SPATIAL COGNITION THROUGH A NONVISUAL EXPERIENCE

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ABSTRACT

The notion examining the interaction between the individual and the physical setting is the concept of perception, which is evaluated by Hall (1966) as the main competence that living organisms possess for survival. In this manner, perceptual product can be defined as the result of perceptual processes through which the stimuli from the environment are converted into cognitive data by the receptor cells of sense organs - mainly the eye. According to Pallasmaa (2005), the eye became the centre of the perceptual world through the invention of perspectival representation, which turned into a symbolic form both describing and conditioning perception.

Also, such concepts as Merleau-Ponty's (2005) bodily experience, a classification of perceptual modalities, have been partly replaced by more holistic approaches, considering the experience as the most essential factor of the physical setting which is defined as the collection of cognitive data of individuals formed by various information processing circumstances (Downs and Stea, 2011).

Cognitive mapping is the process of a mental representation which people acquire, code, store, recall and decode information about the relative location and attributes of the physical setting (Downs and Stea 2011). This imaged information includes impressions about structure or appearance of a place, its relative location, its use and its values. On the other hand, a specific place's structure, value and relative relations can be analysed in a more analytical way. Space syntax is a method for describing and analysing the relationships between spaces and a set of techniques for the representation, quantification, and interpretation of spatial relations in buildings and settlements. Contributing to this debate, this paper explores the cognitive data generated by sighted people in a non-visual bodily experience, as they are guided through "Dialogue in the Dark", a thematic environment consisting of completely dark rooms equipped with scent, sound, wind and tactile simulations of a specific urban setting and syntactic relations of that space.

In this regard, a two-step methodology is applied: the first step comprises cognitive data from the cognitive maps drawn by participants just after their experience, while the second one comprises existing spatial data revealed by syntactic analyses. Finally, the correlation between the cognitive frequencies of the experienced nodes in each cognitive map and the syntactic values of the setting are statistically analysed.

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Statistical outcomes show that without vision, no correlation is found between the syntactic values and the frequency of spaces but, auditive and tactile characteristics of the spaces are significantly correlated with the frequencies of the spaces.

In conclusion, the results show that spatial cognition without vision is mainly dependent on bodily experience of the self which is stimulated mostly by auditive and tactile senses, and also that the effect of the syntactic characteristics of the space derived from visual parameters loosens the ties with the notion of spatial cognition.

Keywords: Cognitive map, Space Syntax, Spatial Cognition, Spatial Experience

1. INTRODUCTION

Lawson (2007), in his influential book 'The Language of Space', emphasizes that space is such a phenomenon wrapping or surrounding all over us so that it is an inseparable matter of fact influencing how we feel, what we do and whom we interact with. Space is more than its physical borders and has a significant force on the balance of both our physical and psychological characteristics. Kitchin (1997) argues that a fundamental need is the need to know about this space, or in other words, the world around us. To achieve this, an organized approach is needed depending on the restrictions of time and space over human experience. As a result, an overall conception of the environment that defines the sense of place and human spatial behaviour is structured in the human mind (Kaplan, 1973).

These internal spatial constructs are investigated under the concept of "cognitive map" in many related theoretical disciplines. Cognitive mapping relates not only how we perceive, store and recall information about the spatial environment but also how we think and feel about the geographic environment (Jacobson, 1998), and it is essential for survival of the human kind (Kaplan, 1973). But what happens if one perceptual modality (i.e. vision) is missing, what (if any) effect does this on our cognitive knowledge of the space?

In this paper, cognitive maps are handled in the context of environment and behaviour theories which can be defined as an internal model of the world which we live in its broadest sense (Golledge & Stimpson, 1997), and it is aimed to investigate the structuring of cognitive maps, through the experience of a specially designed non-visual environment. In this context, a bipartite methodology is evaluated to obtain a comparative study between the cognitive and spatial data of the selected environment. The theoretical background is designed over the concepts of environmental perception through senses and the structure of cognitive maps. Additionally, the method used to analyse the syntactic characteristics of cognitive maps and the space syntax theory is presented through previous studies in relation to cognitive maps. Following the theoretical background, case study environment, methodology of the study and the results are presented. In conclusion the statistical outcomes are evaluated in regard to the theoretical background.

2. GRASPING THE ENVIRONMENT IN MIND AS SEEN OR NOT SEEN

2.1. Experience through the senses

Space is such a phenomenon wrapping or surrounding all over us so that it is an inseparable matter of fact influencing how we feel, what we do and whom we interact with. Thus space has a significant force on the balance of both our physical and psychological characteristics (Lawson, 2007). In this section, the human interaction with space is presented briefly through

the perceptual modalities (vision, tactile, auditory and olfactory) that participate in the experience of space.

In many perceptual and cognitive studies, the significance of the visual perception modalities is emphasized depending on the fact that we are able to collect a significant amount of data with our eyes compared to the other senses. According to Pallasmaa (2005) the perception of sight is well grounded in physiological, perceptual and psychological facts as our most important sense; and the eye became the centre of the perceptual world through the invention of perspectival representation. Vision is often quoted as the spatial sense par excellence (Foulke, 1983). According to Ünlü (1998) sight is not only a kind of pictorial issue but rather consisting of an activity and investigation of the notions behind what is seen in the environment. A visually grasped object is consolidated and integrated with other visually seen parameters in the setting and it cannot be separated from that context afterwards.

Vision provides instant perception of a large spatial field in a glimpse; even our ability to see our environment is quite limited by anatomic characteristics of the eye itself. But still other objects are in our peripheral vision as our attention wanders round on a particular scene (Ungar, 2000). More than the half of the nerve fibres entering the individual's nervous system are originated from the eye and this causes the visual sensation to dominate our environmental perception compared to our other sensual potentials (Lawson, 2007). In addition to that, visual information is coded primarily in the human memory through the Visual Sketchpad of the Working Memory (Goldstein, 2011).

In this manner, Lawson (2007) argues that the environment around us and the daily living customs are chiefly established depending on this kind of visual interaction of the individuals with the environment. For that reason, auditory, olfactory, tactile, features of the space are commonly overlooked by both the designers and the occupants of that space.

Auditory characteristics are inseparable parts of an environment that are coded primarily with the Phonological Loop in the Working Memory (Goldstein, 2011). On the other hand, they are not attached to specific settings, limited to that settings borders and could reach out of that borders. They define an environment's use and representation in one's memory. For instance; silent places impose people to be more aware of natural characteristics of the environment such as wind and the sound of water, noisy places can be distractive.

Olfactory variables of the environment also have an identical role to feel places and creating dramatic memories. The activity of smell enriches the sense of feeling and attributes the experienced environment a unique identity in the individual's memory. Therefore, olfaction helps individuals to identify and recall some places; for instance, marine products that are stored, cooked and sold in port cities make these places have a distinctive identity and an exclusive atmosphere.

Tactile characteristics of the objects, texture in other words, offer another mode of experiencing of an object or environment which can be grasped through the act of touch. Touching is an integrated experience through our feet and hands so that we can understand the material of the items in the environment through the sensation of their harshness or softness (Ünlü, 1998). Sensation of tactile variables of the environment could also be evaluated as an integrated manner of activating other senses through a kinaesthetic manner. Kinaesthetic is a cumulative notion of sensing and perceiving the environment including bodily movement, posture and position of the body. Kinaesthetic experience of the individual could be increased with the help of perceptual modes arisen from the environment such as light, smell and heat differences (Ünlü, 1998). Through such an ecologic approach, a setting is appraised as an inseparable part of the kinaesthetic features of the setting.

Based on the debate above it could intensely be argued that perception is not only the interaction between the eye and brain. On the contrary, perceptual process is such a dynamic involvement of the being with its setting relied on sensual data triggered by the stimulation arisen from the environment. So, perception is actually more than sensual storage; a peculiar and unique kind of experience of the individual through one's body that exceed the sensual processes.

On the other hand, this study's approach is built only on the behalf of sighted people who recognize their environment mostly by their visual senses. It is quite argumentative how a sighted person's experience of a non-visual environment will come out. How will a participant perceive the environment? Will the participant switch to other modalities of senses easily or not? How will the participants construct their spatial schemata without the visual perception and how will they represent it through their cognitive maps?

What happens in the absence of one the senses is a conspicuous question, and in the scope of this paper the absence of vision is questioned depending on its significance among the senses and its strong relationship with the spatial experience and cognition.

2.2. Development and Representation of Spatial Cognition

Cognitive maps are used as successful tools by researchers who try to find accurate answers to questions as follows: How do people perceive and construct the images of some specific settings in their schemata? Are some settings more memorable than others? Which characteristics of the settings impose people to be remembered more?

Downs and Stea (2011; p.312) make a clear definition on structuring cognitive maps as "a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls and decodes information about the relative locations and attributes of phenomena in his everyday spatial environment." In this process, there two ways to acquire environmental knowledge: sensory modalities and direct and vicarious sources of information. During their direct experience, individuals perceive the world by collecting sensational input through their sensual contact with objects in the environment; or in other words through touching, tasting, smelling, hearing and seeing the world. Through this interaction, although the visual information is accepted to be dominant, the sensorial data obtained with all the modalities (visual, tactile, olfactory and kinaesthetic) brought together by the imaginative nature of the process and converted into cognitive data and form an individual's cognitive map (Jacobson, 1998; Downs and Stea, 2011).

Cognitive maps are not necessarily analogous to a cartographic map but they share the same function with a cartographic map as representing various environmental properties such as direction and relative distance (Downs & Stea, 2011). They have a network like structure mainly built up through topological relations of environmental attributes, regardless of their exact size, scale or real shape (Kuipers, 1978; Zimring and Dalton, 2003; Penn, 2003).

Lynch (1960) adds the visual characteristics of the environment to the cognitive map concept with his definition of "imagebility". He established five image parameters such as paths, edges, districts, nodes and landmarks and put forward that every city has a sort of common but still unique imageability which can be defined with these parameters. In this manner, while some cities stick in one's mind through such a river separating a city into two, some cities are recalled through a branch of many paths. Some locations may have a significant landmark such as a mosque that influences the configuration of a city; some others may be constituted of different zones or districts. According to Lynch (1960), a legible and integrated environment carries such an essential meaning for the individual, helps individuals to feel secure and to make contact through a harmonious relationship with each other. So, a setting configured

successful in terms of imageability is also defined and configured successfully in ones' cognitive map with strong meaning and implications.

It is important to lay emphasis on the fact that all of the debate mentioned above is based on the regular people who have no mental or physical disabilities. However, to meet the aim of this paper the cognitive mapping process and representations should be handled in a context in which the visual data of the environment is eliminated.

2.3. Cognitive Map Studies in Relation to Space Syntax Analyses

Space syntax is a theoretical method which investigates the morphological characteristics and associations of how various portions of environment are shaped, perceived, understood by people and how these built environments become the parts of the society. This theory has the potential to provide the descriptions and values of spatial configuration of a specific environment (Long et. al., 2007) through graphical representations. Apart from the diagrammatic representations, space syntax offers various quantitative measurements of integration, connectivity, and intelligibility of spatial settings. Among these concepts, integration is the main concept in the theory of space syntax displaying the relational properties of the spatial units in a certain layout -in terms of shallowness and depth. Through the representation of the degrees of integration the spatial layout and the probable movement patterns of its users are related. This makes possible to interpret the social pattern of a particular layout – how people move, act, keep their personal space and privacy.

On the other hand, connectivity is another important concept in space syntax displaying the direct connectedness between spaces within a certain layout. It represents and calculates the number of direct connections from one space to the other spaces in a spatial system. The connectivity and integration values can be used as an indicator of how intelligible the entire environment (Bafna, 2003).

In many interdisciplinary studies space syntax is used as a methodology together with cognitive maps. For instance, Zheng and Weimin (2010) digitize the cognitive maps through syntactic measures and correlate them with the syntactic values of the real map. Also Tuncer (2007) analysed and compared the cognitive maps derived from participants and the map of the real environment through their syntactic values. Tarçın Turgay et. al., (2015) analysed the relationship between the frequencies of spatial units in cognitive maps and the syntactic values of that units in an existing environment. All of that studies found out there are strong relationships between the real environments and the cognitive maps that represent them.

3. CASE STUDY ENVIRONMENT

In a non-visual environment other sensual modalities gain significance through perception in which "At every instant, there is more than the eye can see, more than the ear can hear, a setting or a view waiting to be explored (...)" (Lynch, 1960, p.2) In this study, it is aimed to investigate the structuring of internal spatial schemes, the cognitive maps, through the experience of a specially designed non-visual environment. Dialogue in the Dark Exhibition in İstanbul is selected as the case study environment. In this worldwide exhibition, visitors are led by blind guides through a specifically constructed and completely darkened space. Conveying the characteristics of a familiar environment such as a park, a street or a bar, a daily routine of the city (in this case İstanbul) turns into a new experience. Approximately 1600 square meter area has been designed as an impression of İstanbul, and the experience through the environment lasts for 90 minutes with max 10 people in one group. A reversal of roles is

created as sighted people are torn from the familiar, losing the sense they rely on most – their sight. The blind guides direct and support the visitors during the tour, providing security while transmitting a world without vision. There are 16 spaces inside the exhibition. The tour guide selects one of the three spaces, the boat, the airplane and football field, in each tour independently. As a result every individual experiences 14 spaces in a single tour.

In this context, this selected environment offers a laboratory like space that provides auditive, tactile, and olfactory characteristics of the daily life in İstanbul, with the sounds of traffic, seagulls, ferries, tram, window shutters, even the wind on the ferry or tactile characteristics of a bus (Figure 1). This unique experience filtered from its visual properties is an opportunity to explore the non-visual perception modalities' role in the cognitive mapping process and to question how a cognitive map is structured when the visual data is eliminated from an experience.
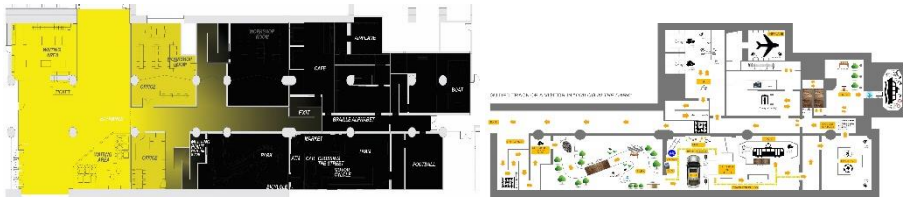
Figure 1. The graphic representation the light distribution dark environment; the graphic representation of the thematic spaces in the environment

4. METHODOLOGY

The methodology has a bipartite framework, one for the cognitive data of the participants and one focusing on the syntactic data of the environment. To obtain the most qualified data from cognitive map drawings, participants are chosen from adult architects depending on their ability for spatial representation. Participants are reached via e-mail, informed about the main structure, aim and methodology of the study and invited to participate a session programmed by the authors. There are 25 participants who attended voluntarily to the study, 7 males, 18 females, aged between 24 and 45. In order to collect the cognitive data, the participants are requested to draw a map of the tour track. After their 90-minute of experience in Dialog in the Dark, all of the participants are directed to the tables reserved for the drawing session. The drawing papers are collected when 20 minutes is completed.

Two types of cognitive data are evaluated from the maps:

1. *The frequency of the spaces in cognitive maps* is measured by ranking the appearance of them on a two sided scale as drawn or not drawn.

2. *The frequency of sensual expressions in cognitive maps* is measured by content analysis. The written expressions are classified into categories as auditory, olfactory, tactile, gustative and they are counted in the context of each space. For instance, regarding the park zone, the smell of basil refers to an olfactory; sound of birds, water and bell refer to auditory; and texture of wooden bench, bridge, pebbles and fences refer to the tactile categories.

Two types of syntactic data, *the integration value of the spaces* and *the connectivity value of the spaces* are obtained from a graph produced by using Syntax 2D software (developed by University of Michigan). These numerical values of each space are obtained from the grids where the group is stopped by the blind tour guide in order to help the discovery of that thematic spatial zone.

Each of the cognitive data is evaluated (1) independently and (2) in relation to the syntactic data. The association between the cognitive data and syntactic data is searched statistically through simple regression analyses.

5. RESULTS AND DISCUSSION

The frequencies of spaces in cognitive maps are shown in the figure below (Figure 2). This graphic represents the distribution of the frequencies of spaces in cognitive maps, and it shows that Entrance, Park, Tram, Boat/Airplane/Football, Braille Alphabet, Café and Exit are the most represented spaces in cognitive maps. These spaces are the first, third and the last five spaces along the route which defines the beginning and end of the tour. In addition, they are the focal points of the tour where the guide slows down, take a break, talk to the participants and guide them to enrich their experience of an urban space (park), a setting (cafe or football field), a vehicle (boat or airplane) or the experience of just being blind. The participants mostly did not draw the spaces at the middle of the route, indicating that they have forgotten those spaces that link the entire tour. On the other hand participants' drawings represent kinds of spatial routes that are enriched by sensual expressions rather than actual pathways; which also exist in the cognitive map theories (Kitchin, 1997). There were not any correct distance estimations as the length of each route (node) but the relations between the routes (nodes) are usually correlated with the exhibition route. The beginning space and the last spaces of that route are the most represented spaces in the drawings indicating that the relative locations on the exhibition route is a factor on the cognitive mapping process while their actual relative locations are not.
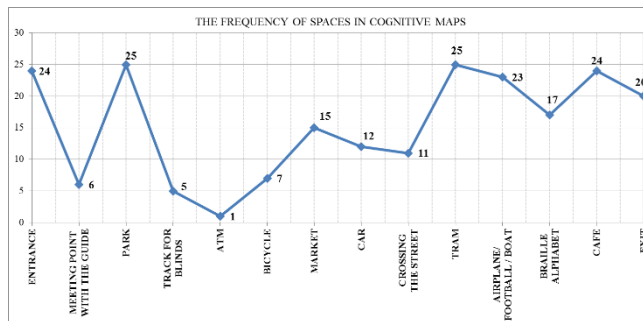

Figure 2. The frequency of the spaces in cognitive maps per thematic spatial zone

The distribution of *the frequency of sensual expressions in cognitive maps* is shown per space in Figure 3. The graphics clearly show that Entrance, Park, Market, Tram, Boat/Airplane/Football, and Café are the spaces that are defined with more number of sensual expressions in cognitive maps. Market and Braille Alphabet also defined with sensual expressions at the middle level. Among the sensual expressions participants mostly define tactile, auditory and olfactory senses. Gustative expressions were expected from the café zone, but still no gustative record is represented in the cognitive maps and it is eliminated from the statistical analyses.

Considering the frequencies of spaces and sensual data in cognitive maps, it can be stated that besides the entrance and the exit of the exhibit, several different characteristics of the

environment and emotional notes are observed. For instance, Park appears as the first significant zone in the dark route, where the sounds and patterns are first emerged in cognitive maps. After park, the experience of getting on a tram in Istiklal Street and getting on a boat are emerged as the other focal points in cognitive maps where emotional and sensual expressions such as sounds of the city, feeling the breeze of wind, sounds of seagulls and motion of the sea are written. These representations can be discussed as the effect of participants' previous experiences of Istanbul and that without vision the characteristics of an iconic city image may have emerged through the other senses. Another significantly mentioned space in maps is the café zone where people sit and chat with the guide in the dark about their experience of darkness and how they have felt about the obstacles and disadvantages they faced in such a dark urban realm which they also are accustomed to live as a daily routine in Istanbul.
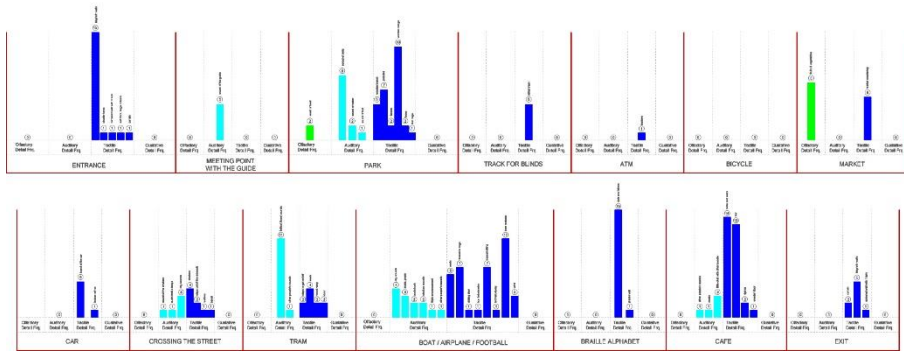
Figure 3. The frequencies of sensual expressions in cognitive maps per thematic spatial zone

The integration diagram of the exhibition layout presents the areas that have the highest degree of integration with warm (red) colours and the areas that have the lowest degree of integration with cold (blue) colours (Figure 4). In the connectivity diagram the areas that have medium connectivity is shown with green colour and the areas that have the lowest connectivity (only one connection to another spatial zone) is shown with dark blue colour (Figure 4). The scarcity of red areas in both the diagrams indicate that the thematic spaces are only related to one or two other spaces and the layout is not designed to be an integrated space.
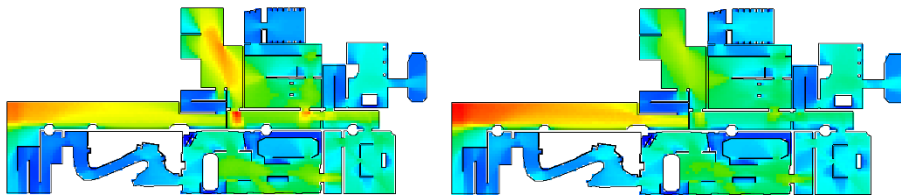
Figure 4. Integration (a) and Connectivity (b) diagrams of the setting

The correlation tests between *the frequency of the spaces* and the *integration* and *connectivity values* of that spaces show no significant relation (Table 1). On the other hand, the correlation tests between *the frequency of the spaces* and *the frequency of sensual expressions* of that

spaces show that the tactile (0.807) and auditive (0.558) senses have a significant relationship with the frequency of the spaces in the cognitive maps (Table 2). The olfactory sense does not show a significant correlation but present a value close to the significance level of 0,05. The gustative sense is not included in the statistical tests.

Depending on these results, it could be stated that;

▪ Neither the integration nor the connectivity values of the spaces are effective on the appearance of those spaces in cognitive maps. The insignificant correlations show that the morphological, in other words syntactic characteristics of the layout were not adequate to create a memorable impact in participants' minds. On the other hand, the exhibition route defined by the guide is represented in cognitive maps both with its path like structure and the order of the spaces on that path.

Compared to the olfactory data of the spatial zones, the auditory and tactile characteristics of the zones have created an intensely significant impact on cognitive maps. This result shows that without the sense of vision, the individuals desperately lean on the auditory and tactile features of space. Besides, the highly significant correlation of the tactile sense indicates that participants had chosen to use their hands and skin to perceive the closest things in the environment, instead of defining the farther things with olfaction or audition.

Table 1. Table showing the correlations between the frequency of the spaces in cognitive maps and syntactic values of the spaces

	r^2	p	Significance
Cognitive frequency of the spatial zone; **integration** value	0,056	0,837 > 0,05	Not Significant
Cognitive frequency of the spatial zone; **connectivity** value	-0,005	0,986 > 0,05	Not Significant

Table 2. Table showing the correlations between the frequencies of the spaces in cognitive maps frequency of sensual expressions

	r^2	p	Significance
Cognitive frequency of the spatial zone; **olfactory data** frequency in cognitive maps	0,115	0,670 > 0,05	Not Significant
Cognitive frequency of the spatial zone; **auditory data** frequency in cognitive maps	**0,558**	**0,025 < 0,05**	**Significant**
Cognitive frequency of the spatial zone; **tactile data** frequency in cognitive maps	**0,807**	**0,000 < 0,05**	**Significant**

6. CONCLUSION

The experience in the Dialogue in the Dark shakes all the sensual realities of the individual since the sighted people are usually accustomed to unite their sensual perceptual data mainly by their visual sense; the eye. However, through this thematic experience, a common feedback is obtained from the participants that they had felt that vision does not allow their other senses to grasp the reality of the daily life. In this absolute darkness, sound becomes the guide to follow, texture becomes the guide to feel the objects, and smell and taste becomes the guide to reach a more holistic perception of the environment. The awareness of the non-visual (or in other words, secondary) sensual modalities is raised and a slightly different cognitive mapping style is developed by the participants. The prominent senses appeared in the cognitive maps show that the individuals may not leave their regular perceptual practice and have tried to

define some sensual borders during their non-visual experience. After all, this totally dark environment has been transferred to the cognitive map with its non-visual attributes like the floor material walked over, walls touched, heard information from other participants and the basic relations between all these components.

It could also be stated that, the non-visual characteristics of this thematic urban space became the essential domains of the cognitive maps and they are mostly defined by the tactile, auditive and olfactory senses of the participants. Consequently, at the end of this non-visual experience, the relations between the borderless spaces, their perceived components and representable attributes come to the forth and able to form a holistic cognitive map which defines a conception/or an understanding of a specific city like environment.

In conclusion, Space Syntax theory gives us the measurements of syntactic relations in a layout and in many previous studies these measurements were found correlative with the representation of that layout in cognitive maps. However, in this study the syntactic measurements of a layout do not show any correlation with the representation of that layout. This presents that when visual perception is eliminated from the experience, some syntactic characteristics of an environment may loosen their ties with spatial cognition, and depending on the unique characteristics of the experience, they leave their place to other kinds of information gained from other senses. And it is also important to note that the memory of a city -even a simulated thematic one in our case, integrates mostly with its sensual characteristics instead of the actual physical boundaries.

REFERENCES

-Bafna, S. 2003. Space syntax: A brief introduction to its logic and analytical techniques. Environment and Behavior 35.1: 17-29.

-Downs, R. M. and Stea, D. 2011. 'Cognitive maps and spatial behavior: Process and products'. In: Dodge, M., Rob Kitchin, R. and Perkins C. (eds.), The Map Reader: Theories of Mapping Practice and Cartographic Representation, London: John Wiley & Sons, pp. 312-317.

-Foulke, E. 1983. Perception cognition and the mobility of blind pedestrians. In M. Potegal, (Ed.), Spatial abilities: development and physiological foundations New York: Academic Press. pp.55-76.

-Goldstein, B. 2011. Cognitive Psychology: Connecting Mind, Research and Everyday Experience (Bilişsel Psikoloji transl. by Gündüz, O. in 2013), İstanbul: Kaknüs Yayınları.

-Golledge, R. G. & Stimpson, R. J. 1997. Spatial Behaviour: A geographic perspective. New York: The Guilford Press.

-Hall, E. 1966. The Hidden Dimension Doubleday & Company, Inc. Garden City, Ney.

-Jacobson, R. D. 1998. Cognitive mapping without sight: Four preliminary studies of spatial learning. Journal of Environmental Psychology, 18(3), 289-305.

-Kaplan, S., 1973, 'Cognitive maps, human needs and the designed environment'. In: W. F. E. Preiser (eds.), Environmental design research. Stroudsburg, PA: Dowden, Hutchinson and Ross. pp. 275-283.

-Kitchin, R.M., Blades, M. and Golledge. R.G. 1997 "Understanding spatial concepts at the geographic scale without the use of vision." Progress in Human Geography 21.2: 225-242.

-Klatzky, R.L., Golledge, R.G., Loomis, J.M., Cicinelli, J.G. and Pellegrino, J.W. 1995 Performance of blind and sighted persons on spatial tasks. Journal of Visual Impairment and Blindness, 89, 70-82.

-Kuipers, B., 1978. Modelling Spatial Knowledge, Cognitive Science, 2, pp.129.153.

-Lawson, B., 2001. Language of Space, Architectural Press, Oxford.

-Lynch, K, 1960. The Image of the City, MIT Press: Cambridge.

-Long, Y., Baran, P. K., Moore, R. 2007, 'The Role of Space Syntax in Spatial Cognition: evidence from urban China', in Kubat A. S., Güney Y.İ. , Ertekin Ö., (eds) in the Proceedings of the Sixth International Space Syntax Symposium, Istanbul: ITU Faculty of Architecture, p.129.01-129.06.

-Merleau-Ponty, M. 2005. Algılanan Dünya, Çev. Ömer Aygün, İstanbul: Metis.

-Ungar, S. 2000. Cognitive mapping without visual experience. In Kitchin, R. & Freundschuh, S. (eds) Cognitive Mapping: Past Present and Future. London: Routledge.

-Unlu. A., 1998. Çevresel Tasarımda İlk Kavramlar, İTÜ Mimarlık Fakültesi Baskı Atölyesi, İstanbul.

-Pallasmaa, J., 2005. The Eyes of The Skin, Architecture and the senses, John Wiley and Sons Ltd. UK.

-Passini, R., Proulx, G. 1988. Wayfinding without vision an experiment with congenitally totally blind people. Environment and Behavior, 20(2), 227-252.

-Penn, A. 2003. 'Space Syntax and Spatial Cognition or Why the axial line?'. In Environment and Behavior, Vol. 35 (1), pp.30-65.

-Tuncer, E. 2007. Perception and Intelligibility in the Context of Spatial Syntax and Spatial Cognition, in Kubat A. S. et al (eds) in the Proceedings, 6th International Space Syntax Symposium, İstanbul.

-Tarçın Turgay, Z., Çanakçıoğlu, N.G and Sarıberberoğlu. M.T. 2015. How does a child act in a theme park?. in Karimi K. (eds) in the 10th International Space Syntax Symposium, London.

-Zheng, L. & Weimin. G., 2010. A spatial cognition investigation by using the integrated methodology combined with cognitive map and space syntax. Computer Science and Education (ICCSE), 5th International Conference on. IEEE.

-Zimring, C., & Dalton.C.R., 2003. "Linking objective measures of space to cognition and action." Environment and Behavior 35.1: 3-16.