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Can cognitive maps of children be analysed by space syntax?

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Abstract

According to environment and behavior theories, individuals in their first years of cognitive development enter a world full of environmental stimuli motivating them to perceive and learn. As a result of many perceptual processes, people convert and transfer perceptual information to their cognitive schemata. The prominent researcher Piaget (1955), who analyzed the perceptual processes of children through cognitive development stages based on age, mainly studied the way that a child perceives the environment within a constructive approach. One of the methods of revealing constructed and stored data in the memory is through the analysis of cognitive maps that children have drawn as they each uniquely perceive the environment and construct specific cognitive schema.

Additionally, Lynch (1960) contributes to the theory of perception with the idea that if an urban part has a strong *imageable* character in terms of *paths, edges, districts, nodes* and *landmarks*, one can orient oneself easily when influenced by the synthesis of perceptual processes. Some other scholars have also been investigating how cognitive maps can be analyzed within the theory of space syntax (Zheng & Weimin, 2010; Zimring & Dalton, 2003; Haq & Girotto, 2003; Kim & Penn, 2004).

In this sense, this article aims to contribute to both the methodology through the analysis of cognitive maps by using *justified permeability graphs* within the theory of space syntax and to the understanding of how the perception of children differs depending on gender and socioeconomic status. This includes a case study of children aged 11 who have drawn their home and nearby surroundings as part of Çanakçıoğlu's research (2011).

Keywords
Children's cognition, Cognitive maps, Environmental perception, Space syntax.

1. Introduction

Children learn their environments through their actions in physical settings and several schemata that they develop through their reciprocal relationship with physical environmental stimuli. What is learned by this motor-sensory correspondence is reflected in certain kinds of behaviour in children. This interactive process depends on both the developmental stage of the child and the characteristics of the physical environment. J. J. Gibson, who tackles environment and behaviour theories through an ecological approach, stresses the importance of individual movement in the extraction of environmental knowledge and defines this process as a *perceptual system* in which the senses, behaviour of the perceiver and the physical environment are inseparable parameters (Wohlwill and Heft, 1987).

2. The development of perceptual process in children

The reciprocal relationship between the physical setting and children, in the scope of developmental psychology, is studied by Jean Piaget (1955), who made great research contributions to how cognitive development is developed in children through a constructive approach. He argues that the cognitive development of children involves conditioning their behaviour by intuitions when they first meet the world; eventually as they grow up through ongoing experiences; they develop organized patterns of behaviours dependent on certain schemata. He argues that these organized patterns of behaviour eventually integrate children with the ongoing life around them and impact how they think through in a more questionable manner gradually depending on their age.

Piaget classifies the perceptual system dependent on the cognitive development of children in four different stages depending on age (Cüceloğlu, 2009): (1) *Sensorimotor Stage* (0-2 years) in which children interact with the outside world with their intuitions and senses (Wilson, 1995); (2) *Preoperational Stage* (2-7 year-olds) through which children, behaving in an egocentric manner, start to represent the objects and occasions with symbols and words and classify the objects in groups (Hart and Moore, 1973); (3) *Concrete Operational Stage* (7-12 year-olds) at which children form the ability to turn intuitions into operations, and can add, subtract, classify and put objects in order depending on their personal experiences; start to understand and feel empathy for others' thoughts; and show a more adaptive behaviour to their environment (Piaget and Inhelder, 1967); (4) *Formal Operational Stage* (12+ year-olds), which is defined as the completion of the constructive approach of cognitive development, when children develop such a systematic attitude that they can use cognitive operations to tackle problems so that they can use conceptions and symbols without residing in concrete issues (Hart and Moore, 1973).

So, it can be summarized that while senses and intuitions are dominant in a child's life in the first two stages, through interaction and stimuli caused by the environment, the child shows the ability to think and question the issues in the last two stages of their cognitive development (Cüceloğlu, 2009).

2.1. Development of spatial perception in children

According to Piaget and Inhelder (1967), the children define their positions in space depending on cues in the environment and later build relationships and paths between these cues. Piaget defines spatial representation in a child's cognition as the reflection of environmental behaviour as symbolic and internalized cognitive information.

Piaget and Inhelder reached four main findings about spatial perception: (1) children learn space through their ongoing individual activities; (2) children's cognitive representations are constructed through the imitation of adult behaviour; (3) spatial perception is accomplished through four stages, which are *sensorimotor, preoperational, concrete operational* and *formal operational* stages, as stated earlier; (4) the development of spatial relationships is completed in three consecutive phases, which are *topological, projective* and *metric* or *Euclidian spaces* (Hart and

Moore, 1973). These consecutive phases of spatial relationship are reflected in cognitive maps as follows:

Topological space

As children reach the age of 7, although they cannot measure and compare objects in an appropriate unit and scale, they intuit that significant relationships such as *proximity, separation, order, enclosure* and *seriation* exist between objects. They can represent these kinds of relations of objects by drawing the patterns or objects in certain manners such as within a row and sequence, receding or approaching each other (Piaget and Inhelder, 1967).

Projective space

Projective space parameters refer to the coordination of objects in relation to others. Objects can be observed as simple perspective expressions despite some distortions. The general coordination of perspective is set up in the drawing (Piaget and Inhelder, 1967).

Metric (Euclidian) space

Through gaining an awareness that objects retain their size relative to the distance in between them as they change locations, the child comprehends that the representation of objects varies depending on altered reference points. Thus, children can organize spatial representations within their cognitive maps with a better understanding of the rules of perspective, and can draw objects in appropriate sizes depending on their locations while accommodating a certain reference point of sight (Piaget and Inhelder, 1967).

Along with Piaget, Lynch puts forward 'image parameters' to discuss how people perceive their environment, construct and recall cognitive data and remember places through some distant characteristics.

2.2. Notion of image depending on Lynch's theory

According to Canter (1977), Lynch is the researcher who brought back the notion of *image* to the Earth by asking the question whether some cities are more *imageable* than others. He addresses this issue by revealing the link between the mind and the physical environment, and puts forward such a classification system through an extraction of his interviewees' sketch maps. He argues in his influential book *The Image of the City* that five characteristics of the *image* of the cities can be examined: *paths, edges, districts, nodes* and *landmarks.*

According to Lynch (1960), while *paths* refer to continuous axis, *edges* are defined as boundaries. Whereas *districts* have certain boundaries within their homogenous characteristics, *nodes* refer to intersection points of paths showing different modes of behaviour, and *landmarks* are distinct reference points of cities that give cues to the visitor.

Lynch's imaginative parameters can also be adapted to interior spaces. *Nodes* may represent common meeting spaces, *paths* may represent linking elements such as corridors, *edges* may represent separating elements such as walls, *districts* may represent spaces designed for different modes of behaviour and *landmarks* may represent diversely emphasized spaces or elements (Gür, 1996).

So, having introduced how children perceive their environment and in what manner spatial perception is related to individual cognitive development, the next part of the paper discusses the first setting in which children meet, perceive and construct an image of home, in terms of a *nest*, in their cognitive schemata.

2.3. Home as the first attachment place of children

The home environment is the primary setting that children recognize and get familiarized and acquainted with. Although they participate in many institutions such as daycare centres, schools and playgrounds as they grow up, home remains the primary environment and the most dominant setting that children get to know (Wohlwill and Heft, 1987).

The prominent French philosopher Gaston Bachelard (1969) discusses home through poetic language about his own experiences, and evaluates home as an existence with a wide and deep meaning. Moreover, he asserts that the *existence of a being* depends on the notion of the house so that house is not only a physical space containing a recollection of time and habits but rather a place full of memories. Bachelard says that children build up their first relationship with the rest of the world through their homes because "the house shelters daydreaming, the house protects the dreamer; the house allows one to dream in peace" (1969, p.88). Additionally, the house provides children the feeling of belonging to their families and society via a network of attachment and intimacy with others.

While children grow up and adapt to their home environment as an origin point where they feel a sense of belonging, they gradually become acquainted with their nearby settings and experience a feeling of freedom. They start to discover the nearby environment attached to their homes: the entrance, stairways, terrace, porch, garden and urban elements such as the sidewalks, playgrounds and urban context in which the house is located. Simultaneously, this process means that children start to construct cognitive maps of the imaginary characteristics of the nearby setting of their homes.

In this manner, Hart argues that the close setting of the home environment becomes the transitional space where children begin to experience the outside world. He discusses this transition as a multilateral process between the grownup, the child and the environment which should be well balanced by families in order to both give children the freedom to explore and experience but also to protect them from the risks and dangers of the environment (Chawla, 1991).

3. Cognitive maps as a tool to analyse the interaction of children in the built environment

As the vast amount of the built environment is generally designed to be appropriate for adults in terms of physical conditions, children tend to behave and become influenced in a different manner than adults. Therefore, to understand the interaction between children and the physical settings, it is necessary to develop diverse research methods to collect data through case studies that include the participation of children. According to Ziegler and Andrews (1987), there are some alternative methods to examine how the child interacts with the environment. Children can either be requested to (1) draw pictorial sketches, (2) show some objects in a representative setting, (3) locate objects on a representative model or (4) be interviewed for verbal comments.

3.1. The scope, aim and outcomes of the previous study

Since this study uses the cognitive data of a previous study, it initially gives a brief overview of previous research and outcomes for a comparison with more recent outcomes. The aim of the previous research was to investigate the factors affecting the processes of perception in children in the scope of environment and behaviour theories. The research question asks how the nearby environment with the child's home at the centre of close surroundings and cultural setting affects the spatial perception and richness of the cognitive schemata of children. The home environment is defined as the physical setting that the child first meets in terms of a *nest* that brings the feeling or sense of attachment. For the comparative study, an equal number of 11-year-old children were selected from two different physical settings with contrasting urban characteristics in Istanbul: (1) a group of children were selected from an informal housing setting, or a *gecekondu housing* structure at the outskirts of the city; (2) a group of children were selected from a gated community setting at the periphery of Istanbul.

The case study researches whether the two independent variables of *gender* and *socioeconomic status* play a role in spatial perception and cognitive maps.

In the case study of the previous research, two elementary schools were selected, one from each of the above-mentioned housing communities. Each group of children were asked to draw their home environments with their nearby settings in a 40 minute session on two different days. A total of 82 children participated in the case study, including 19 girls and 22 boys in the low socioeconomic group, and 21 girls and 20 boys in the high socioeconomic group. Consequently, 82 cognitive maps were obtained to be analysed.

The evaluation phase of the cognitive maps includes:

(1) Piaget's topological space parameters (proximity, separation, order, enclosure and seriation), *projective space parameters* (straight lines, parallel lines and perspective), *metric (Euclidian) space parameters* (conservation, block expression);

(2) Lynch's imaginative space parameters*: paths, edges, districts, nodes* and *landmarks*.

Cognitive maps were analysed with respect to both gender and socioeconomic status. It should also be stated that an equivalent methodology was implemented in the research of Ünlü and Çakır (2002), which comparatively investigates the cognitive maps of primary school children going to school by foot, school bus and other vehicles.

The research conclusions (Çanakçıoğlu, 2011) are summarized as follows:

- An analysis of the *income* variable shows that there is a significant difference between the two socioeconomic groups. This outcome may result because children from high-income groups demonstrate cognitive maps that are richer in cognitive data. This may be due to the tendency of higher income families introducing more toys to their children. These toys may then trigger age-appropriate senses and stimulations.
- A second outcome depending on the *income* variable is that the children from the high-income group living in the gated community draw maps focused more on interior spaces, which are already equipped with many belongings such as pianos, computers, vanity mirrors and guitars etc.
- The children living in the informal setting, draw maps accentuating outdoor spaces such as the grocery store, motorways, internet cafes and fruit trees etc. since they tend to spend their spare time playing outside on the streets,
- When the results are analysed in terms of *gender,* in both income groups, girls tend to draw interiors through a more comprehensive and detailed manner than the boys. This may result from the sociocultural norms of Turkish society that tends to raise girls in a comparatively more inward oriented manner than boys. Consequently, while the girls from the high-income group living in the gated community have their own rooms furnished with special possessions to keep themselves busy indoors, the girls from the low-income group living in an informal setting spend their time at home, where they do not have a separate room for themselves, and do not play outdoors as much as the boys.
- The cognitive maps show that children living in the gated community are not as aware of the physical setting of their home environments as the children living in the informal setting. The reason for such an outcome could be that although a gated community is designed with recreational facilities appropriate for children, children cannot actually use them without the guidance of an adult. Since parents do not feel it is safe enough to allow a child at this age to go to the outdoor areas even though they live in a gated community, the cognitive maps of the children from the high-income group imply that they watch their immediate neighbourhood from their windows. In contrast, the children living in worse physical housing conditions reflect their urban experiences more onto cognitive maps. Although they probably cannot find appropriate facilities designed especially for them, they discover their play materials and spaces outdoors on the sidewalks and void lands. They play with mud, pebbles and bricks, and play hopscotch on the porches of their apartments, creating their own playing scenarios.

As revealed in the previous study, the provided analyses are based on the *spatial parameters* of Jean Piaget (Piaget and Inhelder, 1967) and the *image pa-*

rameters of Kevin Lynch (1960). There is an ongoing debate on the theory of space syntax whether space syntax can be used as a research tool to analyse cognitive data. The main aim of this paper is to find out whether the comparative quantitative method of analysis of *space syntax* may be an alternative method to examine the cognitive maps of children. Next, the paper will discuss attempting to use space syntax as a research tool to analyse cognitive maps through an interdisciplinary approach.

3.2 Space syntax as a tool to analyze spatial cognition

According to the research of Zheng and Weimin (2010), there is a significant relationship between the syntactic configurations of real spaces and cognitive maps of the interviewees who participated to the study. In addition, the analyses show that despite the errors in cognitive maps drawn by the interviewees, there still is a significant consistency between the maps and the real environmental situation. So, it is possible that cognitive maps can be used as an integrated research tool in space syntax studies.

Additionally, Zheng and Weimin (2010) mention that the axial maps of spaces can also be evaluated as the simulations of cognitive data of people moving around these spaces. In the scope of their study, the researchers analyse both the values and correlations between *global integration, local integration, connectivity* and *depth values*, and figure out that cognitive map representations significantly correspond with the existing settings. Thus, it is debated through a progressive manner that cognitive maps integrated with *space syntax* can be used as a tool to analyse the association between spatial organization and spatial cognition.

Moreover, Zimring and Dalton (2003) embrace the research area of space syntax and cognition through a collaborative manner. This contributes to (1) the understanding of the relationship between the physical characteristics of environment and cognitive representations, (2) reveals how physical space is related with behaviour and (3) offers an innovative methodology to analyse the existing spatial structures. In addition, Haq and Girotto (2003) in their study of two hospital settings contribute to this interdisciplinary research area using *intelligibility* as a measure to analyse cognitive maps, search for a way to analyse the idea of movement and offer a complementary grounded theory.

Additionally, Kim and Penn (2004) seek to make research on space syntax interdisciplinary, and try to handle the issue through an integrated manner to reveal the relationship between the outcomes of human behaviour in the physical environment and spatial cognition. According to their survey comparing the sketch maps of residents with the existing layouts in a neighbourhood in London, they find that *local integration* degrees in cognitive maps are especially linked to the syntactic data of the actual environment.

3.3. Space syntax as an alternative methodology to analyse children's cognitive maps

Within the framework stated above, this study aims to:

1.search for a supplementary or alternative research tool to analyse cognitive maps of children

2.contribute to the methodology of analysing cognitive maps of individuals through the quantitative method of *space syntax*.

To implement this aim, 72 cognitive map drawings by children obtained through a case study as part of the research of Çanakçıoğlu (2011) are analysed. These maps, which have already been analysed within the *spatial parameters* of Piaget (Piaget and Inhelder, 1967) and the *image parameters* of Lynch (1960) and have been concluded with some significant results, are now examined using *justified permeability graphs* within the concept of space syntax. The aim is to comprehend whether there are any unique and significant results. In this manner, it is also aimed to discuss whether *space syntax* can be implemented to analyse the cognitive maps of children as a substitute method.

Having reviewed the previous interdisciplinary research in terms *of space syntax* and spacial cognition (Zheng and Weimin, 2010; Zimring and Dalton, 2003; Haq and Girotto, 2003; Kim and Penn, 2004), this paper targets to develop a new approach to analyse cognitive maps. The scope of this paper aims to contribute to the analysis of cognitive maps drawn by 11-year-old children from two distinct social groups.

3.3.1. Steps of analysis of the study

Obtaining significant results requires an equal number of drawings from both of the gender groups and income groups, meaning that 18 girls' and 18 boys' drawings are selected randomly from each income group so that a total of 72 cognitive maps are analysed.

Before explaining the steps of analysis, the acceptance procedure used in the evaluation phase of the drawings should be mentioned. It is not possible to analyse children's drawings as typical layouts or spatial structures through conventional methods. As each child was requested to draw his or her home environment and nearby setting through his/her eyes, there is no need to compare such subjective data with any existing plan data. Therefore, each drawing on an A4 size paper accomplished by the children with their own subjective attitude is accepted as a total cognitive space no matter whether they have tried to draw their homes within a garden, house layout plans within a façade view or houses as a façade within a street silhouette as seen in Figure 1**.** Indeed, children draw their cognitive maps freely as a reflection of their experience. In fact, Kaplan (1973) supports this view, defining cognitive maps as "schematic, sketchy, incomplete, distorted and otherwise simplified and idiosyncratic" and "a product of experience, not of precise measurement".

Consequently, in this study, the analysis of cognitive maps is conducted by *justified permeability graphs*, or *justified gamma maps,* which Hillier and Hanson (1984) say, "permit easy measurement of these syntactic properties. Thus, *justified gamma maps* are intended to allow a form of analysis that combines the visual decipherment of pattern with procedures for quantification."

In addition to Table 1, the analysis steps are as follows:

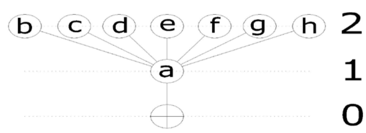
(1) Following the notion of *convex map* described by Hillier and Hanson (1984), a simplified drawing to clearly describe the spatial structure and connections between them within the drawing is prepared for each cognitive map.

(2) Each space of the cognitive map is identified by a letter in a circle, defined as a *node*, to create a basis for a *justified graph*. Following the definition of *root space* by Hillier et al. (1987) and Klarqvist (1993), the exterior space of the house is identified as the *root space* in each spatial representation. Other spaces are identified with *nodes* sequentially, depending on the *permeability* factor between the spaces.

(3) To conduct a syntactic analysis, *justified permeability graphs* are prepared for each cognitive map in order to show the direct relation between spaces by *syntactic step*s, including the *permeability values* and *depth levels* of the spatial structure (Klarqvist, 1993). Both the *permeability* and *depth values* are calculated for each cognitive map. Via the justified graphs prepared, it is possible to convert the subjective data

Figure 1. *Two examples of cognitive maps showing the house within a garden and within a neighbourhood. (Boy, 11; Boy, 11).*

Table 1. *An example to demonstrate the steps followed to reveal syntactic value of each cognitive map.*

	Original Cognitive Map (Girl, 11 years old)	
Step 1	Simplified Drawing Showing the Spatial Structure with Nodes	
Step 2	Justified Graph	
Step 3	Permeability Value	8
	Depth Level	2

expressed by children from a visual to mathematical verification, which can be concretely shown.

(4) In the last step, tables are prepared to see whether any significant results arise and correlate with the total amounts and arithmetic mean value of *permeability* and *depth values*, dependent on *gender* and *income level* variables. Therefore, it is observed that there is the potential for a comparative discussion about boys' and girls' cognitive maps and different socioeconomic levels through a syntactic analysis.

In the evaluation phase of the study, *permeability* and *depth level* data obtained from the cognitive maps are evaluated by *Pearson chi-square* analyses through the statistical software – SPSS Table 8 to find out any significant associations among the *gender* and *income* variables.

Table 2. *Distribution of permeability and depth levels depending on gender.*

	Total Permeability	Total Depth Level
Boys	163	76
Girls	155	68

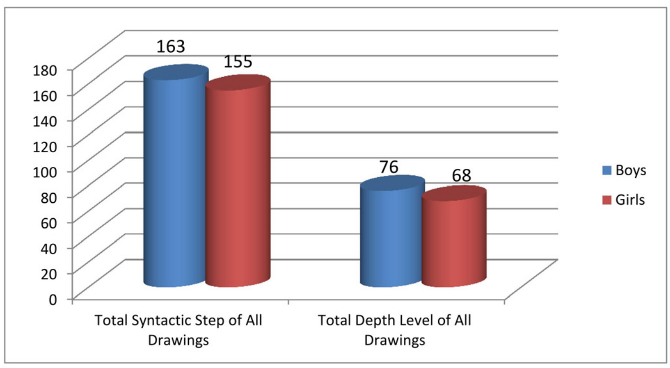


Figure 2. *Graph showing total amount of syntactic steps (permeability) and depth levels depending on gender.*

Table 3. *Distribution of total permeability of boys' drawings dependent on income group.*

	Total Permeability of the Boys' Drawings
Low Income Group	96
High Income Group	67

Table 4. *Distribution of total permeability of boys' drawings dependent on income group.*

	Total Depth of the Boys' Drawings
Low Income Group	50
High Income Group	26

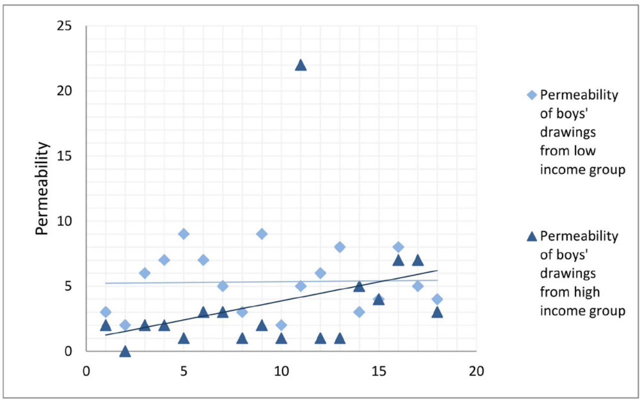


Figure 3. *Scattergram of boys' cognitive maps showing the permeability dependent on the variable of income group.*

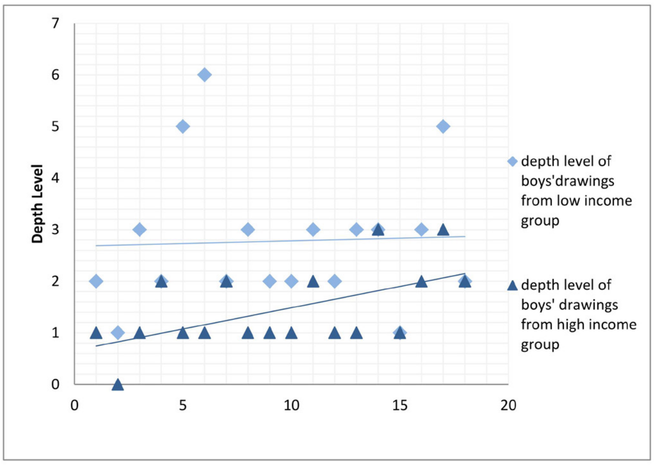


Figure 4. *Scattergram of boys' cognitive maps showing the depth level dependent on the variable of income group.*

Table 5. *Distribution of total permeability of the girls' drawings dependent on income group.*

	Total Permeability of the Girls' Drawings
Low Income Group	104
High Income Group	51

4. Results

- Firstly, all 72 maps are analysed by means of the tree-like *justified permeability graphs* to find the total amount of *permeability* and *depth levels* of all executed data. The distribution of these two values dependent on gender variable can be monitored in Table 2 and Figure 2. Considering total *permeability*, the cognitive maps of the boys reflect more *syntactic steps* in terms of *permeability*, meaning that the spaces are connected to each other through more branches, than the girls'. Considering the total *depth level,* the spaces drawn by boys are represented through a deeper manner than the girls'.
- A second outcome is found dependent on the income variable. As seen in Tables 3-4 and Figures 3-4, the total *permeability* and *depth levels* of boys' cognitive maps from low-income group show higher values than the ones from the high-income group. The highest *permeability* value is detected as 22 with a *depth level* of 6 in the high-income group.
- However, there is also an exception that contrasts with this result. One map from the high-income group shows 0 *syntactic step*, meaning that the child only drew one space and nothing attached or integrated with this space within the cognitive map. The children who drew only one space in their drawings mostly drew their own rooms without any other spaces connected to the space drawn. Cognitive maps reflecting only one space are mostly observed in the high-income group. These cognitive maps are evaluated as "0" in terms of both *syntactic step* and *depth level.*
- As monitored from Tables 5-6 and Figures 5-6, the total amount of *permeability* and *depth levels* of girls' cognitive maps from the low-income group show higher values compared to the other girls' maps from the high-income group. It is also noticed that the gap between the trend lines are wider in the girls' scattergrams than the boys', which means that the cognitive maps

of the girls from the low-income group show a more *interconnected* and *deeper structure of spaces* within their drawings. Nine out of 18 girls' drawings are evaluated as "0" since the girls from the high-income group living in the gated community only drew their own rooms without any other connected spaces to their rooms. Within these drawings, the one and only space which is highly accentuated and richly designated are their own private rooms; these children prefer to emphasize their personal equipment such as computer, TV, musical instruments etc. as seen in Figure 7. From these results, it may be inferred that these children tend to spend most of their time in their rooms and that they attach more personal significance to these because they hold their personal belongings.

- In the final tables and figures, the analyses of all 72 cognitive maps of children are shown. As seen in Table 7 and Figures 8-9, according to Pearson chi-square tests processed in SPSS, the changes in the total amount of *permeability* and *depth level* are significantly higher Table 8 in the drawings of the children from the low-income group than those of the high-income group:
- <u>Income level; permeability</u>: x^2=12,359, df=4, p=0,015 < 0,05 (significant)
- <u>Income level; depth level</u>: x^2= 16,687, df= 2, p=0,000 < 0,05 (significant)
- Both the *permeability* and *depth values* of the low-income group are almost twice that of the high-income group, revealing that children living in the informal setting are more aware of their nearby environments centred with their homes. Indeed, they display the ability to represent the spaces they are living in through a more complex interrelationship and integration within their cognitive maps.

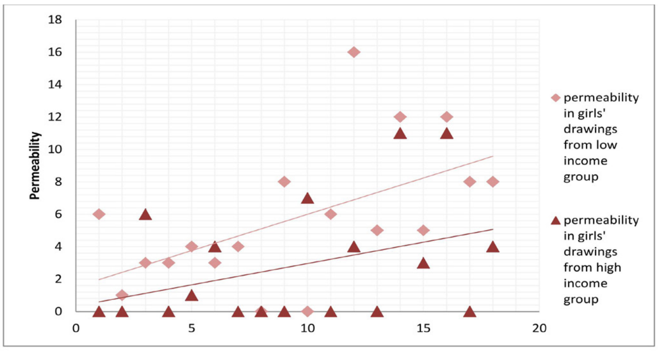


Figure 5. *Scattergram of girls' cognitive maps showing the permeability dependent on the variable of income group.*

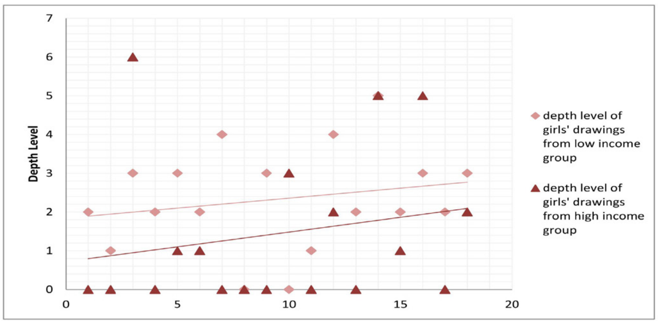


Figure 6. *Scattergram of girls' cognitive maps showing the depth level dependent on the variable of income group.*

Table 6. *Distribution of total depth of the girls' drawings dependent on income group.*

	Total Depth of the Girls' Drawings
Low Income Group	42
High Income Group	26

Table 7. *Distribution of total permeability and total depth of all cognitive maps dependent on income group.*

	Total Permeability	Total Depth Level
Low Income Group	200	92
High income Group	118	52

Table 8. *Association between permeability and depth level with gender and income level.*

Item	x^2	*df*	*p*	*significance*
Gender; Permeability	3,118	4	0,538 > 0,05	insignificant
Gender; Depth level	1,468	2	0,480 > 0,05	insignificant
Income Level; Permeability	12,359	4	0,015 < 0,05	**significant**
Income Level; Depth Level	16,687	2	0,000 < 0,05	**significant**

5. Conclusion

The aim of the study is to find a quantitative supplementary research tool to analyse the cognitive maps of children, thus contributing to the research methodology of analysing individual cognitive maps within the theory of *space syntax*. Through the analysis of children's cognitive data, it is possible to contribute the following assertions to the debate:

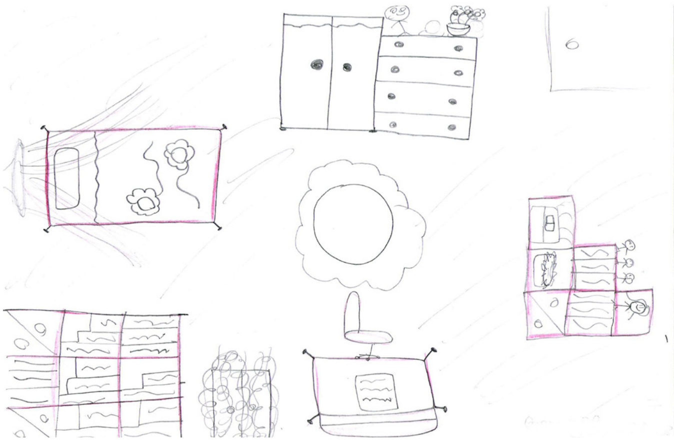


Figure 7. *An example of a cognitive map of a girl from high income group representing only the child's own room. (Girl, 11 years old).*

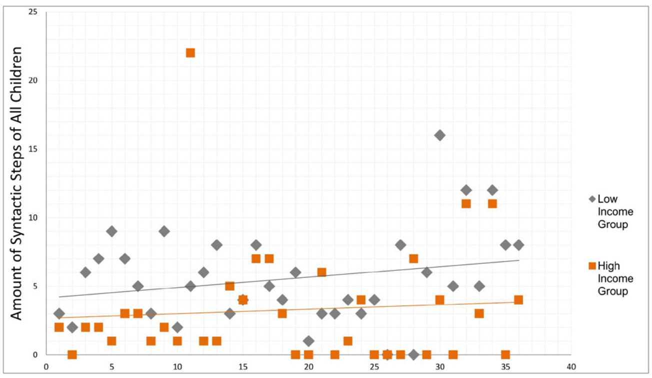


Figure 8. *Scattergram of all children's cognitive maps showing the amount of permeability dependent on the variable of income group.*

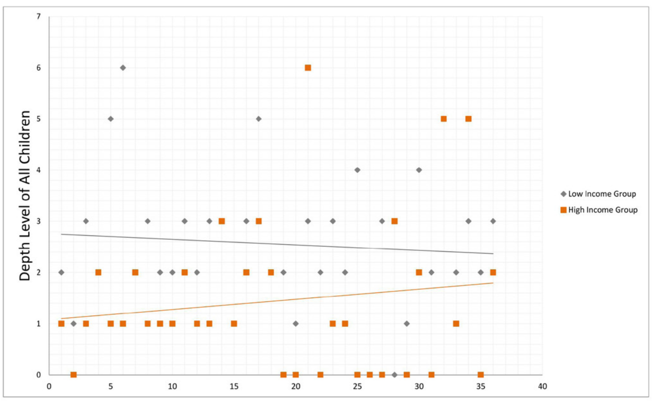


Figure 9. *Scattergram of all children's cognitive maps showing the depth level dependent on the variable of income group.*

From the syntactic analyses of an equal number of drawings of girls and boys at the age of 11 for a total of 72 cognitive maps, it is shown that boys' cognitive maps are more *permeable* and *deeper* in terms of spatial structure compared to girls' cognitive maps. This difference results in both of the income groups. This outcome may be due to the sociocultural norms of Turkish society that is accustomed to raising girls in a more inward oriented manner than boys.

- In addition, it is shown that half of the cognitive maps of the girls from the high-income group living in a gated community are evaluated as "0" in terms of syntactic value since they preferred to draw their own rooms in a fragmented manner, displaying their personal belongings. This finding could also enter the debate on sociocultural issues in Turkey, especially as families from both the middle class and high-income groups tend to have fewer children than those of the low-income group and have a greater chance to reserve a separate room for each of their kids.
- In contrast to the above outcome, children from the low-income group, which does not have the opportunity to have a separate room, are the most likely to have more experience in the other rooms of their interiors and in the outdoor spaces attached to their homes. As low-income families tend to have more kids, they do not have the chance to reserve a separate room for each of the siblings. Also, since these children are used to going to school by foot alone or in the company of their siblings, friends or parents, they have more opportunities to observe their nearby environments within an urban context. Coming in contact with the urban layout becomes a bodily experience that a child may store in their cognition. Thus, it is possible to say that children from low-income groups living in an informal setting have more environmental experience and construct more knowledge within their cognitive schemata, thus reflecting *deeper syntactic values* onto their

cognitive maps.

- Another finding is that the children from the high-income group show a lower capacity, and produce *shallower* and low *permeable* cognitive maps as if they are used to watching the urban life happening around them from their windows in their own rooms. It is possible that these children may be (1) more engaged with their own technological devices such as tablets and laptops or (2) accustomed to going to school by private vehicles. Both lead to only visually experiencing the urban layout, and this is not enough for a child to store experience in cognition. Thus, it appears that children from a high-income group living in a gated community construct less environmental knowledge within their cognitive schemata and reflect *shallower syntactic values* onto their cognitive maps. This raises the concern about whether children from gated communities ever learn to discover the outdoors.
- The three outcomes mentioned above show that the *syntactic value*s of the cognitive maps of children depend significantly on the *income level* variable. The reason why the cognitive maps of children from the low-income group show a significantly higher degree of *permeability* and *depth* level may be due to the distant characteristics of the environments that the children live in and where they spend their spare time. Children who emphasize outdoor spaces in their maps may have had more opportunity to play outdoors and can therefore represent their home environments in a *deeper* and *integrated* manner. Alternately, children who merely emphasize their own rooms with their personal belongings may not have had the opportunity or preference to play outdoors as freely as the other children as they live in a gated community, an artificially designed environment with planned recreational activity areas for children.
- According to these results, *justified permeability graphs* measuring the amount of *permeability* and *depth values* may be used to measure and analyse the cognitive maps of children.
- In conclusion, cognitive maps of children can indeed be analysed by space syntax, giving an affirmative answer to the initial research question and title of the study.

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Çocukların bilişsel haritaları mekân dizimi yöntemiyle irdelenebilir mi?

Çevre ve davranış teorileri kapsamında ele alındığında, insanlar, çocukluk çağının ilk yıllarından itibaren, duyuları aracılığıyla etkileşim içinde bulundukları ve çevresel uyaranların tetiklediği bir ortam dâhilinde, bir algılama ve öğrenme sürecine dâhil olurlar. Art arda ve zincirleme bir biçimde devam eden bu algısal süreçler sonucunda, insanlar, çevreden edindikleri bilgiyi adeta zihinlerinde yeniden inşa etmek suretiyle özgün zihinsel şemalar oluştururlar. Bilişsel olarak sağlıklı bir insanın hayatı boyunca devam eden bu süreç, bireyin öğrenme mekanizması olarak da tanımlanabilir. Bu bağlamda, çocukların çevrelerini nasıl algıladıklarını ve öğrendiklerini konstrüktivist bir yaklaşım çerçevesinde irdeleyen gelişim psikoloğu Jean Piaget (1955), çocukların çevreyle olan etkileşimini ve algısal süreçlerini, yaşa bağlı olarak değişen *bilişsel gelişim teorileri* bağlamında inceler. Her çocuk, çevresini birbirinden farklı algıladığı ve çeşitli çevrelere ilişkin birbirlerinden farklı bilgiler biriktirdiği ve söz konusu bu çevrelere ilişkin kendilerine özgü zihinsel şemalar inşa ettiği için, her çocuğun ortaya koyduğu bilişsel haritanın da tekil ve özgün olarak değerlendirilmesi gerekmektedir. Çocukların çevrelerine ilişkin zihinlerinde inşa edilen ve depolanan bu bilgiyi ortaya çıkarmanın yöntemlerinden birisi, çocukların bizzat kendileri tarafından çizilen bilişsel haritaların analiz edilmesiyle gerçekleştirilebilmektedir.

Zihinsel şemalar ve bilişsel haritaların analiz edilmesi konusunda çevre ve davranış teorileri kapsamında literatüre önemli katkılar sağlayan Kevin Lynch (1960), *yollar, kenarlar, bölgeler, nodlar* ve *nirengi noktaları* şeklinde sınıflandırdığı mekânsal bileşenlerin kullanıldığı güçlü ve nitelikli bir imgesellikle tasarlanmış olan kentsel çevrelerin, insanların algısal süreçlerine anlamlı bir katkı sağladığını ve bu sayede, bireylerin söz konusu bu çevrelerde oryantasyonlarını daha iyi kurabildiklerini belirtmektedir. Bununla birlikte, yukarıda belirtilen çevresel bileşenleri içeren çevrelerin, mekânların hatırlanmasında ve bununla birlikte bireylerin zengin bilişsel haritalar ortaya koymalarında önemli katkısı bulunduğunu ifade etmektedir. Bununla birlikte bazı araştırmalar kapsamında bilişim kavramı, *mekân dizimi* (space syntax) araştırmaları kapsamında irdelenmeye çalışılmaktadır (Zheng & Weimin, 2010; Zimring & Dalton, 2003; Haq & Girotto, 2003; Kim & Penn, 2004).

Yukarıda belirtilen tartışma alanı çerçevesinde bu çalışma, Piaget' nin mekânsal algı parametreleri ile birlikte Lynch'in imge parametreleri kullanılmak suretiyle, çocukların mekânsal algı düzeylerinin cinsiyet ve sosyoekonomik durum değişkenlere bağlı olarak nasıl değiştiğinin kıyaslandığı bir çalışma için elde edilmiş olan bilişsel haritaların analiz edilmesine alternatif bir yöntem sunmayı amaçlamaktadır. Bu sebeple, çalışmanın tartışma alanı, farklı iki sosyoekonomik gruptan gelen 11 yaş grubundan çocukların kendi ev ve yakın çevresine ilişkin mekânsal algılarının incelendiği "İstanbul'da Farklı Sosyal Grupların Yerleştiği Çevrelerde Yaşayan Çocukların Algısal Süreçlerinin Bilişsel Haritalar Yöntemiyle İrdelenmesi" başlıklı çalışmanın (Çanakçıoğlu, 2011), alan araştırması safhasında elde edilen bilişsel harita verilerinin *mekân dizimi* yöntemiyle analiz edilmesi üzerinedir. Başka bir deyişle, çalışmanın ana hedefi, bilişsel haritaların analiz edilme aşamasında, *mekân dizimi* (space syntax) yönteminin alternatif bir nicel analiz metodu olarak kullanılmasına olanak sağlayıp sağlamadığını araştırmaktır.

Çalışmanın içeriğinde, *mekân dizimi* yöntemiyle irdelenen bilişsel haritalar, "koridor, giriş holü ve merdiven gibi lineer mekânların, erkek çocukların haritalarında kız çocuklarınkine kıyasla daha fazla vurgulanıp vurgulanmadığı"; buna paralel olarak, kız çocukların haritalarında içe dönük mekânların daha fazla miktarda ortaya çıkıp çıkmadığı" gibi konular *cinsiyet değişkeni* bağlamında, "üst sosyoekonomik grupta yer alan çocukların çoğunluğunun, kendilerine ait odalarının bulunması sebebiyle, alt sosyoekonomik gruptaki çocuklara kıyasla daha *sığ* (shallow) mekânsal ilişkilerin yer aldığı haritalar ortaya koyup koymadığı" gibi hususlar ise *sosyoekonomik durum değişkeni* bağlamında irdelenmek istenmektedir. Anlamlı sonuçlar elde edilmesi öngörülen bu hususların irdelenmesinde, *doğrulanmış geçirgenlik haritalarına* (justified permeability graphs) başvurulmak suretiyle *derinlik (*depth*) analizleri* uygulanmıştır.