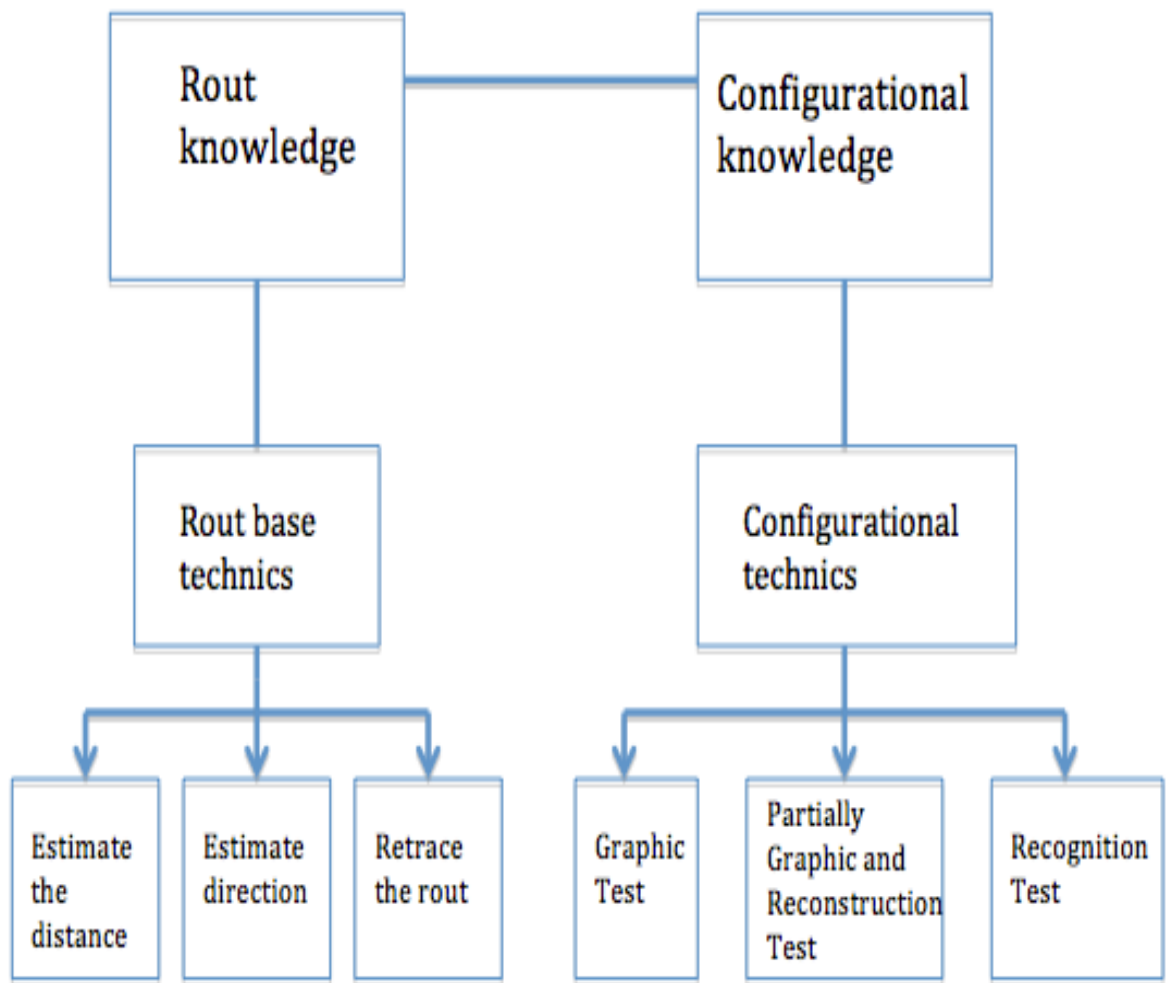


Figure 2.1: Techniques of cognition task.

One technic to get the environmental cognition of an area is to use graphic tests; these tests measure the configurational knowledge of an area, and are covering different types of sketch maps. By the basic sketch mapping technique it is possible to get a freely drawn sketch map from the respondents, in this technique, the researcher gives very little information about the environment and asks respondent to act freely. The respondent was given a blank piece of paper and asked to draw a map of environment from memory, sometimes in sketch mapping, the respondent is given a portion of the map and asked to complete specific features. Figure (2.2) depicts a map with some cue as an example.

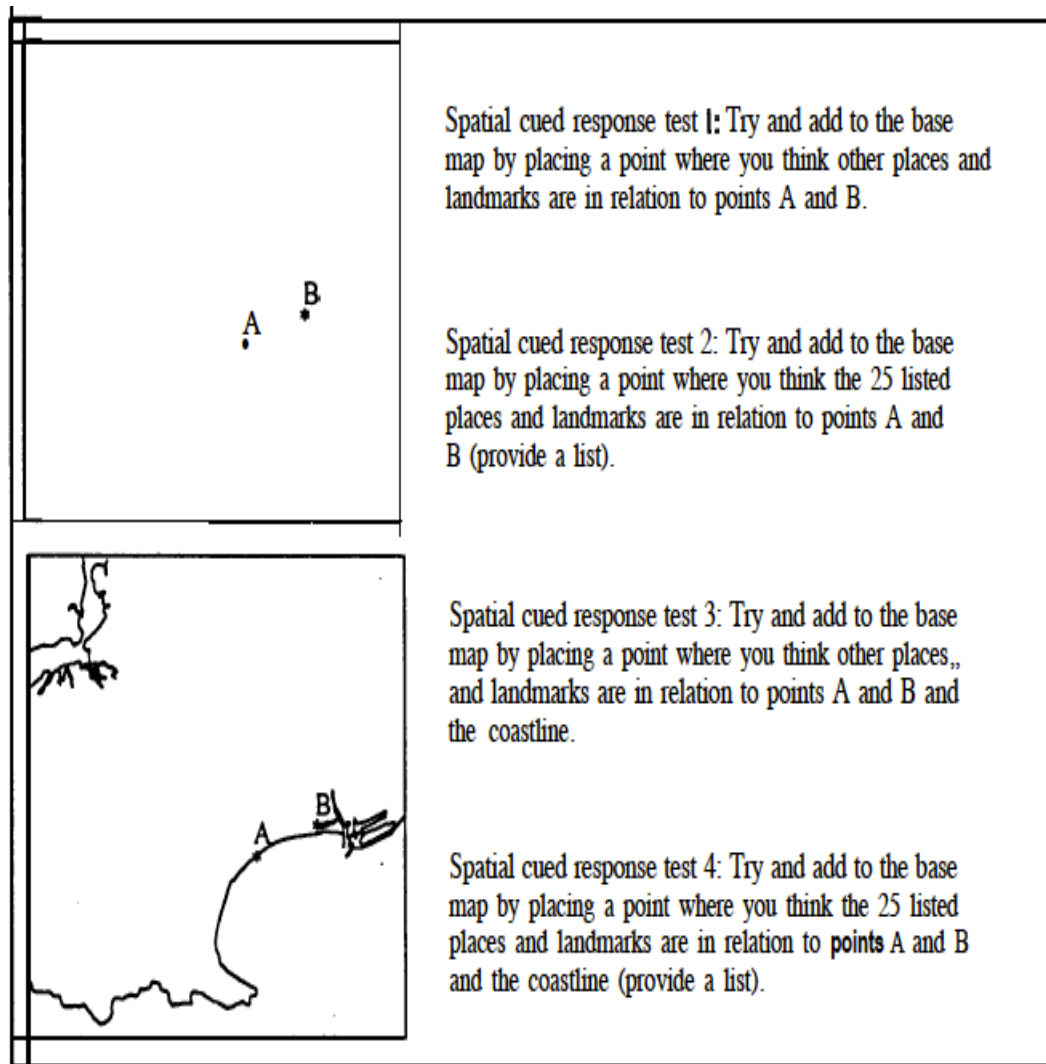


Figure 2.2: Example of a spatial cued response test(source: R kitchen & R.jacobson).

2.1.6 Conclusion

From the literature review, it is evident that there is an extensive body of research on spatial cognition guided by different perspectives and theories. Environmental cognition and cognitive maps research has been embraced by a wide range of disciplines (Devlin, 2001; Golledge, 1999; Golledge & Stimson, 1997). There are many interpretations and different ways of using concepts of mental cognition and mental maps in academic research; on the other hand all of them have common idea that cognitive mapping is by-product of thought process. Term cognitive map was noted first by Tolman (1984), he defined it as an internal representation that animals develop about the spatial relationships within their environment. Considering cognitive mapping in the regard of urban design is an important issue, 'according to the Golledge and Stimson the connection between cognitive mapping and urban

design is not new and has shown remarkable persistence (1997). Seminal works started by Lynch's studies in late 1950s, he contributed empirical research on three disparate cities and explored the cognitive map of persons using sketch map technique. Lynch noted the term of legibility and determined five elements in the city, path, node, landmark, edge, and district. He reported that users understand their surrounding and form mental image with these five elements.

2.2 Space Syntax

“Space syntax is a term that is used to describe a family of theories and techniques concerning the relationship between space and society” (Hölscher and Dalton, 2006, p.2) it is a set of measures for space configuration that have been shown a considerable correlation with how people move through and use building and urban spaces. Space syntax was first developed by Hillier and Hanson at the Department of Architectural Studies, University College of London. (Hanson 1989; Hillier 1989, Hillier & Hanson 1984; Hillier et al 1983; 1992; 1993). It is for representing and measuring the pattern properties of open space in the built environment (Kim & Penn, 2004). Space syntax's theory makes it possible to understand the relation between the culture and society with the specific relational patterns and the effects of the spatial properties of the environment on social activity, such as pedestrian traffic or way finding. According to the space syntax theory, there is a strong relationship between the urban space and the society; spatial layout or structure of the city has a great impact on the human social activities and effects everyday experiences of the individuals (Bafna, 2003).

Hillier showed that by translating the spatial properties of the space into mathematical based measurements, and then by analyzing different kinds of spaces or city patterns, it will be possible to determine many aspects of which the spatial layout structure affects the human social activities (Hillier & Vaughan, 2007). He defined the spatial configuration as the resulting form of numerical representation of space layout, it refers to the interrelations between the different component of the space. This chapter will review the current theories and techniques of space syntax in the field of urban and architectural space. The next chapter will discuss about the advantages of the space syntax and the relation between the space syntax and spatial

cognition. It reviews the common platform between these two field studies, which connects the space syntax to the spatial cognition.

2.2.1 Space syntax theory

Space syntax is best described as “a research program that investigates the relationship between human societies and space from the perspective of a general theory of the structure of inhabited space in all its diverse forms; buildings, settlements, cities, or even landscapes” (Bafna, 2003, 17-29). The notion of syntax refers to relationships between different spaces, or interactions between space and society. “These rules of behavior can be associated with different parts of space; and individual parts of space can be recognized as carrying a specific symbolic or cultural charge” (Bafna, 2003). According to Hillier and Hanson (1984, P.9), “space syntax theory, denies this simple space-as-form and society-as-content distinction”. Rather, “it is a central premise within the space syntax research program that social structure is inherently spatial and inversely that the configuration of inhabited space has a fundamentally social logic” (Bafna, 2003, P18). The relation between the space and society is dynamic, and both of them affect each other and rebuilt themselves. One example of this effect can be seen in creating boundaries to the configure space, these borders of boundaries control the relation of access and visibility between components of spaces and cause to generate pattern of movement among population of there (Bafna, 2003). In space syntax idea space is the common ground of the physical and social cities; the physical city is a complex pattern of space, while all social activities and interactions happen in space. As was mentioned earlier, space syntax relates the physical and spatial contexts with the social circumstances by bringing up the concept of “space configuration “as one of the components of the space (Hillier and Vaughan, 2007). Space Syntax is based on the fact that the urban environment is an interconnected space where spaces link to other spaces. The Space Syntax approach provides an urban morphological representation by looking at only public spaces (open spaces) (Figure 2.3). “These public spaces look like a beaded ring system in which space widens to form irregular beads, and narrows to form strings. At the same time the beads join so that there are always choices of routes from any one space to any other space” (Hillier and Hanson, 1984, p. 90).

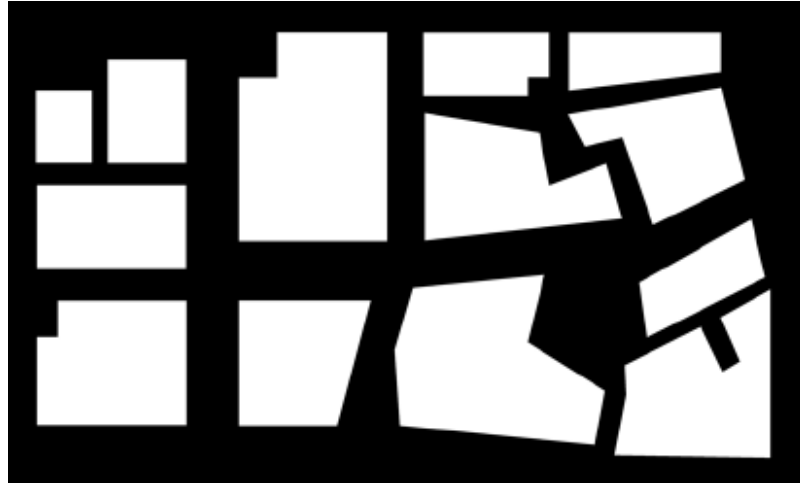


Figure 2.3: The Relationships Between Public Open Spaces (black) and Buildings (White) in an Urban Environment (Source: B. Jiang, 1998).

2.2.1.1 Space configuration

Space syntax reflects the space both objectively and subjectively, according to the space syntax approach; space is not a background to human activity, but as an intrinsic aspect of what human beings do. It is based on two ideas; the first idea includes three geometric ideas, human movement through space, their interactions in space and the visual fields and seeing ambient space from a point in space. All of them have a natural and necessary spatial geometry. “ Movement is essentially linear, interaction requires a convex space in which all points can see all others, and from any point in space we see a variably shaped, often spiky, visual field we call an isovist” (Benedikt, 1979,p 207cited in Hiller and Vaughan, 2007).

Describing the city in terms of geometric ideas can help to understand how we use and experience space and to see how buildings and cities are organized. For example, space in a city is mostly linear (streets, boulevards, avenues, alleys and so on are all linear concepts) with occasional convex elements, which we call squares or public open spaces; each of these convex elements are the center of a variable isovist (Figure2.4).

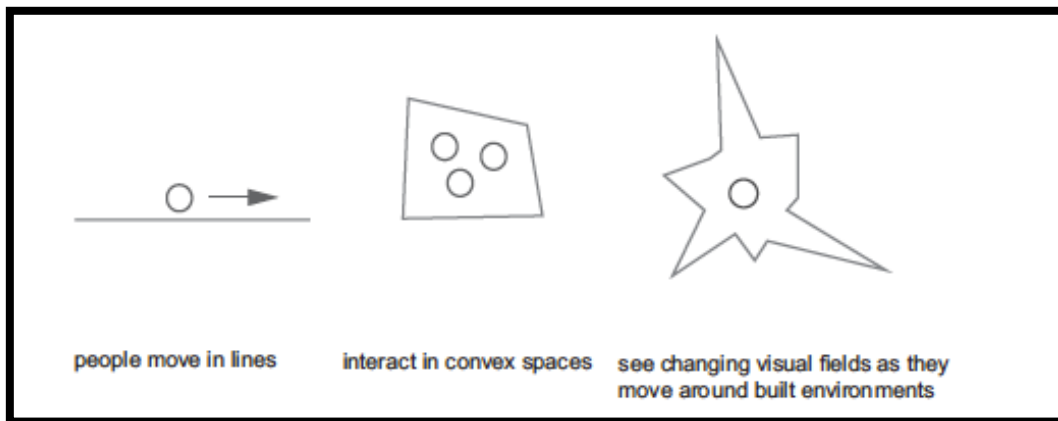


Figure 2.4: Space is not a background to activity, but an intrinsic aspect of it
(source: Hillier, B., Vaughan, L.)

The second idea describes that the individual properties of the space are not enough for human space, according to Hillier and Vaughan (2007), “there are inter-relations between the many spaces that make up the spatial layout of a building or a city. This is what we formally call the configuration of space, meaning the simultaneously existing relations amongst the parts which make up the whole” (p.207).

“Spatial configuration means relations between spaces which take into account other relations, and so in effect relation between all the various spaces of a system” (Hillier 2007 P.2). The spatial layout is different when seen from different points of view in the layout. We can make this visually clear by drawing justified graphs (in which each circle is a room, and each linking line is a door) from spaces 5 and 10 to show what the pattern of space looks like from each. The two graphs from space 5 (left) and 10 (right) look quite different, in that one is shallow and the other is deep, but are of course the same graph looked at from different points of view. “Although they are different, each graph gives the real picture of what the whole layout looks like from that space, and thus, expresses a real property of the layout (Hillier 2005, P.6).

Figure 2.5 illustrates the pattern of space, the graphs are different, one of them is deep and the other one is shallow, because they have been looked from different points; therefore the pictures of the layout seem different and the shape of each graph depicts the degree to which we must pass through other spaces to go from a particular space to all others. The degree is high in the shallow graph and low in the deep graph, if the degree of the space is shallower, it is integrated space and if it is deep then the space is segregated. “So it can be indexed each space in the layout in terms of the degree to which it integrates the complex, and the average for the whole

will be the degree of integration or segregation of the whole” (Hiller and Vaughan, 2007, p.209).

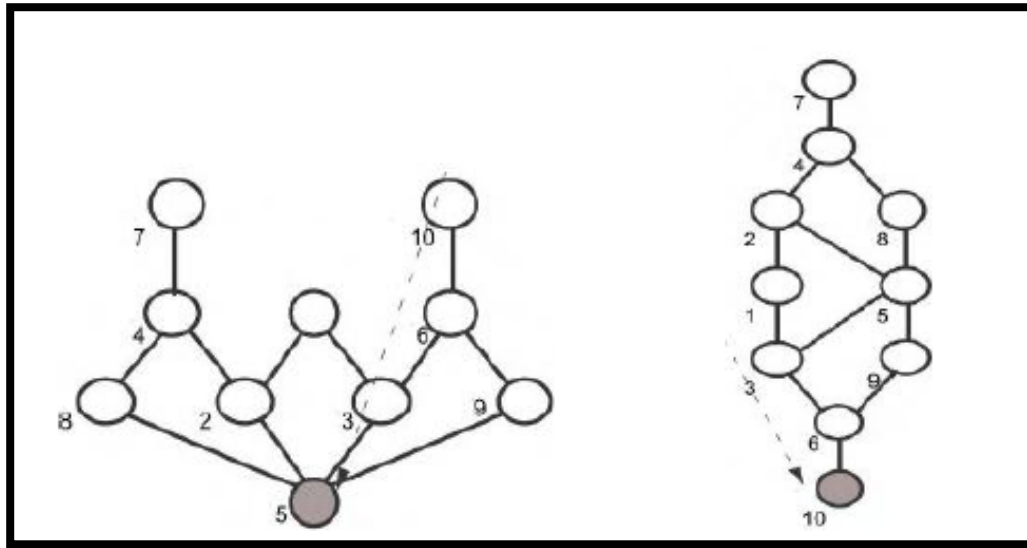


Figure 2.5 : A spatial layout both looks and is different when seen from different spaces within it (source: Hillier, 2005).

Therefore, it can be stated that “configuration” of space describes each space numerically in terms of how it relates to the others. This concept of configured space, which transmits different ideas about social activities or behaviors, is best illustrated in the following example by Hillier (2005) in Figure 2.6.

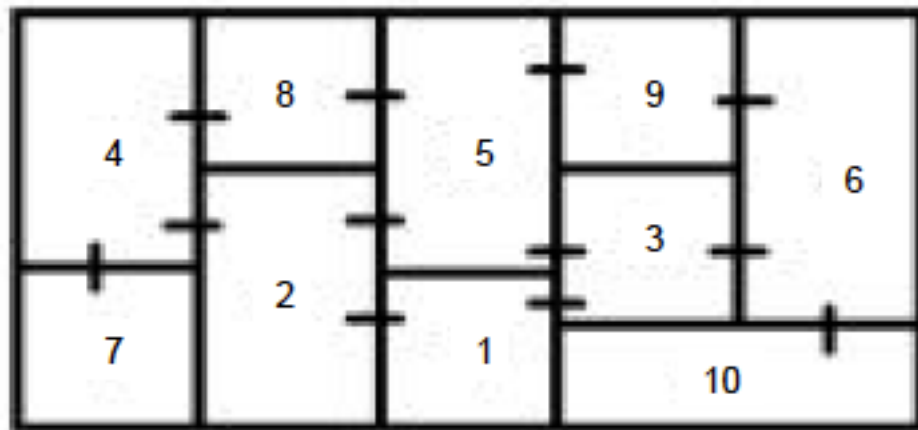


Figure 2.6: An example of a spatial layout consists of a system of space elements (rooms) with links (doors) between them (Source: Hillier, 2005).

Space syntax, takes certain common measures of relationality in graphs, represent the social ideas and then turns them into measures and representations of spatial structure by linking them to the geometric representations (Hillier & Vaughan2007). Geometrically, cities seem to acquire a dual structure, in the form of a global

foreground network and a local background network, “urban studies, proposes that urban street networks have a dual form: a *foreground* network of linked centres at all scales, and a *background* network of primarily residential space in which the foreground network is embedded.” (Hillier, 2001,p.1). Each of these networks, which hold the city as a whole have their own metric, geometric and topological properties. Three distances between each segment and each of its neighbouring segments can be defined by Depth map software. The distance in metres between the centre of a segment and the centre of a neighbouring segment is metric distance, in topological distance the value of 1 is assigned for a one change of direction between a segment and a neighbouring segment and 0 for not any turn and in geometric distance the degree of the angular change of direction between a segment and a neighbor is measured (Hillier, 2014). It can be stated that the relation of urban spaces are more metric in the local level and topo-geometric in global level. “Evidence for global topo-geometry comes from the fact that we need to utilise both the geometry and connectedness of the larger scale space network to arrive at configurational measures which optimally approximate movement patterns in the urban network”(Hillier, 2007,p.1)

Spatial configuration, not only reproduces existing hierarchical relationships, but it also helps produce particular patterns of social relationships (Bafna, 2003). It means that when we analyze different kinds of spaces or city patterns, each space includes social activities in itself and many aspects of spatial layout effect it (Hillier, 2005). According to the Hillier (2007). ”Configuration is a none-discursive concept. Non-discursivity means that we do not know how to talk about it. The difficulty of talking about spatial or formal configurations in architecture, has always seemed a rather peripheral problem to architectural theory” (p.40). If we want to find the intuitive aspects of the idea of configuration, we can begin with considering 4 categories of elements, which are shown in Figure 2.7 All of the groups, have a same configuration, but the “things” which make them (Ingredients) are different. When we look at the shapes, we can readily recognize that all of them have a same shape, despite their different constituents, this fact proves that the human mind is good at intuitively and bad at analytically. It means that human mind can easily, and without conscious thought, recognize and use configuration in everyday life with out thinking

about them. They do this with out knowing what it is, and and how they should use it (Hillier, 2007)

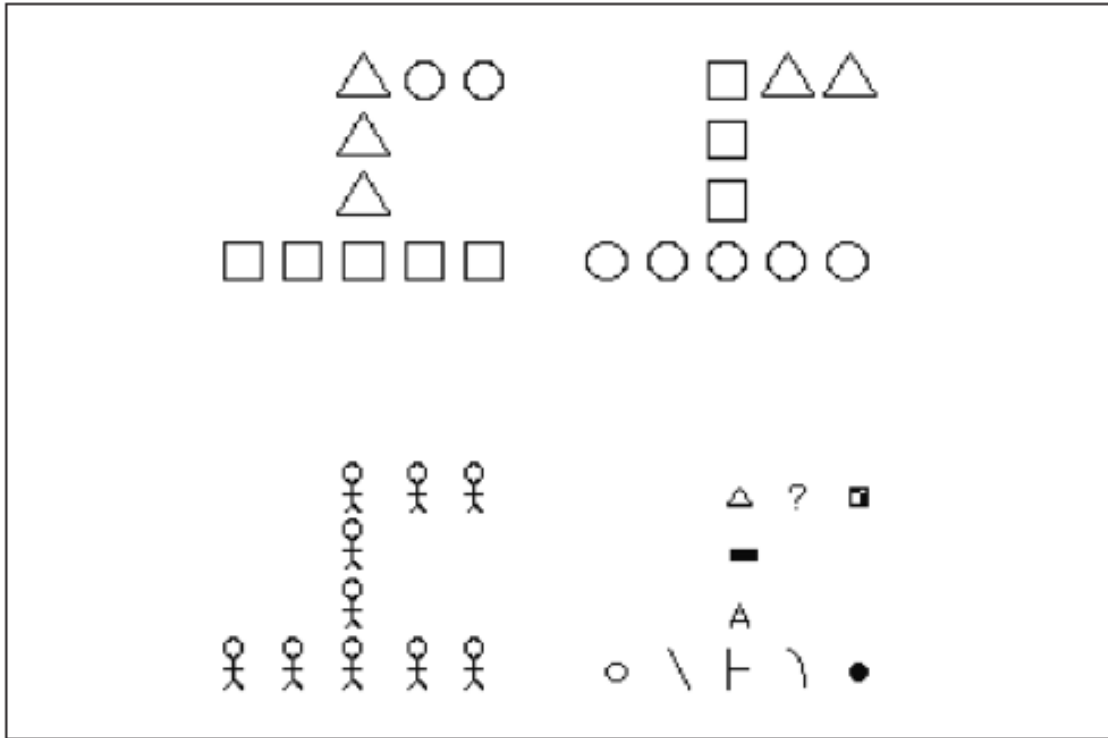


Figure 2.7: Idea of configuration (Source: Hillier, 2004).

Spatial configuration was defined as “spatial relations taking into account other relations” (Hiller, 1996, p. 1). It is the topological relationship between one space to the other spaces. Based on the theory of space syntax, four syntactic properties objectively describe and measure the spatial configuration. In the next part these syntactic properties will be described.

2.2.1.2 Axial map and syntactical properties

For urban environments, an axial map gives the opportunity to objectively measure spatial configuration of the urban environment. Axial map represent axial line, axial lines represent the longest views across spaces that capture the sense of what a person sees while moving in urban areas. People always walk in a straight line to minimize the distance, not a curved line; so axial lines also, can be a representation of a person’s movement behavior. Therefore axial lines simplify the complex urban environment and connect human spatial cognition and movement behavior together (Y.Long, 2007, P43). Figure (2.8) shows the axial map of an urban area.

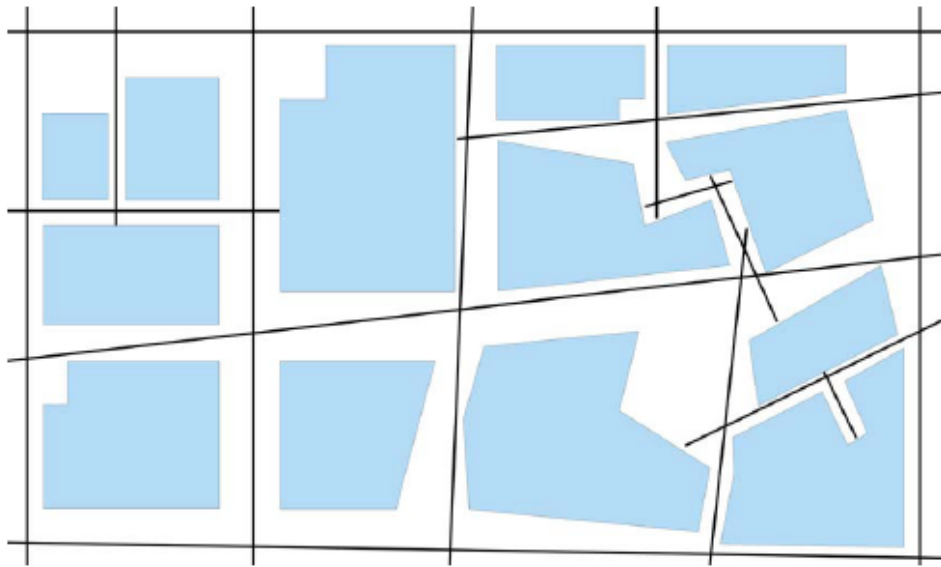


Figure 2.8: Axial Map of an Urban Area (Source: B. Jiang, 1998).

In space syntax approach, it is possible to represent an axial map in the form of a graph, which is called justified permeability graph. (Figure 2.9) This graph is useful to determinate how each space is related to other space and how these relations can be calculated. Configuration justified graph is transformed in to numeric values in order to measure the spatial configuration.

It should be noted that the value, which describes the topological relation of space, (considering just relations of the spaces and not focusing on the distances) is called total depth (TD). TD represents the number of turns (steps) that one needs to take to move from one space/line to another space/line. An axial map is transformed to graphs by replacing each axial line, which represents an open space, with a node and using lines between nodes, instead of intersections between lines. TD has global and local properties, if the relations of the space with all other spaces are being calculated, the average number of the depths gives us the global properties of that space; but if we want to find the depth of the space just for 3, 4, etc. steps this value is the local properties of that space. Researchers usually use 3 steps to calculate local properties, because 3 steps are enough turns for covering a neighborhood.

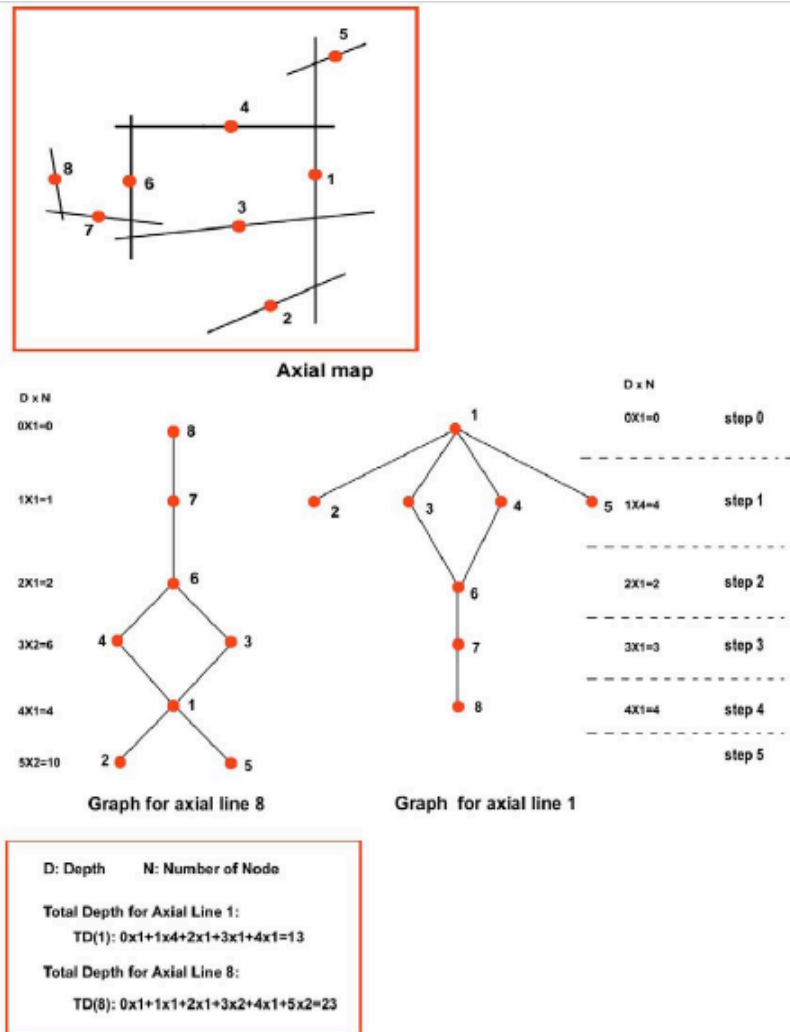


Figure 2.9 : Transformation from axial map to justified permeability graph
(Source: Hillier and Hanson, 1984).

There are three important syntactic measures of spatial configuration of an axial map: connectivity, integration (global and local), and intelligibility. Regarding convex space, another syntactic property, visibility of a convex space, is more appropriately used to study an urban environment (Hillier and Hanson, 1984, Hillier, 1996).

Connectivity shows how a street is connected to another street, you should consider the connectivity and Integration analysis to understand how good (or bad) a certain place, street or street segment is integrated in the whole street network, both shows how a segment is embedded in the whole system. The connectivity value measures the number of points or lines that directly intersect at a given point. It measures the number of immediate neighbors, which are directly connected to the spaces. It represents the first step of the syntactic relationship with the adjacent points in the

system without taking into consideration how the points are linked all over the area of analysis, what it's relation to other segments is and how easily it can be reached. In axial map connectivity of an axial line is measured by the number of lines that are directly intersecting that line" (D.Dhiman, 2006). For example, if an axial line directly intersects with 4 other axial lines, its connectivity value is 4 and if the axial line has more length, it has the chance to intersect more axial lines. According to the Jiang (1998),” connectivity measures how each axial line controls its immediate neighbours, i.e. those lines intersected by the current one. Both connectivity and control are local measures, since they only take into account relationships between a space and its immediate neighbours” p (1).

Integration is a static *global* measure, which describes the average depth of a space to all other spaces in the system; the spaces of a system can be ranked from the most integrated to the most segregated. As it mentioned above depth is a key spatial property in the concept of configuration; for example if we consider a house with different rooms and a salle (hall) commune, it has more fundamental properties because of its relation to the spatial configuration of the house as a whole. Salle commune will have the lowest deep in the house because if we count the number of spaces that should pass through to go from the sale commune to all other spaces, we come to the total, which its value is less than for any other spaces. The general form of this value, which can be applied to any spaces in any configuration, is called integration, thereby, the less depth from the configuration as a whole, the more integration and the most depth in the complex, the most integration value (Hiller, 2007, p 38).

2.2.2 Space syntax and cognition

In this session the relationship between the space syntax theories and spatial cognition will be reviewed. Also It will be reviewed some examples that had be done before about these topics. In all of these studies the discussions are about the relationship between space syntax and spatial cognition. It will be investigated the important connection between mentioned fields and their common platform.

As it has been discussed before, space syntax was first developed by Hillier and Hanson (1984), for representing and "measuring the pattern properties of open space in the built environment" (Kim & Penn, 2004). It is a research program that

investigates human societies and space according to the layout of inhabited spaces; these spaces can have different forms, such as a building, a settlement or a city. The noticeable point that rose to here is that, human societies organize themselves according to these spaces. These inhabitant spaces are configured, a term in space syntax that mean a set of discrete units, which are connected to each other.

Space syntax effectively provides rigorous and quantitative measurements for some of the qualities of the physical settings that environmental cognition researchers have been seriously dealing with. Reviewing the literature in the field of cognition shows the importance of the topological relationship in understanding a built environment and reading a city.

In field of cognition Lynch argued about this understanding and reading the city, by using the term of legibility; and in space syntax approach, Hillier used the term of intelligibility. He described legibility by discussing about the difference of a new modern urban space and an old urban space. According to Hillier (1988), in the modern concept design, although identifying the formed units is easy, when investigating the area as plans from air, people get lost while walk through there; because spaces are over-localized, which Hillier used term of “ enclosure” for this localized spaces. Whereas in the old urban spaces, the plan from air looks complicated because there are not so regularity in the design, but when persons walk through it, like old French town, they don't need for any signs to find their ways. These spaces have their own natural legibility; people can read the town easily because of its specific topological relations within the environment. In this regard if a requirement exists for quantify the various levels of topological relations within urban environment space syntax as an analytical tool can provide a field for doing this quantifying. It rectify the lacks that researcher faced while struggle with cognition issues.

According to the Bafna (2003) finding a strong relation between behavior and spatial structure like de degree of integration has led to a development an interest among cognition and space syntax researchers. According to Allen Penn (2001), “On the basis of a review of some of the relevant findings of space syntax research, it proposes that cognitive space, defined as that space which supports our understanding of configurations more extensive than our current visual field, is not a metric space, but topological or pre-topological in nature. “(P.1).

Bin Jjiang is on other researcher that investigate relation of the space syntax and spatial cognition he mentioned to the lynch and Kuipers studies that said, the traditional view on spatial cognition is said to be based on cognitive maps (Lynch 1960) - a mental map about the geographic space. However, it is generally agreed that the cognitive map is not entirely maplike (Kuipers 1982, p. 202). "Maps are based on Euclidean geometry, i.e. spatial objects are represented with precise co-ordinates along objects edges or outlines. However, spatial cognition is not necessarily based on metric measures, for instance, spatial adjacency cannot be perceived by a metric measure, as trivial distance difference might exclude a site from a particular neighbourhood." (Bin Jiang, p1,2001). he continued by describing this that the central concept of spatial cognition is distance, and it plays an important role in human activity. As stated by Montello (1997), "it helps us orient ourselves and locate places during navigation. It is used to evaluate costs of travelling from one place to another, and it helps us utilize resources efficiently (time, money, food). Clearly, knowledge of distances in the environment effect the decision to stay or go, the decision of where to go and the decision of which route to take It therefore seems likely that an understanding of the perception and explanation of spatial behaviour."(p.297).

The distance that space syntax concerns itself with is a sort of topological distance (Buckley and Harary, 1990). i.e. the distance of two intersected axial lines is one, and distance of non-intersected lines is the shortest path between them. Distance concept in space syntax follows and fits well with cognitive distance. If person follows a way that it has more angle and turns, this way is shown longer psychologically, and the routs with fewer right angle seems to be more shorter, (Sadalla, 1980). Figure 2.10 illustrates two routes from point A to point B, people in general follow the route with more turns have a longer distance estimate than another route with only one turn. Below figure is as an indication of the resemblance between topological relationships to human perception.

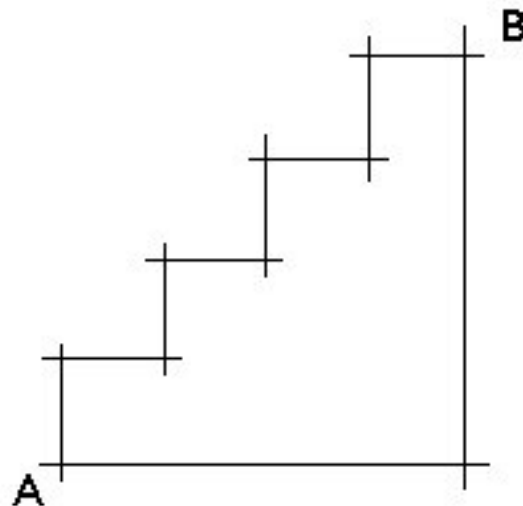


Figure 2.10: Distance estimates influenced by the route structuring (Source: Jiang).

2.2.2.1 Some examples from previous studies

Understanding the relationship between configuration, cognition and behavior was the subject of Young Ouk Kims doctoral research (Kim, Y.O., 1999). Kim conducted a study of the Hampstead Garden Suburb area of North London to understanding the relationship between configuration, cognition, and behavior, in which he combined observations of spatial behavior, questionnaire interviews, including a sketch mapping exercise with a sample of 76 local residents, and space syntax analysis of the spatial configuration of the area embedded in its surroundings as well as of the sketch maps. The Suburb is divided into two halves. The older half is relatively more intelligible than the newer. By comparing them Kim was able to draw some significant conclusions on the effects of spatial configuration on the way that residents understood their neighbourhood, and the role played by intelligibility in that. By investigation, Kim found that spatial configuration was correlated with observed movement, with the more intelligible area showing stronger correlations. This area was also found to be more “legible” by the residents who perceived their neighborhood to be of a greater size. Second, he applied Space Syntax to analyze sketch maps. He simply counted the frequency with which features occurred in all sketch maps among the same population and found strong correlations between axial integration in residents’ sketch maps, frequency of physical elements (streets and roads), and axial integration of the real map. Also, correlations were found between sketch map integration and observed movement. Again, correlations were more powerful in the more intelligible area than the less intelligible one.



Figure 2.11: Global integration Map of Hampstead Garden Suburb, North London, area of kim's study that investigated the relationship between the spatial syntax and the respondents' sketch maps (Kim and Penn, 2004: 490).

An article, by Haq & Zimring (2003), is concerned with tracking the wayfinding movements and decisions made by people. This study explores whether people's topological knowledge changes as they get to know a setting. This research was part of a doctoral thesis. It included empirical experiments in three complex hospitals located in a U.S. city. Respondents have been asked to do a variety of tasks related to wayfinding behavior and cognitive understanding.

During the research a series of wayfinding experiments has been done in selected hospitals. A large proportion of these being space syntax measures. In addition, each participant was asked to draw a plan for the hospital they walked in. They were instructed to draw all the paths that they recalled and to put all the locations they could remember beside those paths. The number of times each path appeared in sketch maps was counted. Also by comparison with an actual plan of the setting, a value was given to the overall correctness or configuration of the sketches. The investigation was made by comparing the cognitive maps drawn by the participants and the connectivity values of the real maps, as well as the effect of certain configurational settings on movement.

Some of the strong research findings of this article were first, the important relationship between syntactic configurational measurements of space and cognitive mapping products drawn by the participants. They found a significant correlation between the frequency with which certain paths (axial lines) appeared on cognitive maps or sketch maps drawn by the participants and the connectivity values of the axial lines. Second, important relationships were found between configuration of space, wayfinding, and spatial cognition. During exploration, they relied more on local topological qualities, such as how many additional nodal decision points could be seen from a given node. As they got to know the setting better, their wayfinding behavior was better predicted by more global qualities such as the space syntax integration of a node. This suggests that people rapidly move from a local to a more global topological understanding as they learn a setting. In addition, space syntax measures were good predictors of the participant's ability to point to out-of-sight locations and of their sketch maps.

2.2.3 Conclusion

In this session, the current theories which are in relation with spatial cognition and space syntax are mentioned, the common platform which these two fields have, are reviewed and the needs for juxtaposing these two approaches, in order to understanding and finding the questions and problems, which designers and planners are struggle with them, are argued. Space syntax provides possibilities for investigating the relation between them, with its mathematical base. It quantifies the various levels of topological relations within an urban environment; this makes it an important tool in cognitive studies, since the evidence from spatial cognition studies has pointed to the importance of topological relationships in comprehension of a built environment.

3. APPLICATION OF THE METHODOLOGY IN THE CASE AREA

The aim of this chapter is to review the methods, which are utilized in this thesis. The types and the techniques of data collection are explained, together with reviewing the backgrounds of the applied methods in the selected case area. Two kinds of the data are used in this thesis, configurational measurements (syntactic description of space) and cognitive representation (people's mental representation of space).

3.1 Syntactic Configurational Measurements

Figure 3.1 indicates the lay out of Beyazıt area; it is necessary in order to provide the axila map of the area.

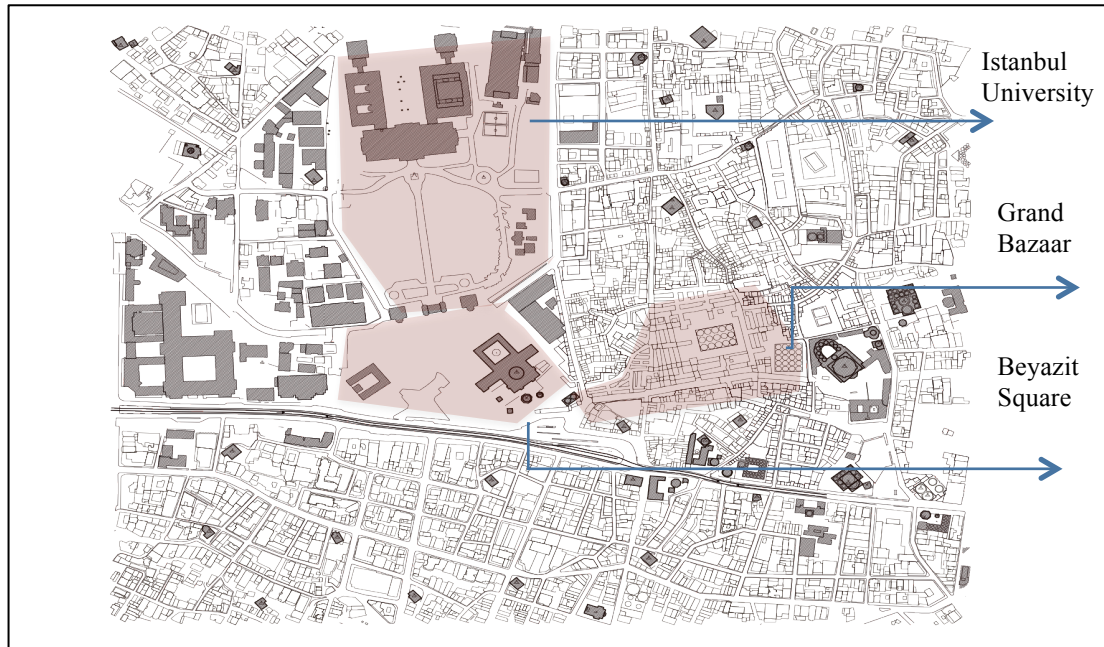


Figure 3.1: Layout of Beyazıt area.

One step to answer the research questions is to find the syntactic configurational measurements. In the first step, space syntax methodology is applied in the research as an objective approach. As it has been described in the previous chapter, space

syntax method is a practical technique, which makes it possible to analyze the configurational features of an urban system as a whole. By using the Depth Map software for space syntax, it is possible to represent and describe the selected area syntactically. Depth map is a single software platform to perform a set of spatial network analyses, for example, inter-visibility relations between different parts of space layout.

It translates the properties of space layout into mathematical based measurements of space configuration that can be compared with other aspects. The axial map, which represents the layout of the studied area, is created by the use of the area's map for analysis the spatial features of Beyazit area; it depicts the fewest, longest lines of visibility, Figure (3.2).

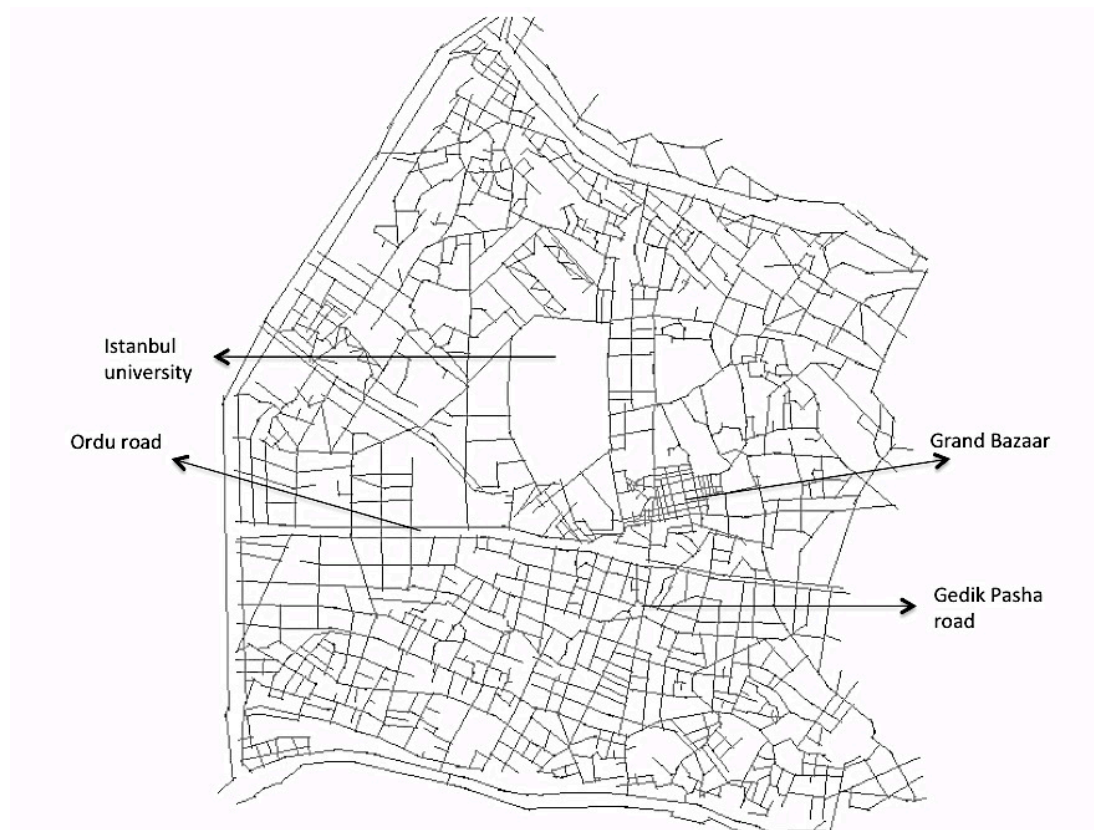


Figure 3.2: Axial map of studied area and its surround (Beyazit).

Preparing the axial map is the first step to analyze the area syntactically, in the other words, it is used to obtain three necessary syntactical values; named integration value, connectivity and intelligibility. These values are independent variables, which are used to measure spatial configuration of an area objectively. All the axial line-means the longest and fewer lines that can cover the considered space- was drawn on

the base map of Beyazit, to create the axial map of Beyazit area. As regard the previous notes, the layout of the area is necessary in order to get the axial map as a basic map for obtaining the syntactic values. For this purpose the axial map, which was drawn in Auto Cad program, was saved as DXF format and then it was imported to the depth map soft ware, after converting the imported map to the axial map and implementing the required setting, the syntactic values represented on the Depth map program. These syntactic values are: Integration, Connectivity and Intelligibility.

3.1.1 Integration measurments analaysis

The following discussions, initiated with axial line analysis based on the integration. Integration is a value, which measures the degree of the integration of the line, it means that it counts the steps of turn that should be done in order to reach all the points in the urban system from an individual point. It determines the topological relation of a point with the other points. Looking at this graph, rang of the colors can be seen, these colors ranged along red to blue. Red and blue color refers to the maximum and minimum degree of the integration, respectively and the colors between them, which range from warmer to the colder one, refer to the degrees between maximum and minimum values. By looking at this graph the red lines can be considered as the most integrated spaces in Beyazit area and the blue ones as the most segregated spaces. As it has been described in detail in the previous chapter, the points, which have high integration values, are located in the location with less depth and the points, which are more segregated, are located in the deeper spaces. As it can be seen in Figure 3.3 the red lines are in the main streets of Beyazit Square and also are in the main way of the Grand Covered Bazaar. It should be considered that there are two types of integration values: global integration and local integration. Figure 3.3 indicates the global integration analysis and Table 3.1 illustrates the global integration values (H-H).



Figure 3.3: Global integration graph analysis of Beyaz.

Table 3.1: Global integration key values.

Global integration key values	
Minimum value	0.267
Maximum value	0.952
Average value	0.6415
Count point	1393

Global integration value shows the average depth of the space to all other spaces in the system, as it is known, this value is strongly related to the movement, it is hold for vehicular traffic; while taking to account the pedestrians movement, the lines measurements are limited to the neighborhood, and this calculation leads to use

another concept in space syntax called local integration. Figure (3.4.) shows the local integration graphs of Beyazit area, it is the analysis for radius 3 ($r: 3$), means it performs the analysis on each street by considering only the streets within depth 3. It could be applied for radius 5, 8, n also. As it can be seen in the graph, the main routs of the Grand Bazaar, which carry many pedestrian movements along the day have high integration value since they are shown in red color; Also there is another famous road in the area named Gedik Pasa, which many pedestrians pass through it, looking at the integration value of this road, we can conclude that it is one of the integrated roads of the area, these roads are marked in the map. (Figure 3.4) Table 3.2 indicates the minimum, maximum and the mean local integration values of the Beyazit area.

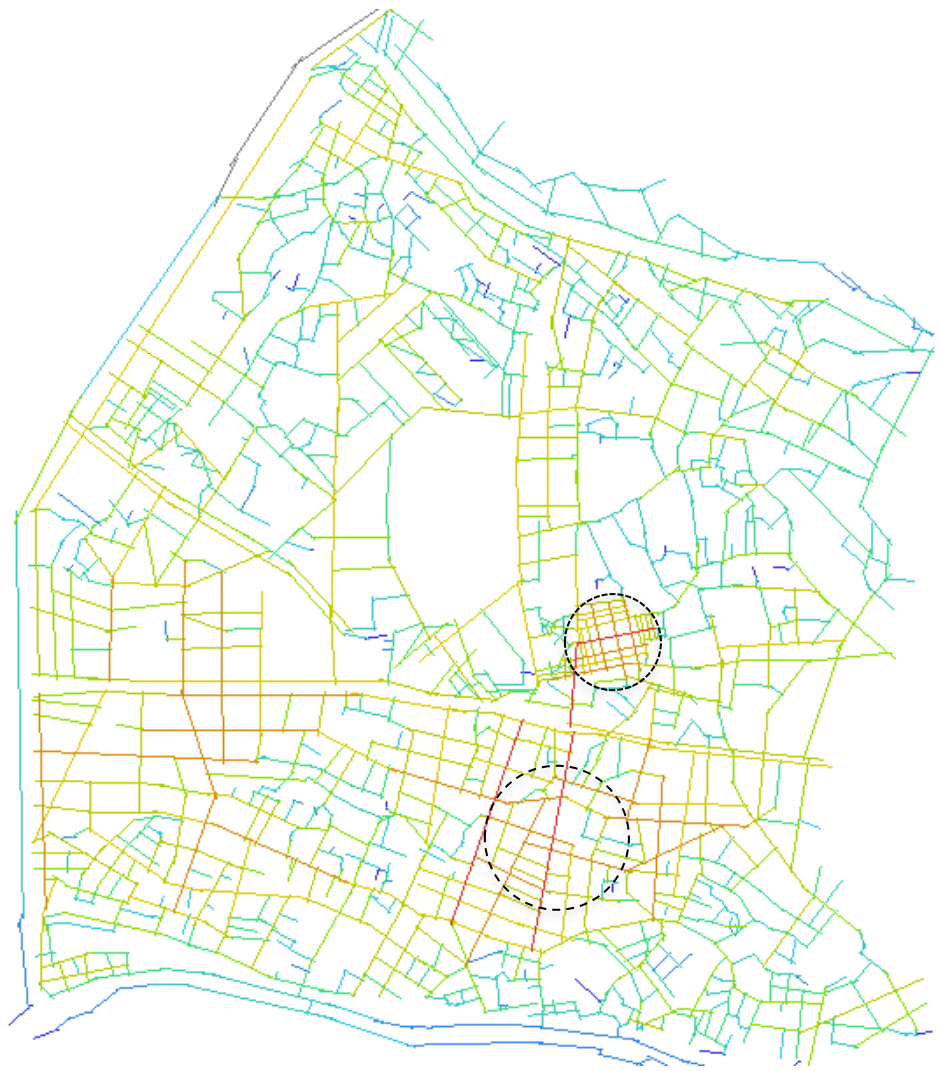


Figure 3.4: Local integration graph analysis of Beyazit.

Table 3.2: Local integration values.

Local integration key values	
Minimum value	0.33
Maximum value	3,03
Average value	1.51
Count point	1393

3.1.2 Connectivity measurements analysis

Another syntactical value, which has been analyzed, is connectivity; figure (3.5) s illustrates the connectivity graph analysis of the area. In the next step to obtain the relationship between all points of the system, a visibility graph analysis, which is based on connectivity, is prepared. The range of colors from red to blue are shown in the map (Figure 3.5), the red lines show high connectivity value of the area and means that the number of the points or lines which intersect directly at the given point is high.

Blue colors refer to the low connectivity values. The warmer color, the more high connectivity value, the less warm color the less connectivity value. It can be seen that again the main road of covered bazaar and two other marked roads have high connectivity values. Table (3.3) indicates the minumum, maximum and mean connectivity values of Beyazit area.

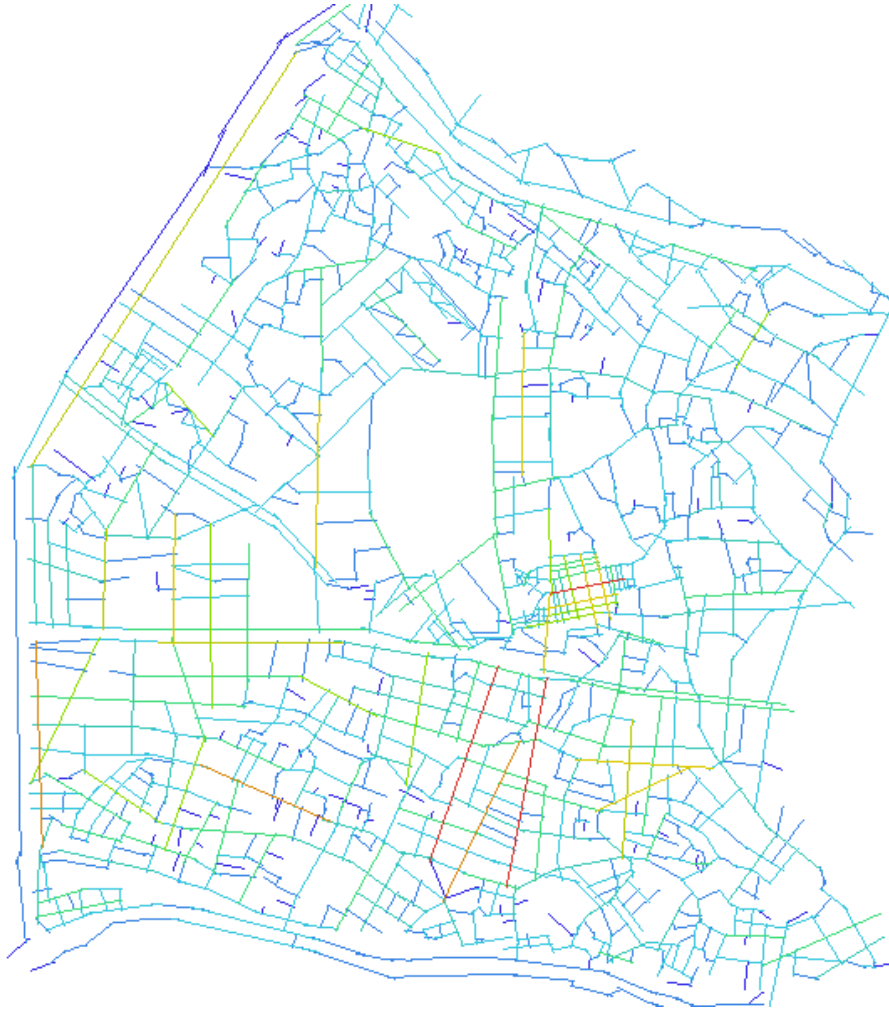


Figure 3.5: Connectivity graph analysis of Beyazit.

Table 3.3: connectivity key values of Beyazit area.

Connectivity key values	
Minimum value	0.00
Maximum value	14
Average value	3.05
Count point	1396

3.1.3 Intelligibility

In next step, the intelligibility value of case area is obtained. As it has been argued in the previous session in detail, in order to create a general spatial configuration in the human's mind about the space, it is necessary to find a strong relation between global information and local information. When we look at the definition of the connectivity and global integration we can see that they are local and global values respectively, so it is possible to learn the local and global information from their analysis. In practice, the intelligibility value is computed by the degree of linear correlation between connectivity and the global integration value (Hillier and Hanson, 1984). If people walk in the intelligible area they can find out the global relation of the spaces based on the local information, which is taken from their environment easily. If intelligibility is juxtaposed with legibility it can be learned that in both of these concepts, the configurational properties of spaces are very clear and coherent, therefore when people walk on the legible and intelligible spaces, they can form very clear and correct cognitive maps in their minds. Next the intelligibility of Beyazit area is analyzed, intelligibility is one of the syntactical parameters which its value is calculated mathematical by aid of Depth Map program. In order to compute this value, primarily the drawn axial line is converted to axial map (in the depth map program) then the connectivity values and global integrations are calculated, the correlation of this value are considered as the intelligibility value which is shown by r^2 , figure (3.6) illustrate the scattergram of intelligibility. The result of the r^2 is 0.16, which is approximately a low value, as it is known, Correlation which are < 0.35 are generally considered to represent Low or week correlations, 0.36 to 0.67 modest or moderate correlation s and 0.68 to 1.0 strong or high correlations (R.Tailor, 1990). Therefore, it can be concluded that the area has low intelligibility value; it means that the correlation between the global integration and connectivity is week.

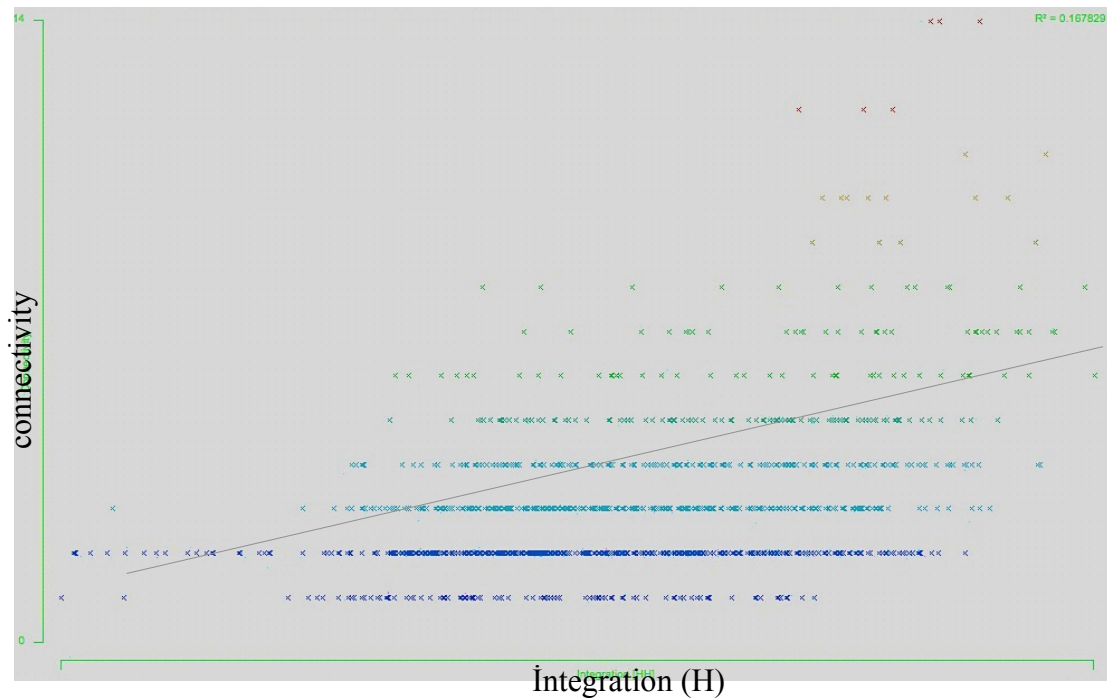


Figure 3.6: Scattergram of intelligibility for Beyazit area.

3.2 Finding Spatial Cognitive Representation

In the previous chapter, the definition of cognition and its importance have been discussed. It seems that knowing how an individual understands around space can be helpful for the planners and designer to create spaces, which are easier to be remembered and the use of them are more pleasurable. As it has been mentioned in the literature session, there are a variety of techniques to collect and analyze data in order to find how people understand and think about their surrounded space. In this research, according to the aim of the study, relations of the spaces with each other are analyzed.

In the first part, these relations has been described and analyzed syntactically and the intelligibility of the studied area has been found out, this chapter tends to find the legibility of the area and learn what is respondent's cognition about the area, in this regard configurational techniques are applied. To achieve more valid results, it is preferred to use more than just one technique; graphic tests and recognition tests are used to collect the data, therefore it would be possible to find the legibility of the area in parallel to intelligibility, which has been found by space syntax.

3.2.1 Cognitive mapping task

20 respondents were asked to draw the sketch maps of their environments on the maps prepared by the researcher. Participants were asked to draw Beyazit area's sketch map considering the routes and landmarks, which they remember. Ordu road and some other places in Beyazit area, which are important and familiar to many people, have been drawn as a cue to give a scale for the respondents; therefore it would be possible to have approximately same scales in all samples. Figure (3.7) is the given map to the respondents.

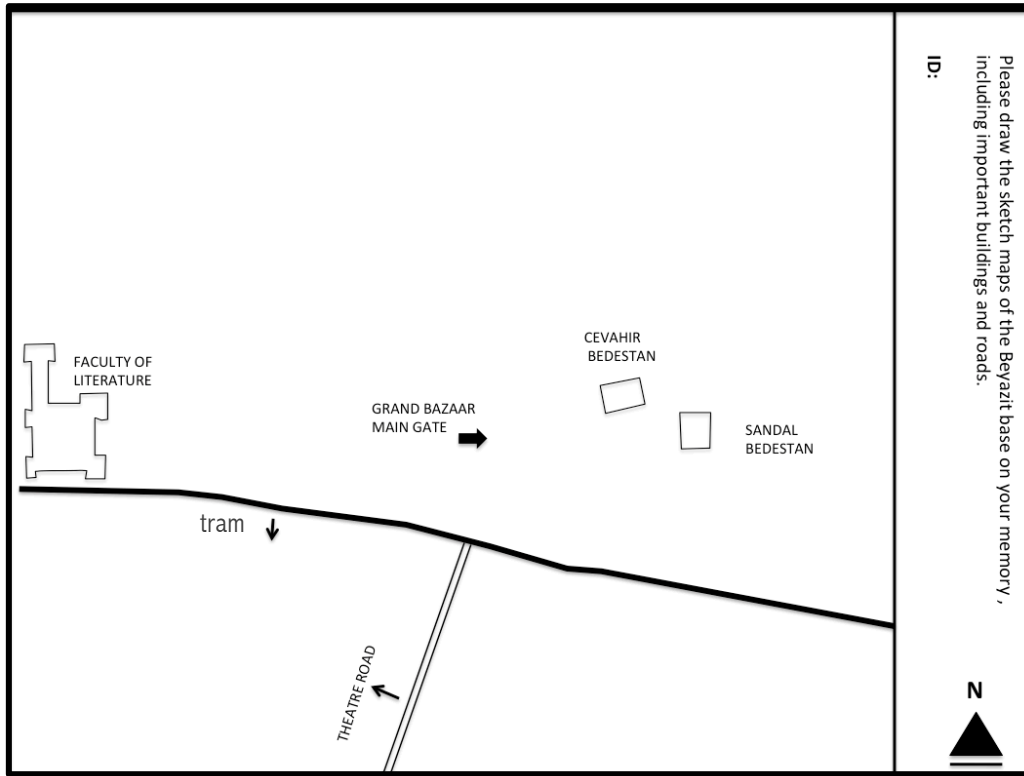


Figure 3.7: Blank map, which, was given to respondent with some clues.

Ordu road and two Bedestan of Grand Bazaar are given in the respondent's map; one of the faculties of Istanbul University and also Theatre road has been drawn in the blank map as cues. These maps are prepared in 20 sheets and each respondent filled one, to select the sample respondent 20 individual are considered, these individuals are chosen between 2 different social groups, 10 person from Istanbul university students and 10 were chosen among tradespeople of Grand Bazaar.

Beyazıt area is known for all the respondents, therefore, in addition to investigating the results from these different social groups, whole results are comparable with each other, due to the same level of the ability of the spatial cognition of them about the area. If the number of the respondents was more, the validity of the results could be more trustworthy, but the results found from these 20 individual show that it was an adequate number for this level of the study.

For each respondent 20-25 minutes was given and they were asked to draw the ways and landmarks of the area according to what was remained in their minds, after this test, the recognition test was taken from the same individuals. Figure (3.8) shows some examples of their drawings. All the other sketch maps are available in the appendix A&B.

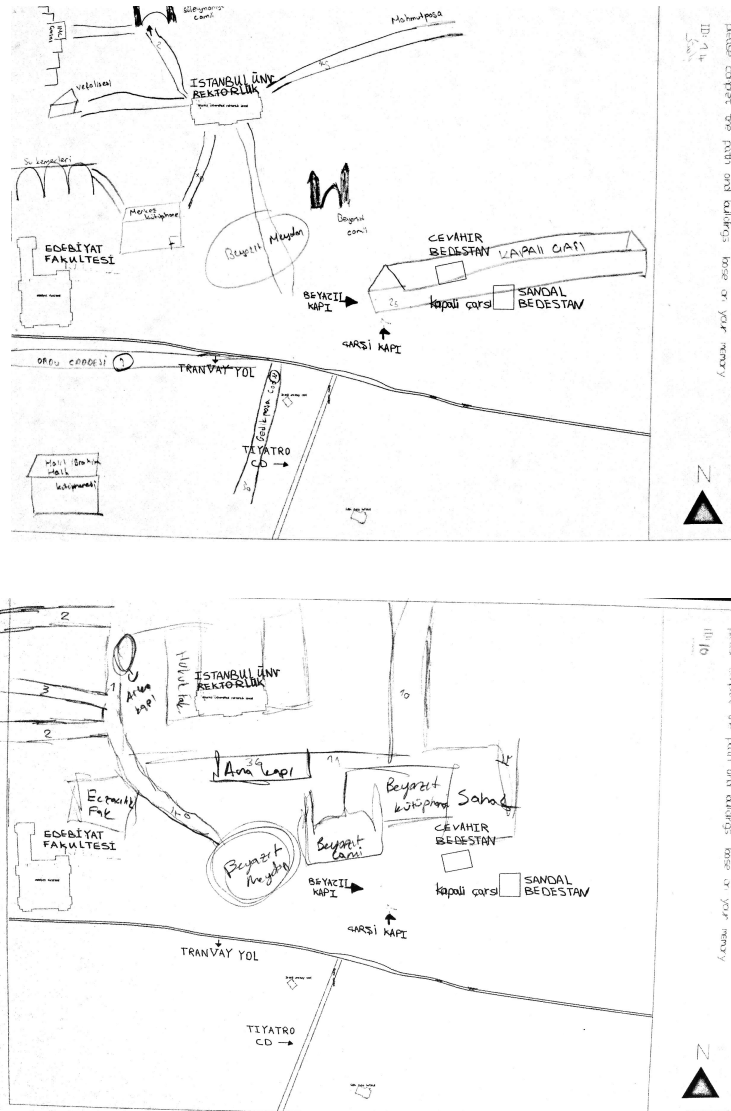


Figure 3.8: Samples of sketch map from Beyazıt, drawn by respondents.

3.2.1.1 Analyzing the sketch maps and the results discussion

The above-mentioned procedure was applied to perform the task of the cognitive mapping measurements. The main goal of this procedure was to prepare a common ground to compare of the spatial cognition findings, with the numerical values of the configurational measurements of the space. For this purpose, it was tried to transform the qualitative values into the quantitative ones. It began with creating a table, including a column, which shows the number of respondents and a row that includes the number of the paths and buildings, which are drawn by participants. (Appendixes F & H)

The value of these paths and buildings were entered by encoding the results. In fact, these codes reflect the cognitive representations of the respondents. The results of these representations in the sketch map (path and land marks) can be translated to a quantitative one by encoding system. For analyzing the data statistically, measuring them is necessary, the measurement procedures should have a scale, in this study, according to the variable's type, the Ordinal Scale is used. Using this scale, allows comparing the degree to which two subjects possess the dependent variable. By following Kim (2001) and Yixiang's (2007) techniques, an ordinal scale for scoring the paths and the buildings was developed. It is ranging from not drawn to correctly drawn. If respondents draw the paths correctly they were encoded with the score of 3, if they draw partly correct, they were encoded with the score of 2, if they draw incorrectly they were encoded with the score of 1 and if a path did not exist in their sketch map they were encoded by the score of 0. The correctness measure by considering the shape, length, angle and direction of the drawn paths. This scoring range is applied to the buildings too. Based on ordinal scale, which was mentioned above, landmarks and paths, which were included in the sketch maps, have been measured as landmark scores and path scores. They reflect the frequency and degree of accuracy of landmarks/paths in the sketch maps. The sketch maps were used to quantitatively analyze the respondents' cognitive representations of the Beyazit area. Finding the relationships between the spatial configuration and cognitive representations (one of the research questions) is addressed by analyzing the relationship between syntactical parameters and the data, which is gained from the sketch maps.

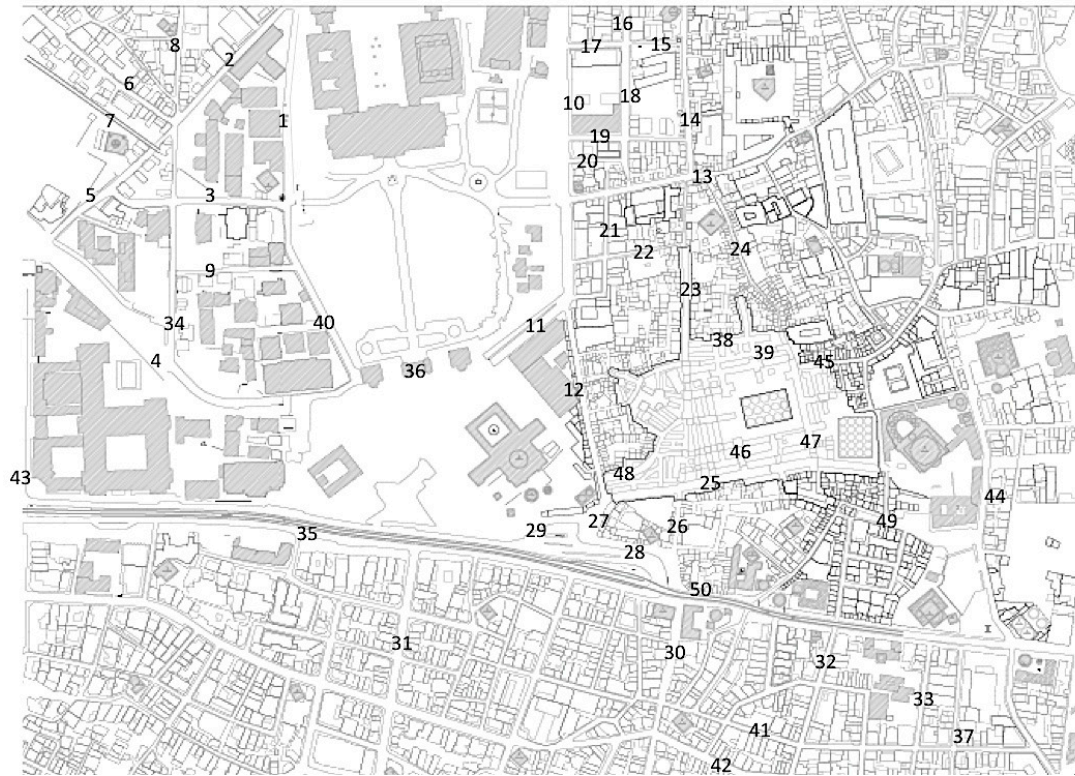


Figure 3.9: Number of drawn paths.

In order to find the results, after encoding the paths and the buildings, which were drawn in the sketch maps, the total score of each path for all the 20 responds calculated, by overlapping the results; the environmental cognition of the respondents formed in the way which could be seen in figure 3.10



Figure 3.10: General Cognitive map of the Beyazit area with its paths and landmarks, it produces by overlapping the respondent's results.

Results: In the figure 3.10, the result of the path-score table is demonstrated schematically, according to the degree of correctness and frequency of the paths and buildings, which remain in the respondent's minds. They are shown by color ranging from black to the light gray, from most to the less score for each of them respectively. It is seen that the paths that correctly remained in more respondents minds, (shown by black color) are not much, and also if we want to address it to the Lynch statement about the five elements which stick in mind about a city, we can see that almost most of the routes which were drawn, can be counted as a boundary, for Istanbul university and Grand Covered Bazaar. Therefore, it can be inferred from the maps that, Beyazit area can be considered as 3 districts in the maps (Istanbul university, Garand bazaar, Beyazit neighborhood) and the paths which are stick more in mind play a 'boundary' role in these districts.

Path analyzing results: The highest score belongs to the rout 1 and then rout 10 which both of them are around Istanbul university, an other high score belongs to Gedik Pasha Yokushu, looking to the Grand Bazaar the most important way is rout 25, which is the rout that starts form the main gate of Bazaar and ends to the gate, which is faced with Nur Osmaniye masque.

Table 3.4 demonstrates 3 paths, which have highest scores respectively, as we can see; path 10, which is located at the right side of Istanbul University, is the path in common between both students and tradespeople, which has the highest scores.

Table 3.4: Three most high-score paths, obtained by sketch maps analysis.

Table		Max score 1 >	Max score 2 >	Max score 3
Students	Path 1	24		
	Path 10		22	
	Path 3,path 25			12
Tradespeople	Path 30	13		
	Path10, path25		12	
	Path 13			10
All	Path 10	34		
	Path 1		32	
	Path 30			24

There for we can conclude that path 10, which is remarked in figure (3.11) is the most recognizable path among both students and tradespeopl, and difference of the socio-economical case of these two categories of the respondents, have the least affect on rememberability of this path.

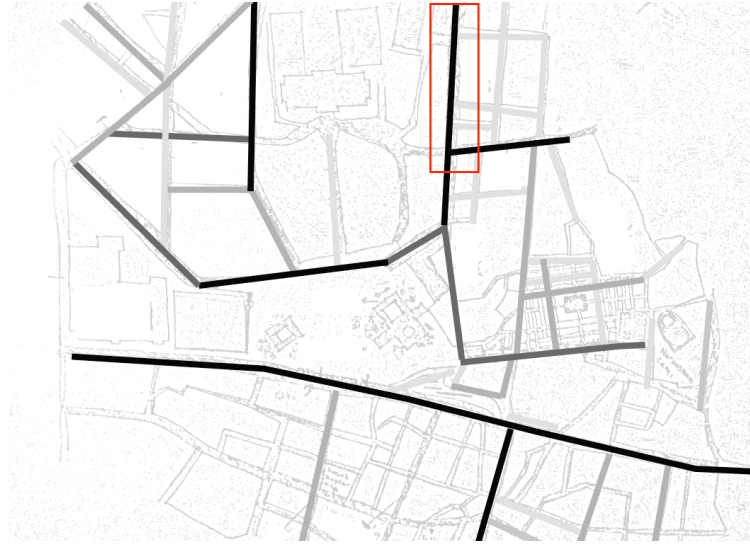


Figure 3.11: cognitive map of beyazit, remarked path 11.

An other path which seems to be important while analyzing the results, is Marcan rout, it is recognizable due got the same score of 10 both from students and tradespeolpe, it means that both groups remembered this way in a same degree. Figure (3.12)

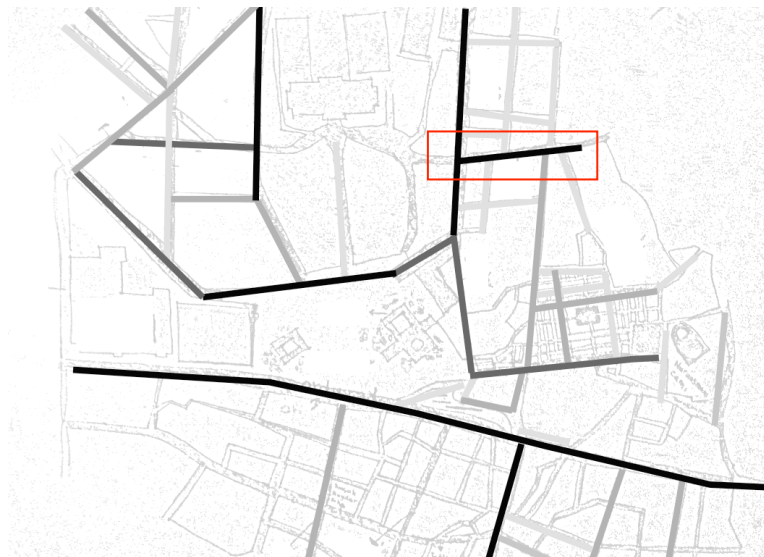


Figure 3.9: Cognitive map of beyazit remarked Marcan rout.

Path 2 (marked red) is important just for students and is remained in their minds more, while path 25 (marked blue) reminded in the tradespeople's minds. Other paths approximately have the same degree of rememberability for the students and tradespeople (figure 3.13).

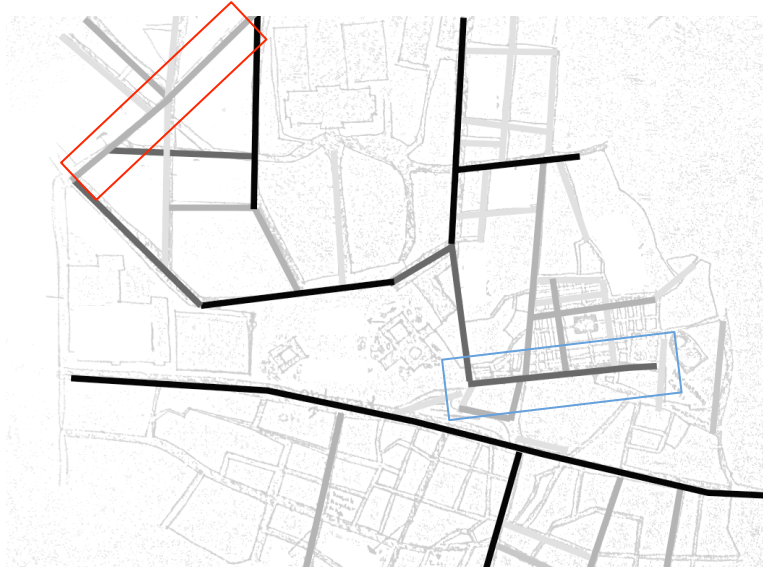


Figure 3.10: Cognitive map of beyazıt, remarked path 25(blue) and path 2 (red).

To capture how and to what extend the area is reminded in the respondent's minds and finding their spatial cognition, the results of drawn paths and buildings in the sketch maps compared with the real map. The real map is considered as the reference and base, all the scores of the paths and buildings in the real map, which are included in the sketch maps are considered as 3 scores, at the end of the calculation of the sketch maps for path's drawings, it has been seen that the degree of matching the perceived path with the existing paths and the mean value that every individual can draw the area truly is 11.8%.

Table 3.5: percentage of respondents' perception of Beyazıt area.

Max percent which a person perceived The area's path	30.66 %
Min percent which a person perceived the area's path	2.66%
Mean value	11.8%

Sketch map's Analyzing Results for Buildings: The same calculation was done for the buildings, which were drawn in the sketch maps, the results showed that, buildings which are drawn in sketch maps are just 12.8 % matched with the real map. If the results are measured by considering both path's scores and building's scores, we can say that the cognitive map of the area is just 12.3 percent matched with reality.

By analyzing the building-score table, it can be seen that Beyazit masque is perceived as an important land mark for people, because by comparing the scores of the cognitive mapping for the students and sellers, it can be seen that the maximum score in both students and sellers categories, belongs to the Beyazit masque, while other buildings which have rather high scores are more important just for student or just for sellers due to their different experiences. Therefore, Beyazit masque is very important landmark that the effect of other factors could not be considerable in its perceiving process. Three high-scored buildings are shown in table 3.6.

Table 3.6 : Three most high-score for land marks, obtained by sketch maps analysis.

Table		Max score 1 >	Max score 2 >	Max score 3
Student	Beyazit masque	18		
	Pharmacy faculty and Sahaflar market		15	
	Main gate of university			14
Trades-people	Beyazit masque	20		
	Nurosmaniye masque & camberlitas		10	
	Sahaflar market			9
All	Beyazit masque	38		
	Sahaflar market		24	
	Pharmacy faculty			21

3.3 Comparing Space Syntax Analysis Results with Cognition Results

In the first part of this chapter, by analyzing Beyazit area syntactically, the global integration, local integration and connectivity values of the paths, which were drawn in sketch maps, were obtained; in the second part by analyzing the cognitive maps by encoded system, the scores of the all the paths were obtained. Now it is going to compare these path scores with the all three syntactical properties and find if there is a correlation between them or not.

The result of these comparisons is shown in the table (3.7). As it can be seen, there is a positive correlation between path scores and the syntactical values of Beyazit; this finding confirms Kim's studies. The degree of the correlation of the path's values with global values can be considered as mediocre amount and with local values (local integration and connectivity) is considered as a poor correlation. By addressing to the pervious studies, this poor correlation is due to the poor degree of intelligibility of the area and these results are not surprising.

Table 3.7: Correlation Between sketch map analyses for path with syntactical properties.

Correlation of the paths scores with global integrations value of paths	+ 0.37
Correlation of the paths scores with local integrations value of paths	+0.27
Correlation of the paths scores with connectivity value of paths	+0.24

One of the questions which rises in this study is: Do syntactical properties of paths have relation with the ability of the respondents on sketch map drawing, and their spatial cognition of the space? To find an answer for this question, the paths were separated in two categories, the paths, which their syntactical values were more than their average value of that syntactic property, and those, which their values were less than the average value. Those with syntactic values more than mean, are considered as high value and those which were lower than average are considered as low values. For example the average of the global integration of paths was 0.83 then if a path's global integration is bigger than 0.83, it is assumed as a high global integration value

and if it is smaller than 0.83 it is considered as low integration value among others. (Table 3.8)

Table 3.8: Mean values of syntactical properties and paths scored in sketch maps.

Mean value of global integration	0.83
Mean value of local integration	2.12
Mean value of connectivity	5.4
Mean value of drawing paths in sketch map	7.3

Table3.9: Number of paths with high values.

Number of paths with high global integration value ([path] INT.H > [mean] INT.H)	23
Number of paths with high local integration value ([path] INT.loc > [mean] INT.loc)	21
Number of paths with high connectivity value ([path] con > [mean] con)	22

Sketch maps include 50 paths, from these 50 paths; integration (H) values of 23 paths are more than mean value of global integration. 21 paths have more local integration values than mean, and the connectivity values of 22 paths are more than the mean connectivity.

Analyzing the results of the table 3.10 by comparing the path scores of the sketch maps shows:

- 52.17% of paths, which have high integration (H) value, gained high scores from cognitive map task and have high path-scores.
- 52.38% of paths, which have high local integration values, gained high scores from cognitive map task.
- 59% of paths, which have high connectivity values, gained high scores from cognitive map test (Table 3.10).

Table 3.10: percentages and numbers of high score-paths with high syntactical values.

	Number	Percent
High score-paths with high integration (H) value	12	52.17
High score-paths with high local integration value	11	52.38
High score-paths with high connectivity value	13	59

Investigating the results by considering 2 syntactical properties at the same time shows that the probability of the prediction becomes more, if at least 2 syntactical properties of a path are high.

Table 3.11: Number of paths, which have 2 high syntactical values.

Number of paths with high global integration value and high local integration value	15
Number of paths with high global integration value and high connectivity value	12
Number of paths with high local integration value and high connectivity value	18
Number of paths with high local and global integration and connectivity values	13

As it can be seen in the table3.12,

- If a path has both high local integration and connectivity values, the probability of that path to stick in the respondents mind is 61 percent (Table 3.12).
- If a path has both high global integration and high local integration values, the probability of that path to stick in the respondents mind increases to 66.6 percent (Table 3.12).
- If a path has both high global integration and high connectivity values then 83% of paths in this case can have high scores of memorability. This shows

that the highest percent is when the paths have both high global and high connectivity values. (Table 3.12)

Table 3.12: Percentages and numbers of high-score path, which have high syntactical values.

	Number	Percent
High score-paths with high integration (H) value and high local integration value	10	66.6
High score-paths with high integration (H) value and high connectivity	10	83,3
High score-paths with high local integration value and high connectivity	11	61.1
High score-paths with high local and global integration and connectivity values	10	79

Finally, comparing the score of sketch mapping by considering 3 syntactic properties in the same time, when the result of 79% is gained, it can be said that about 80% of the paths, which their all 3 syntactical properties, 2 local values and a global values are high relatively, can remain in mind truly and perceived more by Individuals.

In continue, all of the processes mentioned above were done for the low values too, in order to complete the analyzing and confirm the obtained results.

As it can be seen in the table 3.13 and 3.14:

- Among 50 paths, which are included in the participants sketch maps there are 27 paths which their global integration values are less than the average integration value, therefore, as it was said before, these values are considered as rather low values relatively. From these 27 paths, which have low integration (H) values, 21 paths are gained low scores form the cognitive mapping test too.
- Among 50 paths, 29 paths have low local integration values and 28 paths have low connectivity values.

Table 3.13: Numbers of paths with low syntactical values.

Number of path with low global integration	27
Number of path with low local integration	29
Number of path with low connectivity	28

- 77, 79.3 and 85.7 percent of paths, which have low global integration and local integration and connectivity values, respectively have low cognitive mapping scores too (Table 3.14).

Table 3.14 : Percentages and numbers of low-score paths, which have low syntactic values.

	Number	Percent
Low score-paths with low integration (H) value	21	77
Low score-paths with low local integration value	23	79.3
Low score-paths with low connectivity value	24	85.7

If we compare the cognitive mapping results of paths by their syntactical parameters, by considering two spatial properties, simultaneously the results will be:

- 80 percent of the paths, which have both low global and local integration values, have low paths, scores in the cognitive mapping test too.
- 88 percent of paths, which have both low global integration and low connectivity values, have low path scores too.

- 84.6 percent of paths, which have both low local integration and connectivity values, have low path scores too, and About 90 percent of the paths which all three syntactical values are less than the average, gain less path scores form the cognitive mapping test (Table 3.16).

Table 3.15: Numbers of paths with two low syntactical values.

Number of path with low global integration value and low local integration value	20
Number of path with low global integration value and low connectivity value	18
Number of path with low local integration value and low connectivity value	26
Number of path with low global, local integration, connectivity value	18

Table 3.16: Number and percentage of low-score path, which have two low syntactical values.

	Number	Percent
low score-paths with low integration (H) value and low local integration value	16	80
low score-paths with low integration (H) value and low connectivity value	16	88
low score-paths with low local integration value and low connectivity	22	84.6
low score-paths with low integration (H) value and low local integration value and low connectivity value	16	88.9

3.3.1 Finding the correlation between properties

Table 3.17 demonstrates the exist correlation between syntactical properties with each other and the correlation of each of them with cognitive map scores for the 50 path which are drawn in the cognitive maps. The results are shown with sample validations. As can be seen from table 3.17 cognition scores are correlated with global integration in % 99 confidence interval (significant. 2 tailed: 0.008), but cognition scores have less correlation with local integration and connectivity scores that these correlations are significant only in %90 confidence interval (relatively sig : 0.055 and 0.082) which are less than 0.10). Although the correlation of the cognitive maps scores and global integration is a mediocre but it is very confident.

Table 3.17: Correlations.

		G. Integration	L. Integration	Connectivity	Cognition
Integration h	Pearson Correlation	1.000	0,498**	0,304*	0,371**
	Sig. (2-tailed)		0.000	0.032	0.008
Local Integration	Pearson Correlation	0,498**	1.000	0,780**	0.273
	Sig. (2-tailed)	0.000		0.000	0.055
Connectivity	Pearson Correlation	,304*	,780**	1.000	0.248
	Sig. (2-tailed)	0.032	0.000		0.082
Cognitive map scores	Pearson Correlation	,371**	0.273	0.248	1.000
	Sig. (2-tailed)	0.008	0.055	0.082	

If we consider the distribution of the syntactic properties of the selected segments, which have cognition scores, syntactic properties have significant correlation between each other. Correlation of connectivity and global integration, which is shows intelligibility, mathematically is 0.34; in the area which is drawn in the respondents cognitive maps. This value is decrease to 0.16 in the whole Beyazit area (calculated in the part 3.1). It means that respondents tend to remember and perceive spaces, which are more intelligible.

3.4 Data Distribution Analysis

Table 3.19 demonstrates the descriptive statistics values of the syntactical properties of the paths and the cognitive map's scores. It can be seen that the skewness of cognitive map scores are more than zero, actually the skewness for a symmetrical distribution which is normal distribution is zero, also it can be seen that skewness for syntactical properties are near to zero means that their data are distributed more normally by considering the skewness.

Kurtosis is another measurement, which quantifies whether the shape of the data distribution matches the normal distribution. It can be seen that in connectivity kurtosis is much near to zero, local and global integration have negative kurtosis and cognitive map's scores have positive kurtosis. The Histograms for cognitive map scores and syntactical measurements illustrate data distribution schematically.

(Figure 3.14, 3.15, 3.16, 3.17)

Table 3.18: Descriptive Statistics.

	Integration H	Local int	Connectivity	Cognition
n	50	50	50	50
Mean	.83100	2.12686	5.46	7.38
Median	.82950	2.02100	4.00	5.00
Std. Deviation	.049523	.371466	2.950	7.863
Skewness	.149	.102	.849	1.801
Std. Error of Skewness	.337	.337	.337	.337
Kurtosis	-.202	-.550	.023	3.156
Std. Error of Kurtosis	.662	.662	.662	.662
Minimum	.713	1.330	2	0
Maximum	.952	2.998	14	34

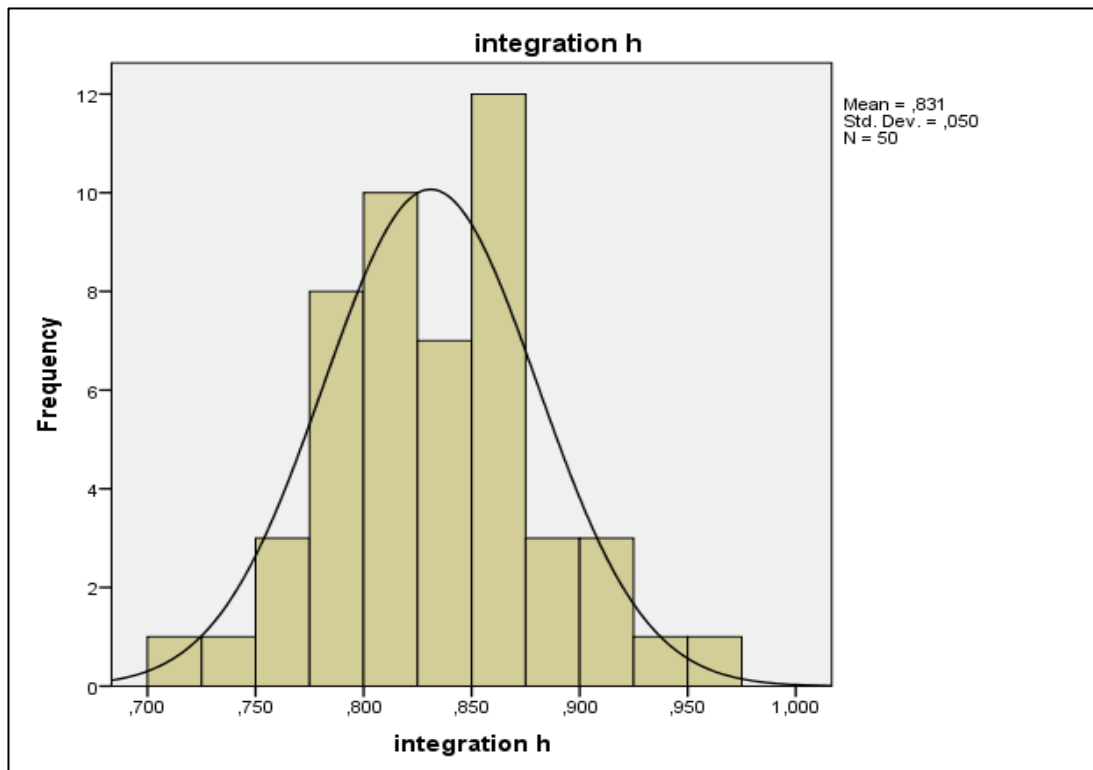


Figure 3.14: Histogram/ Global Integration.

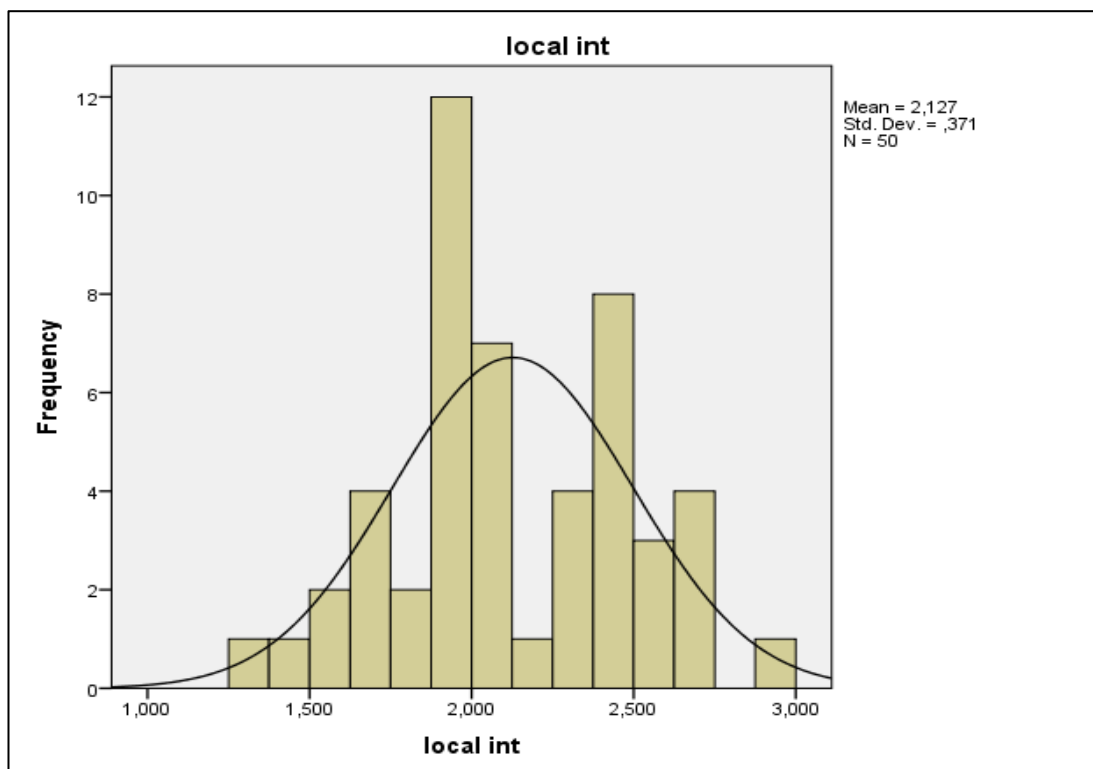


Figure 3.11: Histogram/ Local Integration.

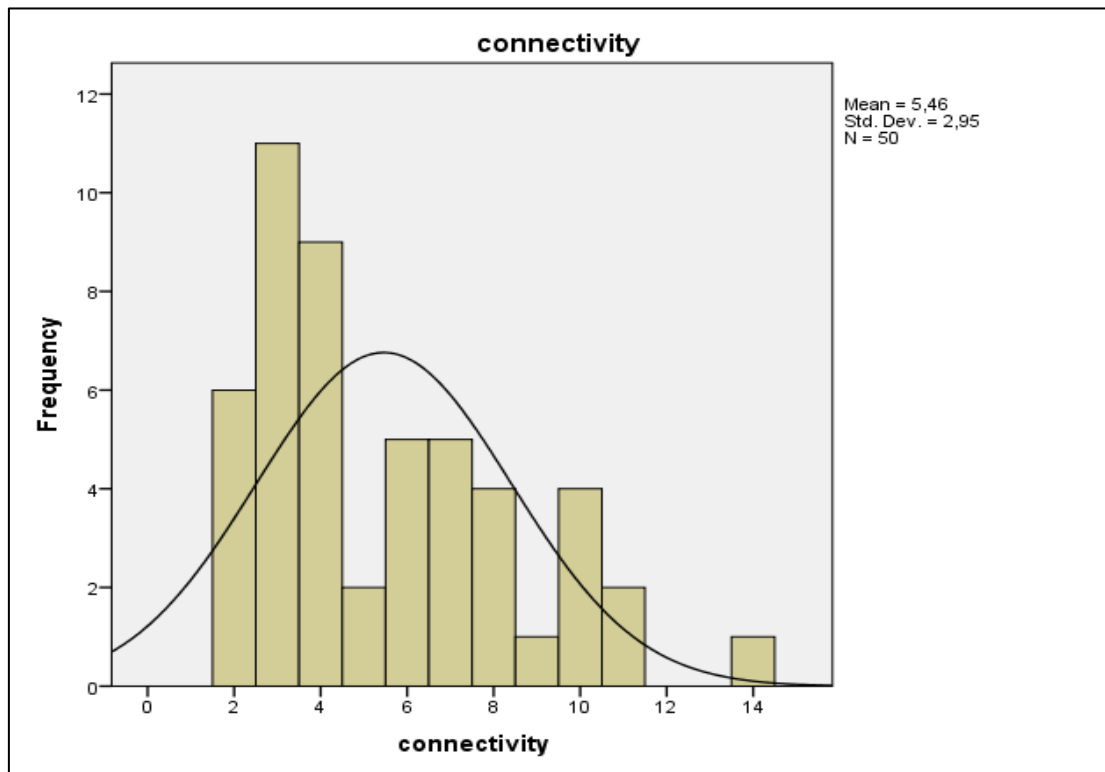


Figure 3.12: Histogram/ Connectivity.

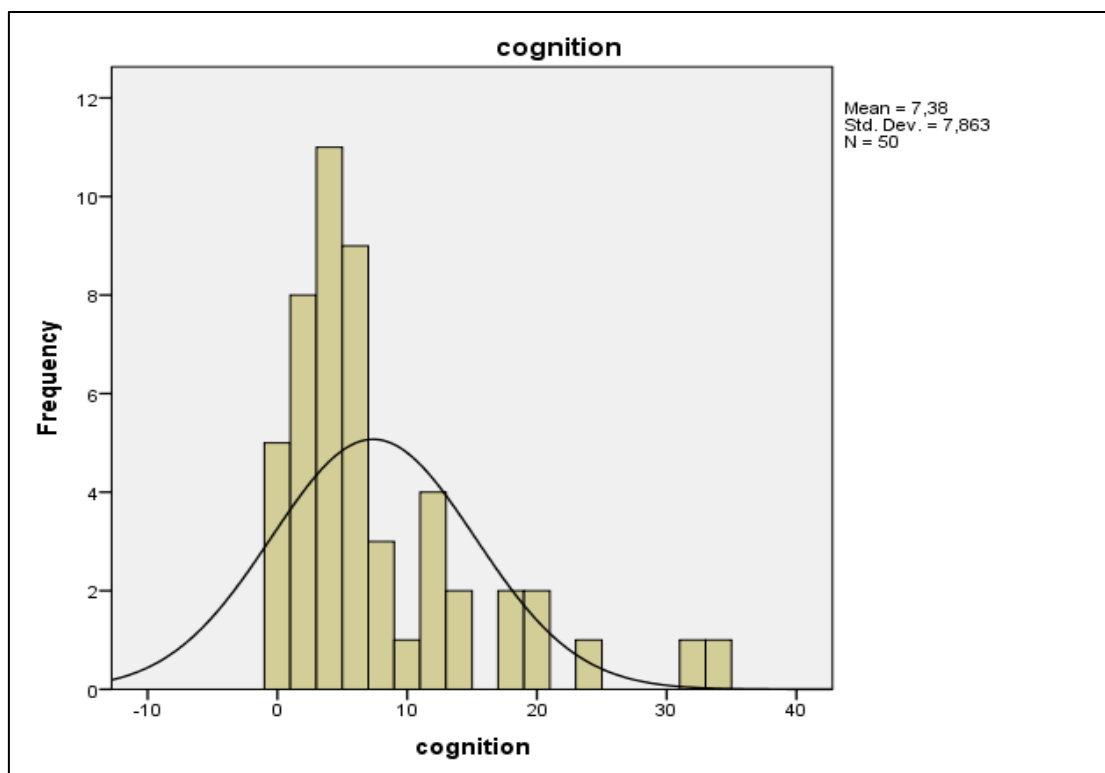


Figure 3.13: Histogram/ Cognitive Representation.

3.5 Recognition Test

There are variety of techniques used by researchers in the fields of geography, psychology, urban planning, and cognitive science to collect and analyze data on how people understand and think about space. One of these techniques which is utilized in this research is recognition test. This technique is developed by Cohen and Evens (1984), applying this technique can help to understand the cognition of the respondents about the area. 68 scenes from Beyazit were photographed, after drawing the sketch map, these pictures were shown to the respondents and they were asked to locate each picture in the real map of Beyazit. The results of the survey were analyzed by the same encoding system, it means that if respondents recognized and located the pictures truly they got 3 score, if respondents recognized and located the pictures partly correct or wrong they got 2 and 1 score respectively, and finally 0 score for the pictures with no answers. According to the analyzes, the pictures which recognized and located in the real map truly (more than others) are the pictures of pharmacy faculty, Chemberli Tas element, building of Ziraat Bank, Beyazit masque and faculty of literature. Table (3.19) indicated the score of these five buildings. The score of all pictures are shown in appendi

Table 3.19: Scores of the pictures in recognition tests base on how respondents located them in the real map.

Picture	Picture number	Score
	18	33
	50	30
	16	27
	36	22
	11	18
Average score for all pictures		6.57

The results of recognition tests are approximately same with the results of the sketch mapping. In both of these cognitive mapping techniques (recognition test and sketch mapping), Beyazit masque, faculty of pharmacy and Chamberly Tash element has gained highest scores by the respondents.

In order to compare the results of the recognition test with syntactical properties, 6 photographed scenes with high scores and 6 photographed scenes with low scores were chosen and compered with the syntactical properties of the routs, which these scenes are along them. Actually, there is no correlation between these values, but how ever there is a very low correlation between global integration values and the scores from recognition task. It seems that recognition and remembering a scene depend more to the building characteristics, because as table (3.21) illustrated, although a scene is located in a space, which has high syntactical values, people could not recognize it because of its poor building characteristics. Table (3.20) indicates the correlation recognition tests scores with syntactical values.

Table 3.20 : Correlation score of buildings from recognition test with syntactical values of them.

Co-relation Recognition score with global integration value	0.20
Co-relation Recognition score with local integration value	0.09
Co-relation Recognition score with connectivity value	-0.19

Table 3.21: Syntactical values of the spaces which scenes are taken from.

Pic	Pic num	Score	Int (H)	L.int	Connectivity
	18	33	0.79	1.97	7
	16	27	0.86	2.45	6
	17	21	0.9	2.36	6
	11	18	0.82	1.5	4
	50	30	0.86	2.45	5
	6	0	0.78	1.8	2
	3	3	0.71	1.4	3
	13	1	0.85	2.93	14
	22	0	0.86	2.4	5
	55	2	0.87	2.99	14

4. DISCUSSION ANCONCLUSION

4.1 CONCLUSION

4.1.1 People's cognition on the Beyazit area

In the process of deciding to plan and design the city, designers and urban managers may face with different issues and it is essential for them to have as much knowledge as possible on all dimensions that affect the city. Perceiving the urban space and our environmental cognition is an important issue and Kevin Lynch (1960), has emphasized the issue's importance stating: "we must consider not just the city as a thing in itself, but the city being perceived by its inhabitant". As previously discussed, there is relation between the physical environment and our mental representations of it. In this regard, a proper analysis is necessary in order to make precise decisions and generate successful city plans, develop healthy communities and also to find out the costs and profits of different design patterns. This means that designers need to know the present city image and then design an appropriate image that they desire to have. Related to these arguments, in this study one critical step is to determine the spatial cognition and analyze urban image through conducting a detailed investigation in Beyazit area. Thus the main question which this study is deal with is:

What is the spatial cognition of people about the Beyazit area? Which spaces remind in minds more?

In order to reach an appropriate answer for the research question that raised in studying the image of the Beyazit area, the methodology was progressed by getting cognitive maps of the participants and interpreting them by using Kevin Lynch's (1960), 'cognitive urban image' method. Participants were asked to draw Beyazit area's sketch map considering the routs and landmarks, which they remember. This research is done in the light of the literature review, which examines cognitive process of memory and imagery that affect learning of routes, landmarks and configuration.

For getting a combined of all sketch maps and overlapping them, an ordinal scale is utilized by following a technic that is developed by Yixiang, which was discussed in detailed in previous capture. Analyzing the sketch maps uncovered some underlying results, it indicated that about 12 percent of cognitive maps match with the real layout of the Beyazit area. Comparing the Beyazit area sketching maps with the real layout some important points can be inferred:

- Grand Bazaar and Istanbul University campus are perceived as district.
- The main paths, which are more stick in the individuals' minds, are the paths around the Istanbul University, Gedik Pasha road, Tran way and the Marcan paths.
- The main paths which people memorized them more have the role of edge in respondents' cognitive maps.
- Beyazit masque is considered as an significant land mark for respondents.

In spite the similarity between the building characteristic and building use that three masques of Beyazit area have, naming; Beyazit masque, Nurosmaniye mosque and Atikali Pasha masque, the degree of considering Nur Osmaniye and Ali Pasha masques as a land mark are lower than Beyazit masque. It seems to be related to the poor accessibility to their gates.

- Sahaflar market, which have a liner form and can be considered as a path is perceived as on other landmark of the area.
- The Beyazit neighborhood as a district is not perceived.
- Beyazit square is perceived as a node and the path passing through has not been perceived.

Totally according to the analyzing the results, approximately 12.3 percent of cognitive maps match with the real layout of the Beyazit, on average it can be stated that people could draw 12 percent of the real map in the sketch maps correctly. By considering the clues that obtained from sketch maps, the area can be refined and redesign in the way that can be more easy-perceptible and the area's legibility can be improved as well.

4.1.2 Syntactical description of the Beyazit area

Another work, which is done in this thesis is describing the area syntactically and finding the intelligibility of Beyazit area.

The findings of the previous chapter of this thesis regarding the research questions underlined the above-mentioned results considering the aspects of spatial configuration and spatial cognition.

It is important to learn how it is possible to control the spatial variable at the level of the complex patterns of space, to make up the city. First of all the area is described syntactically. According to the analysis the intelligibility of the area was 0.16. Therefore, it can be seen that the area has low intelligibility value. According to the practical definition of the intelligibility, it means that there is a poor correlation between global integration and connectivity which is a local value, and according to the pervious literatures, it can be stated that if intelligibility is juxtaposed to the legibility concept of lynch's approach, it can be defined as a visual image of the city evoke properties inherited in the configured space (Hillier, 1996). Looking in this framework, it can be concluded that the syntactical properties of the Beyazit area guide people to better understand their surrounding and perceive the environment, is poor in this area.

4.1.3 Comparison of syntactical values of Beyazit area with cognitive mapping

Another issue that this study struggle with it, is to find the answer of this question:

- 1- If syntactical properties of the area can have noticeable role in predicting the degree of memorability of the area and the respondents' ability of drawing correct sketch mapping or not?

By comparing results of the mean average of syntactical values with the mean average of path scoring analyzing of sketch maps, it is obvious that if a syntactical property of paths is high then it can be claimed that the probability of obtaining correct sketch mas of the paths is high and it is true for the low values as well.

It means that the higher syntactical values the higher cognition and the lower

syntactical values the poor cognition. Of course the degree of probability become more if all of these issues is considered by two syntactical values, and it will be more stronger if all three syntactical properties of paths, means global and local integration and connectivity values be high. Therefore it can be concluded that by knowing the syntactical properties of an area it is possible to predict that how people's cognition is. Therefore, it can be a decent clue for the new decision-making and design process in order to create a more successful urban environment.

4.1.4 Practical implication

Designing a legible environment attach a lot of importance during the rapid urbanization and mass development of cities, which make the environment more complex. Thus, "understanding the characteristics of the urban environment that contribute to legibility is very important, particularly for newcomers, and has potential to inform the future of urban design and planning for a better living and working environment" (Nasar, 1994 cited in Yixiang, 2007, p.227).

According to the research's results there is a positive correlation between cognitive representations and syntactical properties of the spaces. As syntactical properties are independent variables urban designers can manipulated these properties of space in the practical design stage. It can be possible to increase the intelligibility of a neighborhood by designing a layout, which its paths have high connectivity value and also high accessibility to all the other paths. Since as it was mentioned before intelligibility is association between connectivity and global integration (Hillier, 1996). There fore by increasing the intelligibility of Beyazit the legibility of area will be more and people, who are use there could have more clear cognitive map.

According to the results respondents recognized and remember the paths, which have high syntactical values, so it would be better to pay more attention to these path for example to their sidewalks, pavements, etc in order to leave a good impression in the people's mind.

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APPENDICES

APPENDIX A: Sketch Maps of Beyazit area (drawing by Students)

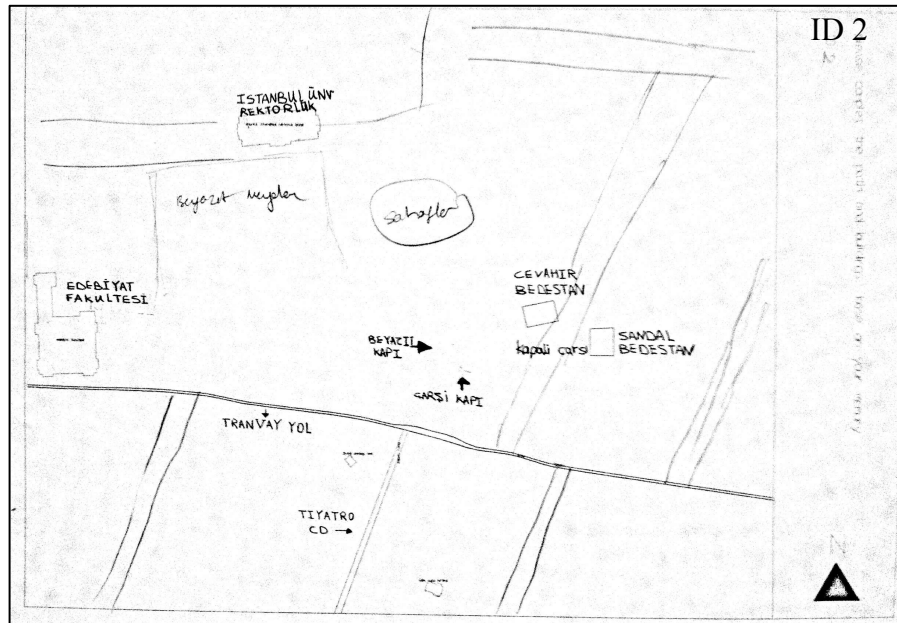
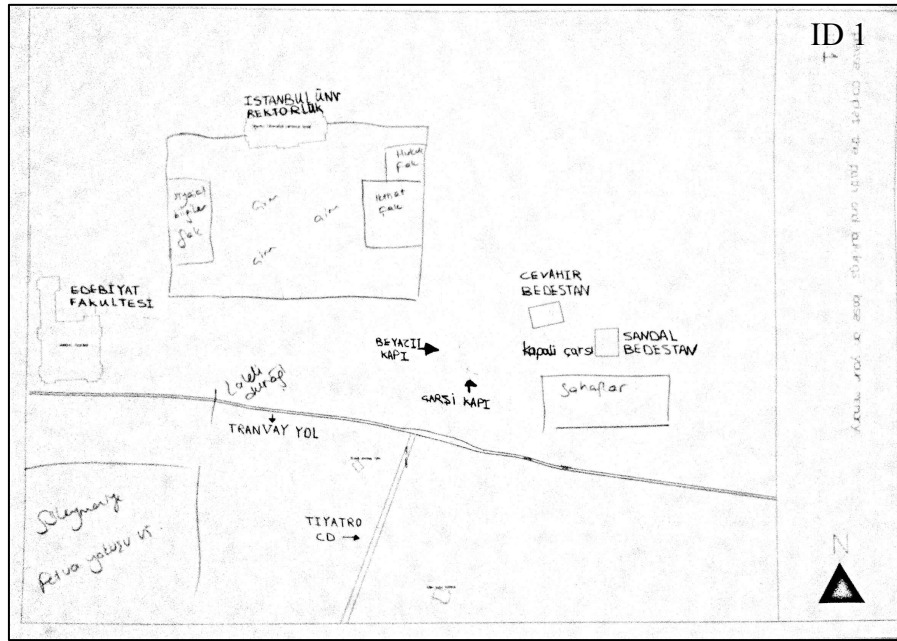


Figure A.1: Sketch maps for ID1 and ID2.

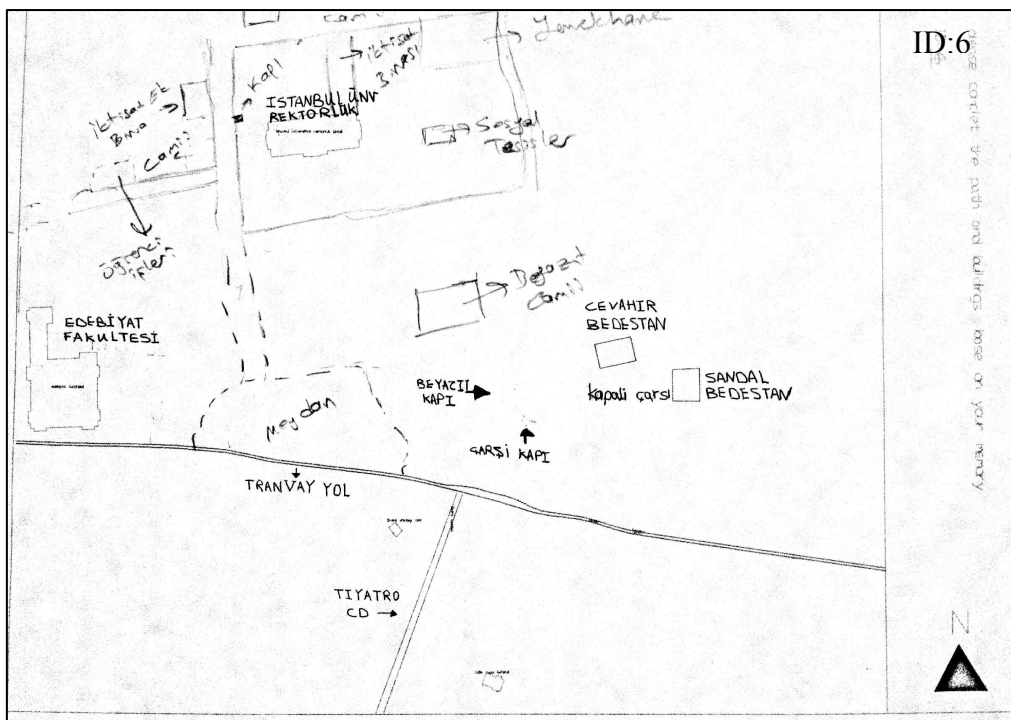
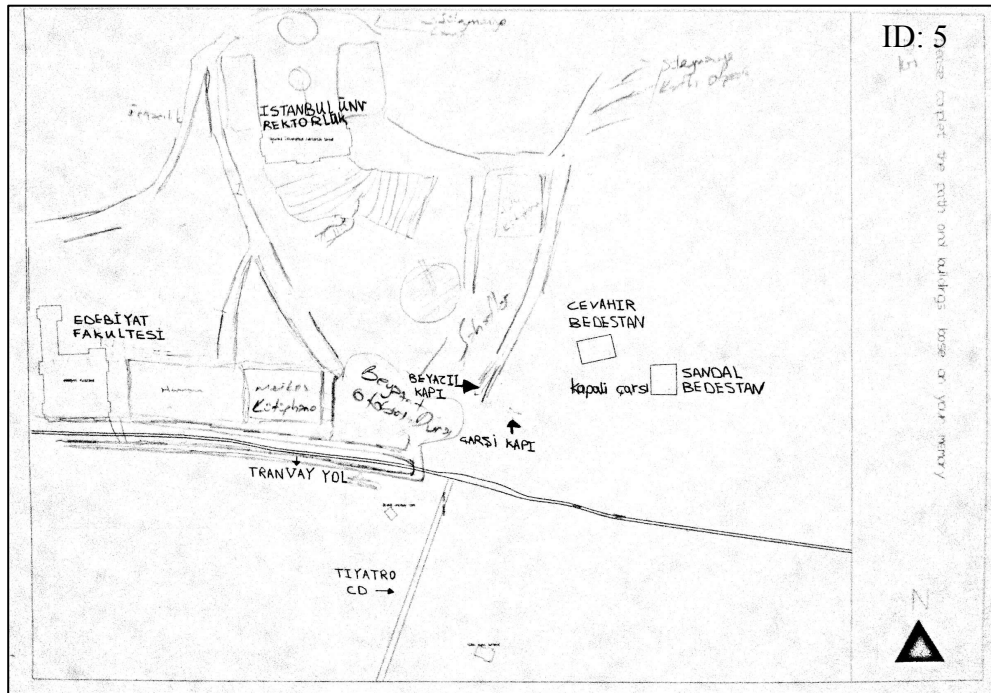


Figure A.3: Sketch maps for ID5 and ID6.

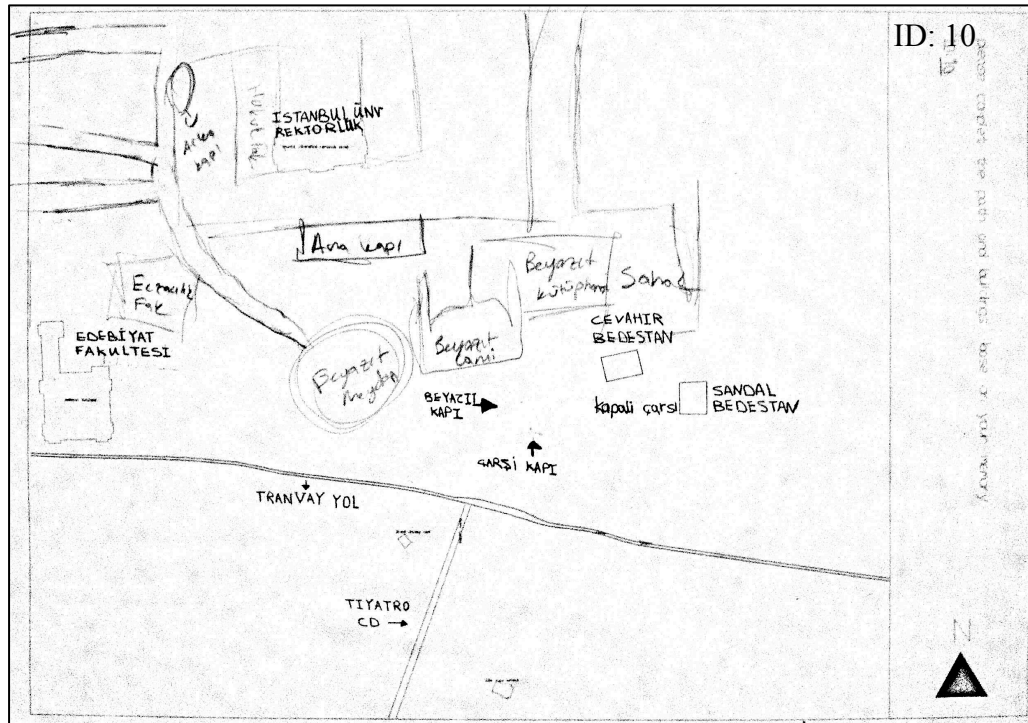
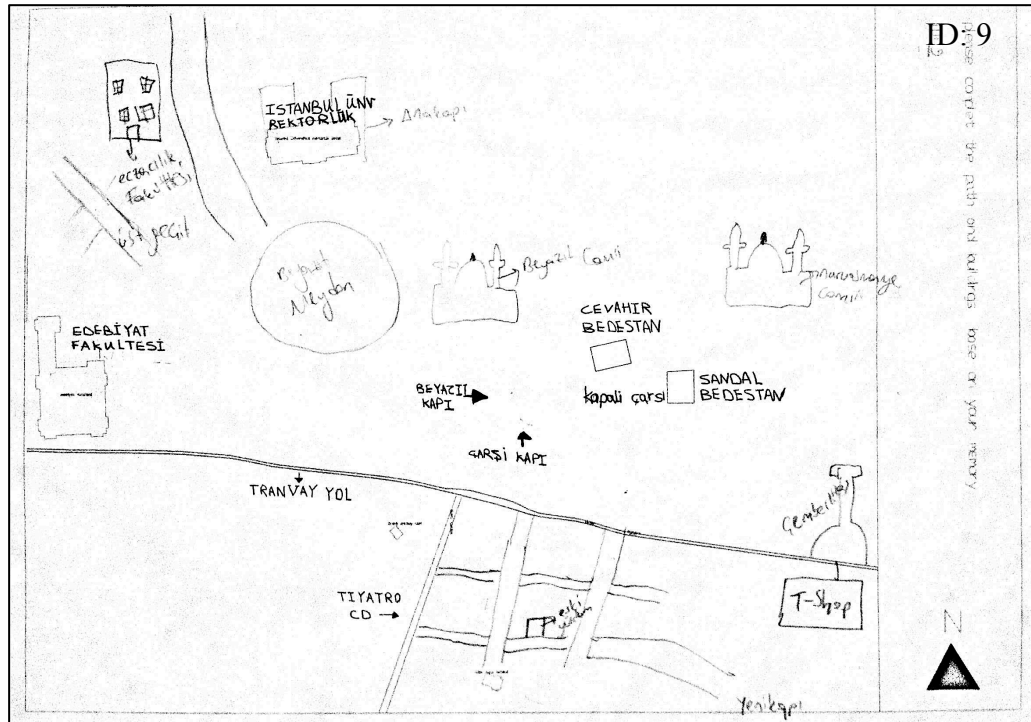


Figure A.5: Sketch maps for ID9 and ID10.

APPENDIX B: Sketch Maps of Beyazit area (drawing by Traders)

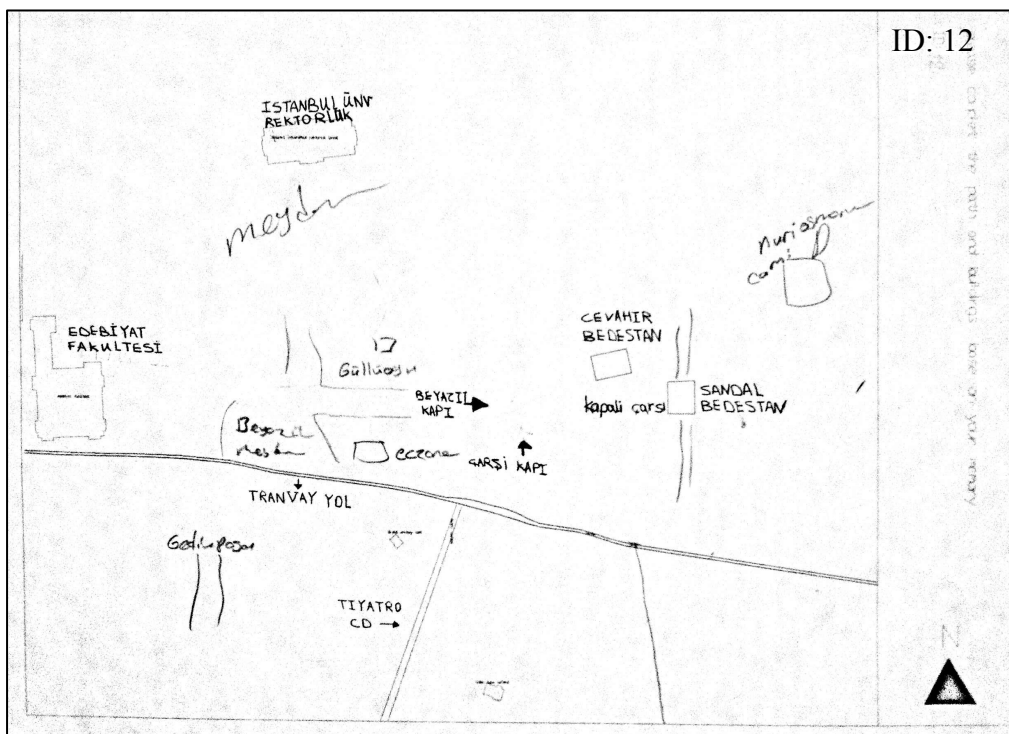
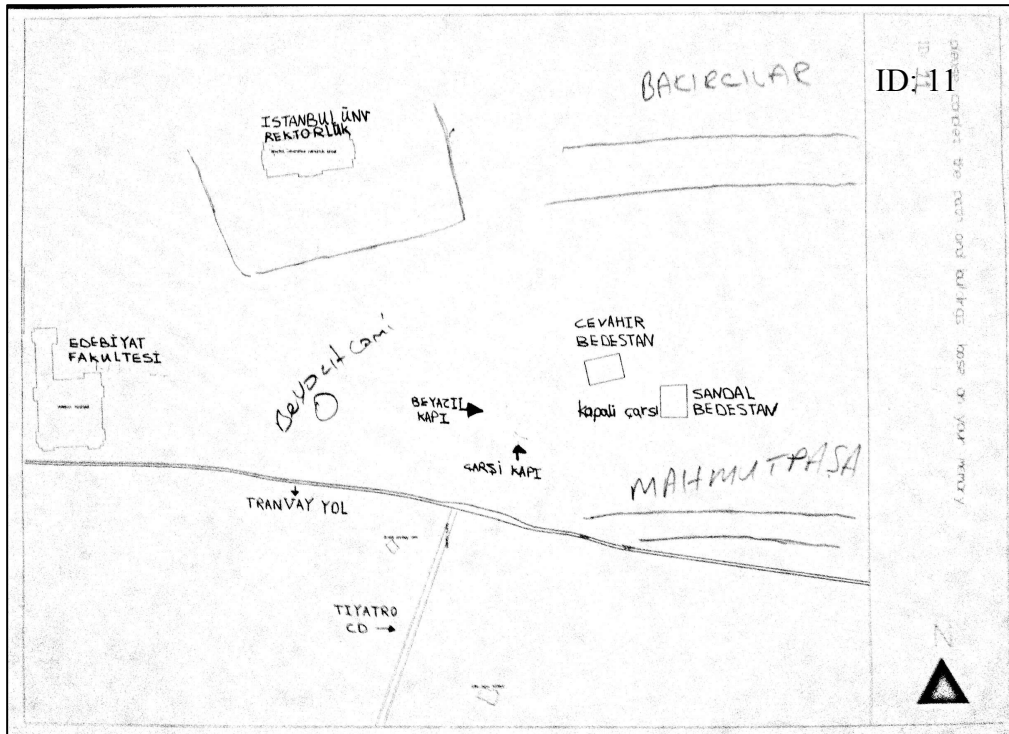


Figure B.1: Sketch maps for ID11 and ID12

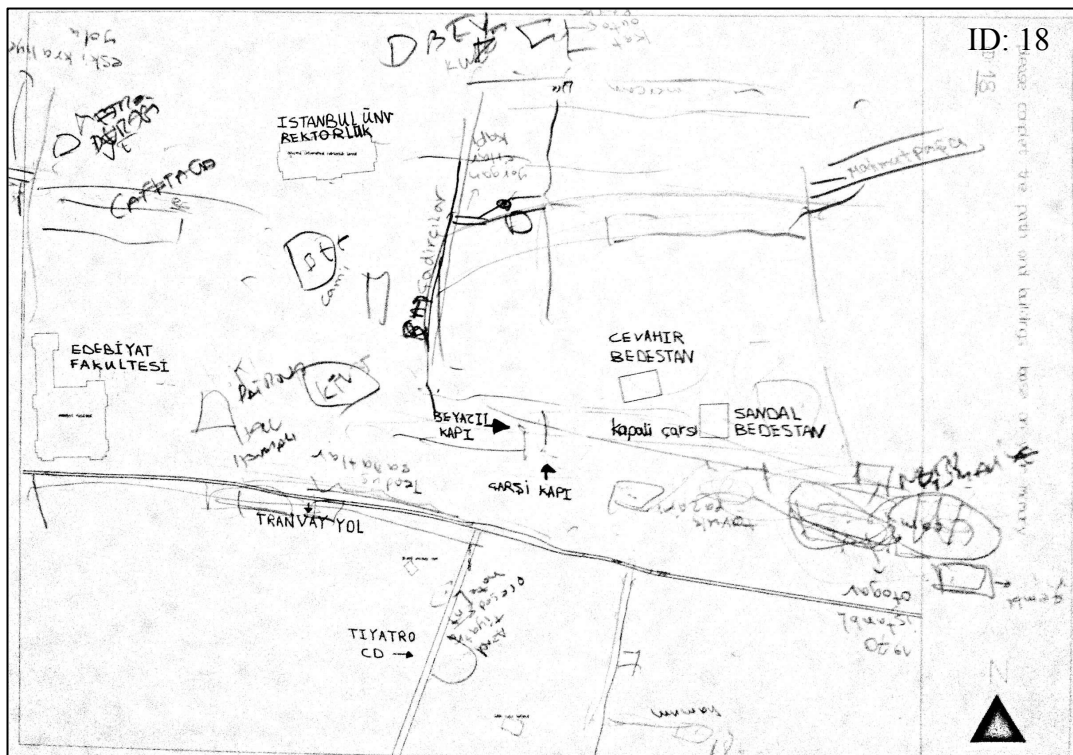
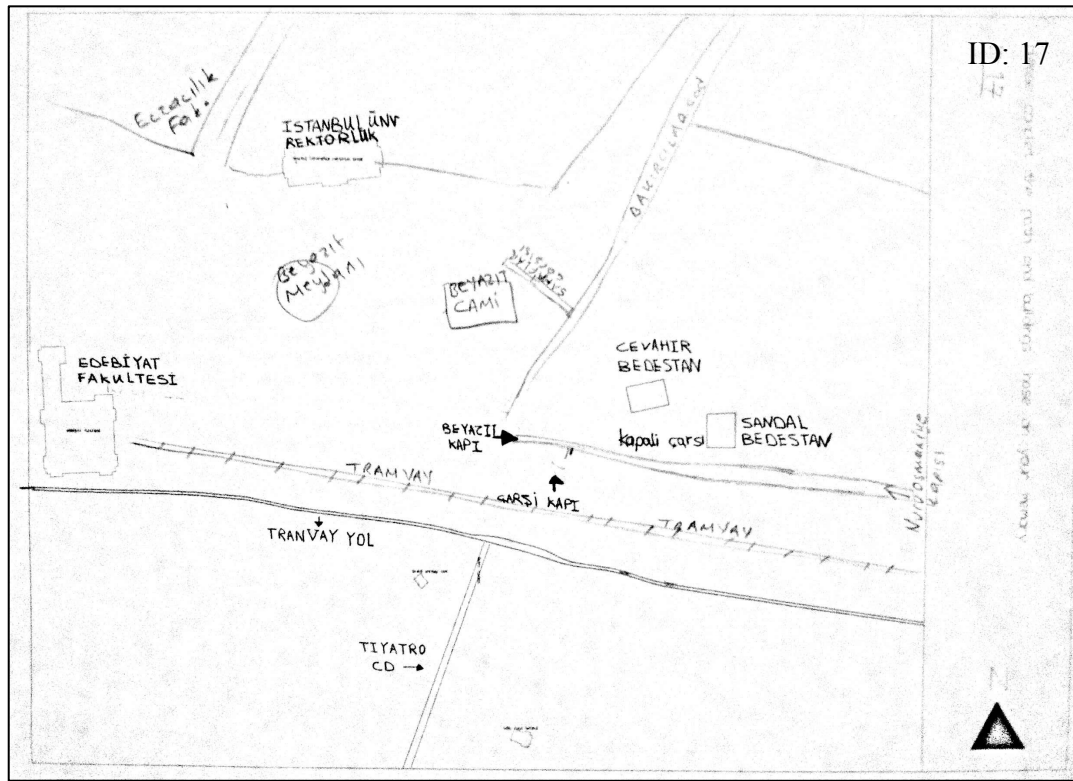


Figure B.4: sketch maps for ID 17 and ID 18.

Based on your memory, please locate each picture (the number below each picture)
Correctly on the real map of ID _____ Beyazit area as many as possible you can

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APPENDIX D: Data analysis sheet for recognition test, by students and tradespeople (Sketch Map)

Tabel D.1: Scores of pictures.

	Pic 1	Pic 2	Pic 3	Pic 4	Pic 5	Pic 6	Pic 7	Pic 8	Pic 9	Pic 10
ID 1	1	0	0	0	0	0	0	0	0	0
ID 2	2	0	0	0	0	0	0	3	0	0
ID 3	3	0	0	3	2	0	0	3	0	0
ID 4	0	0	0	2	2	0	1	2	0	0
ID 5	0	0	0	0	0	0	0	0	0	0
ID 6	0	0	0	0	0	0	0	0	0	0
ID 7	0	0	0	0	0	0	3	0	0	2
ID 8	0	0	0	0	0	0	0	0	0	0
ID 9	0	0	0	0	0	0	0	0	0	0
ID 10	0	0	0	0	0	0	0	0	0	0
ID 11	0	0	0	0	0	0	0	0	0	0
ID 12	0	0	0	0	0	0	0	0	0	0
ID 13	0	0	0	0	0	0	3	3	0	0
ID 14	3	0	0	3	3	0	0	0	0	0
ID 15	3	3	0	3	3	0	3	3	0	0
ID 16	2	2	0	0	3	0	3	0	0	0
ID 17	0	0	0	0	0	0	0	0	0	0
ID 18	0	3	3	0	0	0	0	0	0	0
ID 19	3	0	0	0	3	0	3	0	0	2
ID 20	0	0	0	0	0	0	0	0	0	0
sum	17	8	3	11	16	0	16	14	0	4

Pic 11	Pic 12	Pic 13	Pic 14	Pic 15	Pic 16	Pic 17	Pic 18	Pic 19	Pic 20
3	1	0	0	0	0	1	1	0	0
0	0	0	2	0	0	0	1	0	0
0	0	0	0	0	3	3	3	0	0
3	0	0	2	3	3	2	0	0	0
0	0	0	0	0	2	0	2	0	0
0	0	0	0	0	0	0	3	0	0
3	0	0	0	1	3	2	3	0	0
0	0	0	0	0	0	2	3	0	0
0	0	0	0	0	3	1	3	0	0
0	0	0	0	0	3	0	3	0	0
0	2	0	0	2	0	0	0	0	0
0	0	1	3	0	2	3	0	0	0
0	0	0	0	0	0	3	2	0	0
3	0	0	3	0	0	1	1	0	0
3	3	0	3	0	2	3	3	0	0
0	0	0	0	0	3	0	2	0	0
0	0	0	0	0	0	0	2	0	0
0	0	0	0	0	0	0	0	0	0
0	3	0	0	0	0	0	0	0	3
3	2	0	2	3	3	0	1	0	0
18	11	1	15	9	27	21	33	0	3

Pic 21	Pic 22	Pic 23	Pic 24	Pic 25	Pic 26	Pic 27	Pic 28	Pic 29	Pic 30
0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	3	0	0	0	0	0	0
0	0	0	0	3	0	0	0	0	0
0	0	0	3	0	0	0	0	0	1
0	0	0	0	2	2	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	3	3	0	2	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	3	3	0	0	0	0	0
0	0	0	1	3	3	0	0	0	0
2	0	3	15	11	7	0	1	0	1

Pic 31	Pic 32	Pic 33	Pic 34	Pic 35	Pic 36	Pic 37	Pic 38	Pic 39	Pic 40
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	3	3	2	3
0	0	0	3	0	3	2	0	0	0
0	0	0	0	0	3	3	0	0	0
0	0	0	0	0	0	3	0	0	0
0	0	0	0	0	0	3	0	2	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	3	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	1	2	3	0	0	0	0
0	0	0	0	2	3	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	2	3	3	0	0	0	0
0	0	0	6	7	22	17	3	4	3

Pic 41	Pic 42	Pic 43	Pic 44	Pic 45	Pic 46	Pic 47	Pic 48	Pic 49	Pic 50
0	0	0	0	0	0	0	0	2	0
0	0	0	0	0	0	0	0	1	0
0	0	3	3	0	0	0	0	3	0
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0
0	0	0	3	0	0	0	0	0	3
0	0	3	0	0	0	3	0	0	3
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	2
0	0	1	3	0	0	0	0	0	1
0	0	0	0	0	3	2	2	0	3
0	0	0	0	0	2	0	0	2	3
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	3
2	2	1	1	0	1	1	0	0	0
2	2	9	11	0	6	6	2	8	30

Pic 51	Pic 52	Pic 53	Pic 54	Pic 55	Pic 56	Pic 57	Pic 58	Pic 59	Pic 60
0	0	0	0	0	2	1	0	0	0
0	0	0	0	2	0	0	0	0	0
0	0	3	0	0	3	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
1	0	3	0	2	14	3	0	0	0

Pic 61	Pic 62	Pic 63	Pic 64	Pic 65	Pic 66	Pic 67	Pic 68
0	0	0	0	0	0	0	0
0	0	0	0	3	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	3	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	2	3	0	0
0	0	0	0	0	3	0	0
0	0	0	0	0	2	0	0
0	0	0	0	0	3	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	5	14	0	0

Note: All of the pictures from pic1 to pic 68 are shown in the appendix G.

APPENDIX E: Data Analysis Sheet for Landmarks drawing by students and tradespeople (Sketch Map)

Table E.1: Scores for landmarks.

ALL	1	2	3	4	5	6	7	8	9	10
ID1(ST)	0	0	0	0	0	0	2	0	0	0
ID2(ST)	0	0	0	0	0	0	0	0	0	0
ID3(ST)	0	3	3	0	3	0	0	3	0	0
ID4(ST)	0	3	3	0	0	0	0	2	2	0
ID5(ST)	0	0	0	0	1	0	0	1	0	0
ID6(ST)	0	0	2	0	0	0	0	3	0	0
ID7(ST)	3	3	3	3	3	3	3	0	0	0
ID8(ST)	0	0	3	3	3	3	3	3	3	2
ID9(ST)	0	2	2	2	3	0	0	0	0	0
ID10(ST)	0	3	2	0	2	0	0	0	0	0
ID11(TR)	0	0	3	0	0	0	0	0	0	0
ID12(TR)	0	0	1	2	0	0	0	0	0	0
ID13(TR)	0	0	0	0	0	0	0	0	0	0
ID14(TR)	0	0	2	0	0	0	0	2	0	0
ID15 (TR)	0	3	2	0	3	0	0	0	0	3
ID16(TR)	0	0	0	1	0	0	0	2	0	0
ID17(TR)	0	0	3	2	3	0	0	0	0	0
ID18(TR)	0	0	3	3	0	0	0	0	0	0
ID19(TR)	0	0	3		0	0	0	0	0	0
ID20(TR)	0	0	3	2	0	0	0	1	0	0
Sum of scores	3	17	38	18	21	6	8	17	5	5

Note: ST: student; TR: Trademan; 1: Calligraphy Musium; 2: IU Main Gate; 3 Beyazit Masque; 4: Nur Osmaniye masque; 5: Pharmacy Faculty; 6: Bank; 7: Social Science Bulding; 8: Suleymaniye Masque; 9: Kurufasulye SELLERS; 10: Fire tower (element).

11	12	13	14	15	16	17	18	19	20
0	0	1	0	0	0	0	0	2	0
0	0	2	0	0	0	0	0	0	0
0	0	2	0	2	0	0	0	0	0
3	0	2	0	0	0	0	0	2	0
3	0	3	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	3	2
0	0	0	0	0	0	0	0	3	0
3	3	3	3	3	3	3	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	2	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	3	0	0	0	0	0
3	0	2	0	2	0	0	2	0	0
3	0	2	0	0	0	0	0	0	0
0	0	0	0	0	3	0	0	0	0
0	0	3	0	0	0	0	0	0	0
3	0	0	0	0	3	0	0	0	0
0	0	2	0	0	3	0	0	0	0
0	0	0	0	0	1	0	0	0	0
18	3	24	3	10	16	3	2	10	2

Note: 11: Central Library; 12: Ozbek Bazaar; 13: Sahaflar Bazaar; 14: Marmara Bazaar; 15: Halk Library; 16: - Çemberli Taş (element); 17: Student Affairs Building; 18: Grand Bazaar; 19: Economy Faculty; 20: Refectory.

21	22	23	24	25	26	27	28	29	30
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	2		0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
3	3	2	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	2	3	2	0	0	0
0	0	0	0	0	0	2	0	0	0
0	3	0	1	2	0	0	0	0	3
0	2	0	0	2	0	0	3	3	3
0	0	0	0	0	0	0	0	0	0
0	0	3	0	0	0	0	3	3	0
3	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
6	10	5	1	6	3	4	6	6	6

Note: 21: Bus Station; 22: Hamam; 23: Floor Parking; 24: Beyazit Library; 25: Vezneciler Metro Staion; 26: By-Hilton Hotel; 27: Vefa High School; 28: Azad theater (present hotel) 29: Istanbul Parking; 30: Çemberli Taş Station.

31	32	33	34	35	36	37	38	39	40	41
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	3	2	3	2	1
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	3	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	3	2	3	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
5	2	3	2	3	1	6	2	3	2	1

Note: 31: Beyazit Station; 32: Gulluoglu shop; 33: Ali Paşa Medrese; 34: Surp Church; 35: Yahya Kemal Musium; 36: Literature Faculty; 37: Political Science Faculty; 38: Communication Faculty; 39: Burger King; 40: Nargileciler Shops; 41: Çupal Oglu high school.

APPENDIX F: Data Analysis Sheet for paths drawing by students and tradespeople
(Sketch Map)

Table F.1: Scores for Paths.

ALL	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10
ID1(ST)	2	0	0	0	0	0	0	0	0	2
ID2(ST)	0	0	0	0	0	0	0	0	0	2
ID3(ST)	3	1	2	1	0	0	0	0	0	3
ID4(ST)	2	3	3	3	0	0	0	0	3	3
ID5(ST)	3	2	0	0	2	0	0	0	0	2
ID6(ST)	2	0	2	0	0	0	0	0	0	2
ID7(ST)	3	0	0	1	0	0	0	0	0	3
ID8(ST)	3	3	0	1	0	2	0	0	0	2
ID9(ST)	3	0	3	0	0	0	0	0	0	0
ID10(ST)	3	1	2	0	0	0	0	0	2	3
ID11(TR)	1	0	0	0	0	0	0	0	0	1
ID12(TR)	0	0	0	0	0	0	0	0	0	0
ID13(TR)	1	1	0	2	0	1	0	0	0	1
ID14(TR)	1	0	0	0	0	0	0	0	0	0
1D15 (TR)	3	0	0	3	3	3	3	0	0	3
1D16(TR)	0	0	0	0	0	0	0	0	0	3
1D17(TR)	2	0	0	0	0	0	0	0	0	1
1D18(TR)	0	0	0	0	0	0	0	0	0	3
1D19(TR)	0	0	0	0	0	0	0	0	0	0
1D20(TR)	0	0	0	0	0	0	0	0	0	0
sum	32	11	12	11	5	6	3	0	5	34

Note: ST: Student; TR: Tradesmen; SP: Score of path drawing in the sketch maps.

SP11	SP12	SP13	SP14	SP15	SP16	SP17	SP18	SP19	SP20
0	0	0	0	0	0	0	0	0	0
2	0	3	0	0	0	0	0	0	0
1	0	2	1	0	0	0	0	0	3
3	1	3	3	3	3	0	0	0	0
0	2	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0
3	0	2	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
0	2	3	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	3	3	0	0	0	0	0	0	0
0	3	3	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
14	13	20	4	3	3	3	0	0	3

SP21	SP22	SP23	SP24	SP25	SP26	SP27	SP28	SP29	SP30
0	0	0	0	0	0	0	0	0	0
0	0	3	0	0	0	0	0	0	3
0	0	2	0	3	0	0	0	0	3
0	0	1	0	3	2	2	2	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	2	0	0	0	0	0
0	0	0	0	1	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	3
0	0	2	0	3	0	0	0	0	0
0	0	0	0	3	0	0	0	0	3
0	3	0	0	3	3	0	3	3	3
0	0	0	0	0	0	0	0	0	0
0	3	8	2	18	5	2	5	3	24

Note: SP: score of path.

SP31	SP32	SP33	SP34	SP35	SP36	SP37	SP38	SP39	SP40
1	0	0	0	0	2	0	0	0	0
3	0	0	0	0	2	0	0	0	0
0	3	3	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	1	3	0	0	0	0	0
0	0	0	0	0	2	0	0	0	0
0	0	0	0	0	3	0	0	0	2
0	0	0	0	0	2	3	1	2	0
0	0	0	0	0	0	0	0	0	2
2	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	2	0	0	0	0	0	0	0	0
0	0	0	0	3	0	0	0	0	0
0	0	0	0	3	0	0	0	0	0
0	0	0	0	0	3	0	0	0	3
0	0	0	0	0	0	0	0	0	0
0	0	0	0	3	1	0	0	0	0
0	0	0	0	0	2	0	0	0	0
3	3	3	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	1
9	8	6	1	12	20	3	1	2	8

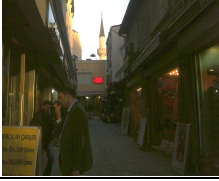
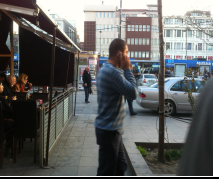
Note: SP: score of path.

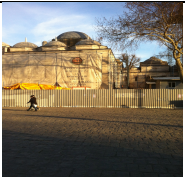
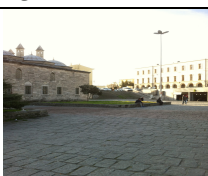
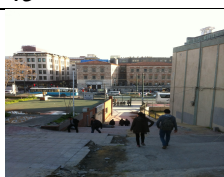
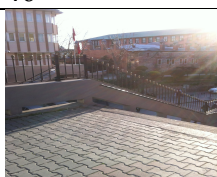
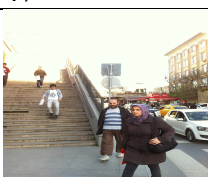
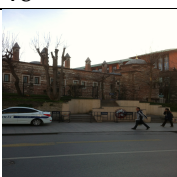
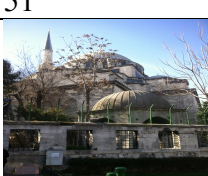
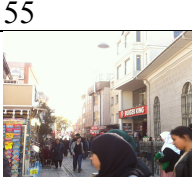
SP41	SP42	SP43	SP44	SP45	SP46	SP47	SP48	SP49	SP50	TS	P
0	0	0	0	0	0	0	0	0	0	7	4.66
0	0	0	0	0	0	0	0	0	0	18	12
0	0	0	0	0	0	0	0	0	0	31	20.66
0	0	0	0	0	0	0	0	0	0	43	28.66
0	0	0	0	0	0	0	0	0	0	16	10.66
0	0	0	0	0	0	0	0	0	0	8	5.33
0	0	0	0	0	0	0	0	0	0	19	12.66
0	0	0	0	0	0	0	0	0	0	23	15.33
3	3	0	0	0	0	0	0	0	0	14	9.33
0	0	0	0	0	0	0	0	0	0	20	13.33
0	0	0	0	1	0	0	0	0	0	4	2.66
0	0	0	0	0	1	1	0	0	0	5	3.33
0	0	0	0	0	1	0	0	0	0	13	8.66
0	0	0	0	0	0	0	0	0	0	6	4
0	0	0	0	0	0	0	0	0	0	29	19.33
0	0	2	3	0	0	0	0	0	0	16	10.66
0	0	0	0	0	0	0	0	0	0	13	8.66
0	0	3	0	1	0	0	0	0	0	21	14
0	3	0	0	3	0	0	2	2	2	46	30.6
0	0	0	0	1	0	0	0	0	0	2	1.3
3	6	5	3	6	2	1	2	2	2	354	Av: 11.79

Note: SP: score of path; TS: total score of path drawing by ID---; P: percent; Av: average percent.

APPENDIX G

Table G.1: Number of photos.

1	2	3	4
			
5	6	7	8
			
9	10	11	12
			
13	14	15	16
			
17	18	19	20
			
21	22	23	24
			

25	26	27	28
			
29	30	31	32
			
33	34	35	36
			
37	38	39	40
			
41	42	43	44
			
45	46	47	48
			
49	50	51	52
			
53	54	55	56
			

57	58	59	60
			
61	62	63	64
			
65	66	67	68
			

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