



## Enformel Bir Konut Çevresinin Çocukların Aktif Kamusal Katılımı Açısından İncelenmesi

**Araştırma Makalesi**  
Research Article

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### ÖZ

Çocukların kentsel mekanlara aktif katılımları, günümüzde küreselleşmenin etkisiyle giderek azalmakta olup, çocukların kamusal alana katılma ve okula yürüyerek gidebilme ayrıcalığı, günümüz İstanbul kentinde, ağırlıklı olarak enformel konut yerleşimlerinde rastlanan bir olgudur. Öte yandan, enformel yerleşimlerde yaşayan çocuklar, yeterli gözetim ve güvenlikten yoksundur. Bu çalışma, enformel konut yerleşimlerinin fiziksel karakteristiğinin iyileştirilmesinin, yalnızca çocuğun kamusal mekâna güvenli bir şekilde katılımını değil, aynı zamanda çocukların okula yürüyebilme imkanlarını da destekleyeceği hipotezine dayanmaktadır. Nisanteppe Mahallesi'ne ilişkin gerçekleştirilen alan çalışmasında, sokak ağının (street network) yürünebilirlik potansiyeli, *mekansal dizim* (space syntax) yöntemiyle ortaya çıkarılmıştır. Elde edilen bulgular, bölgenin Nişantepe İlkokulu ve Ortaokulu'nun yer aldığı kuzeydoğusu bölgesinde yer alan sokağın, bölgenin en yüksek *bağlantısallığa* sahip aksı olduğunu ortaya koymuştur. Bunun yanı sıra, bu bölge, aynı zamanda, mahallenin en yüksek *bütünleşme*, R3, R5 ve R7 *lokal bütünleşme* değerinin bulunduğu bölge olarak öne çıkmaktadır. VGA tabanlı *agent* analizlerinde, Nişantepe'de yeni yapılandırılan sokak ağının okula *yürünebilirlik* potansiyelini desteklediği fark edilmektedir.

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### ANAHTAR KELİMELER

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## Examining an Informally Developed Housing Environment in terms of Active Public Participation of Children

### ABSTRACT

Children's participation in urban spaces has been withdrawn due to the effect of globalization specifically in metropolitan cities. Today, in Istanbul, the opportunity for free participation of children in the public domain and the privilege of walking to school is among informal housing settlements. However, these children lack adequate supervision and security. Therefore, this study hypothesizes that urban strategies that can be implemented for the physical improvement of these environments can be a tactic that will not only support the child's safe participation in the public sphere but also support children's walkability to school. The walkability potentials of the street network were revealed through syntactic graphs of Nisanteppe neighbourhood where children predominantly walk to school. As a result, it was revealed that the street in the north-eastern part of the region is the one with the highest connectivity value towards the area where Nisanteppe Primary and Secondary School are located. It was noticed that this region also emerged as the highest value of global integration, R3, R5 and R7 *local integration* values. In the *agent analysis* revealed through a VGA based examination, it was revealed that the newly formed street network in Nisanteppe supports the potential of the *walkability* of the school route.

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### GİRİŞ

The environment and behaviour theory, which considers the behaviour of the individual as a reflection of the environment, does not consider either the environment or the individual as an independent component. Conversely,

the theory of environment and behaviour considers the individual and the environment as two mutually influencing notions (Moore, 1979). In this framework, it has been widely studied that the experience acquired as a result of the actions performed in the architectural or urban

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space is stated to be intertwined with the environmental conditions as well as the biological status of the individual (Piaget and Inhelder, 1967). Therefore, every question asked about human behaviour in space reveals both the necessity of researching the biological development process of the individual and the physical conditions of the environment in which the individual is growing up, as well as the cultural norms and values belonging to the social group that directly affect this environment. In this context, transactional theory, which focuses on human experience, argues that behaviour is a result of relations between the environment and humans (Lewin, 1951).

When this intertwined relationship between the individual and the environment is examined in terms of children, there are important priorities to be considered regarding this multidimensional interaction between the child and the space (David and Weinstein, 2013). The built environment has both direct and symbolic effects on the child in such a way that the constituents of the physical environment may facilitate the realization of some behaviours while hindering others. Besides, examining the built environment and the child's development can help research the various environments that the child uses. By researching the environments and institutions used by children, the improvement potential of these spaces for the needs of the child can be questioned. In addition, it is stated that the environments designed for children have the potential of strengthening personal identity concerning children's development; promoting the development of competence; providing opportunities for physical, social and cognitive development; promoting a sense of trust; and serve common functions such as allowing the social interaction and privacy that the child needs. For that reason, whenever it is possible, children should take an active role in the planning and organization of the physical environment in which they live and take action. Moreover, the impact of the physical environment on children should be examined within the context of the social and cultural system. Finally, children should not only be considered as the users of homes, schools, and environments where children's special care needs are met since such physical environments are also shared with parents, teachers, nurses and other adults, their needs should be considered in design decisions (David and Weinstein, 2013).

In this regard, outdoor play through which the child is active in urban areas is an important issue for the social and physical development of the child. So, play can be considered the best way to learn for the child, as children actively explore, discover, and gain experience while playing, and accordingly, these experiences allow them to make their plays more challenging and complicated (Theemes, 1999). In this sense, the concept of play contains many meanings such as all kinds of emotions, experiences, feelings, success, sadness, joy, and difficulties in the imaginary life. For this reason, it can be

asserted that the formation of an inclusive and child-friendly play environment depends on the features that support the participation of children from all age groups. The environmental support required for such an environment and the participation of children is related to the fact that the play domain is a well-defined space that provides access and opportunity for sometimes individual play and sometimes group play with a variety of abilities, interests and needs. A play environment that is well-integrated with the urban space, carefully designed to meet the developmental, sensory-motor, behavioural, social and emotional needs of each child, has the potential to enrich and expand the play opportunities of children (Doctoroff, 2001) contributing to support the active participation of children including their families, and thus to make the city more socially sustainable.

Therefore, investigating the interaction between the child and the city has the potential to benefit the issue of how designed environments can be adapted or improved for the children's competence levels, as it contains a field of knowledge that contributes to the development of the child. In addition, the issue of how the environments and neighbourhoods related to housing areas can be designed according to the competency and skill levels of children in the design stage may lead to the formation of more inclusive and sustainable urban housing areas.

In this context, Gehl (2011) states that an ordinary and inclusive urban street consists of mixed outdoor activities and various groups of people where pedestrians walk on the sidewalks, children play near the front doors of buildings, two passers-by greet each other, etc. Gehl (2011, p.9) classifies this diversity of the street as a public space according to three different activities: necessary activities, optional activities, and social activities. Necessary activities include compulsory actions under all circumstances such as going to school, work, and waiting for the bus while optional activities include voluntary actions such as hanging around and walking for some fresh air. On the other hand, social activities include children's play outdoors, conversations between people, as well as actions such as indirect encounters and greetings. This type of action, through which people come together spontaneously, is usually seen on the streets and squares of the city, as well as activities become dense around schools and workplaces.

In line with Gehl's views, Jacobs (1961) also states that a safe street is one whose inherent safety depends on the natural activity of people. In this context, she states that public and private settings in an urban layout should not leak into each other as in the suburbs. In addition, she states that there should be *eyes on the street* as the street's natural owners and inhabitants and that one side of the buildings on that street should always be positioned in such a way that the buildings may directly observe the street.

According to Jacobs (1961), the third factor is due to the unintentional crowding of the pavement; if there is always someone on the street, the activity of the street initiates spontaneous behaviours. In addition, another prerequisite of the *eyes on the street* is that a certain number of shops and public spaces with various functions, which continue to live day and night, are distributed along the streets. Therefore, according to Jacobs (1961), it can be said that the liveliness of a street depends on its mixed-use.

However, Gehl's and Jacob's approaches on urban landscapes, which should be formed by the natural human patterns consisting of different types of activities as it is stated above, have changed rapidly in some cities due to the impacts of migration and globalization. In this context, studies examining the interaction of the child with the environment evaluate the experiences of children in the city as a result of the social and physical characteristics of the urban space. Children's participation in urban spaces either in terms of outdoor play, social interaction in public spaces or walking to school has been withdrawn from the streets due to the effect of globalization specifically in metropolitan cities.

When the change of cities from past to present is examined, it can be noticed that the individuals who participated in the public spaces of the city and played freely, especially in the pre-80s period, were mostly children. According to Jacobs (1961), the width of the pavement is important both for the diversity of the street and for the children to play. Nine to ten meters wide pavements can meet the play demands of not only adults but also children. Moreover, when there are trees along these sidewalks, there is enough space for pedestrians to walk, adults to stroll, to sit on benches and children to play. Although such wide sidewalks do not commonly exist in many cities, the streets have continuously been interesting and surprising places for children. For this reason, whenever possible, children try to adapt to narrow sidewalks rather than the playgrounds specifically designed for them.

Despite this willingness of children, they were unfortunately the first individuals to be withdrawn from the streets because of these negative effects. Urban areas prior to the intense physical and social transformation of cities due to the globalization effects were the public spaces where children played spontaneously and safely due to both the modest scale of the cities and the neighbourhood culture where socially similar groups lived together. Following this argument, the design of urban environments in such a structure that supports children's walkability (Michail et al., 2021) can also enhance the development of children's urban perceptions of their environments. Michail et al.'s study (2021) conducted with children aged 9-10 in the UK showed that children who walk to school enjoy physical activities such as

playing, jumping and running while walking. In addition, active social relations with parents and family seniors during walking, and socialization relations such as meeting with friends, talking, and playing, and greeting neighbours were found to be positive effects on children who go to school on foot.

In this framework, it is found that the children who actively participate in the public domains and reach the school on foot or by using zero-emission vehicles, can get to know their neighbourhoods better and accordingly can protect their physical health (Ozbil et al., 2021) and increase their social interactions with their peers.

In this context, the research questions of this study are listed as follows:

- How can children's walkability to school be promoted in housing environments?
- What kind of urban strategies can be applied for the active and safe participation of children in the public domains in one of the housing environments – Nisantep- in the metropolitan city of Istanbul?

In this framework, the hypothesis of the study is based on the necessity of increasing the walkability value of the street network, which includes the school road, to create the concept of *eyes on the street* in the housing settlements on the periphery where children can still actively participate in the public space, socialize, and play freely. Therefore, this study is based on the hypothesis that urban strategies that can be implemented for the physical improvement of these informally developed environments can be a tactic that will not only supports the child's safe participation in the public sphere but also supports children's walkability to school and even the usage of zero-emission vehicles such as scooters and bicycles.

### **Participation of the Child in the Public Domains at Informal Housing Settlements in Istanbul**

One of the main purposes of the existence of the city is to provide regulations that will ensure the highest level of development of the social and cultural lives of future generations as well as the generation living in the city. To achieve this aim, besides the development of the physical, social, legal and economic institutions of the cities, the necessary technical infrastructure and services should be developed to meet indispensable human needs such as education and health (Cansever, 1994).

The urban plan of Istanbul was designed in line with the zoning plans prepared with administrative decisions until 1950s. However, some parts of Istanbul were not designed in line with any plan due to the inevitable social and economic dynamics that emerged especially after the 1950s. These unavoidable social and spatial differentiations in Istanbul, which transformed the city

from a metropolis to a megapolis, have a great impact on the segregation in the housing patterns (Akpınar and Kahvecioğlu, 2007). In this sense, Istanbul became a city where the city borders expanded rapidly from the 1950s to the 1980s and its population expansively increased depending on the effect of migration from rural areas to cities, industrialization and uncontrolled urban growth and its internal dynamics (Yonder, 2007). This expansion revealed a serious insufficiency in the housing stock in Istanbul. For this reason, a significant amount of land in metropolitan cities, especially in Istanbul, was covered with unplanned informal housing patterns (Davis, 2006; Arefi, 2011). Although different segments of the society generated different forms of housing production named *gecekondu* settlements as a solution to the housing deficit (Yıldız and Tütengil, 2007), and the changing physical and social structure of the city has led to a historical break that affected the social sustainability of the city. Unfortunately, this physical situation still continues especially on the outskirts of the city where the inhabitants are in deep poverty.

The expansion of the city in the east-west direction after the 80s, and in the north direction after the 2000s, revealed new districts in Istanbul where not only informal settlements but also gated communities are located. The distances between the districts that were newly added to the city's periphery and downtown increased gradually, which necessitated the construction of new highways and accordingly the increase in the number of motor vehicles. The city, which has undergone significant physical changes, has begun to have such a social structure that is increasingly differentiated in social terms due to excessive migration and population growth. Besides, the income distribution differences between the newly emerged social groups in the city caused the emergence of new housing patterns that developed in a heterogeneous way. In addition to the mansions on the shores of the Bosphorus, wooden mansions on the inner lands, and stone masonry buildings in the historical peninsula, new residential areas called *gecekondu* settlements, satellite towns and gated communities, started to emerge in the city.

In this context, the fact of informally planned settlements, which is one of the important dynamics of Turkish sociology (Senyapili, 2004) has become a physical and social challenge in Turkey beginning in the 1950s. Türkdoğan (2002) argues that urban integration will never happen, contrary to the arguments that these rural-origin groups, which create new settlements on the outer periphery of the city, will lose their identity by integrating with the city over time. The fact that there is no change in the expectations of the people living in the informal settlements, that they cannot find a regular job, and that there is no significant difference in their social status indicates that these groups of people have turned into a new sub-identity called the 'culture of poverty' in the

society. According to another view (Isik and Pinarcioglu, 2012), these newly formed poor groups are far from being a homogeneous group. On the contrary, the urban poor is a segment within the city that has been economically differentiated over time and has formed diverse ranges of supremacy. Based on these unequal ruling relations, the concept of perpetual poverty means that the ones who came to the city became economically superior to the others and increased their economic welfare over the late influxes.

The households living in the first informal settlements of Istanbul were mostly made up of people with insufficient education, low income, working in the informal sector and immigrating to the city to find a job (Senyapili, 1986). The most important criterion in choosing a house for these families with a low level of education was neighbourly relations (Ayata and Ayata, 1996). Social groups living in these informal settlements, which had a serious population over time, became an important social phenomenon that steers Turkish politics due to their voting potential and gained legal status by obtaining their title deeds in the recent past. So, it is widely discussed that the laws enacted for informal areas were ineffective, and government policies increased land speculation and generally led to an increase in the land values of these areas (Yonder, 2007). Senyapili (1986) states that informal settlements in Turkey do not directly point to a specific physical structure but should be seen as a social settlement model that transforms within itself, changes and expands over time. In this context, it can be stated that this transformational settlement model still continues in Turkey. Today, a significant part of these informal settlements has been reconstructed in a multi-storey form on the same parcel due to their legalization procedures despite the unplanned street networks. Therefore, these informal housing settlements contain a physical appearance filled with apartment-type of buildings over time that is relatively devoid of recreational facilities with insufficient green space and narrow street network systems.

As explained about the recent urbanization period of the city above, it is asserted that the participation of children in the outdoor urban domains is innately interrelated to this newly blended multi-layered urban fabric in the megapolis of Istanbul, which has such a heterogeneous diversity in social and physical terms. Therefore, it can be stated that the way children participate in the city and experience the urban domains also depends on this fragmented social and physical diversity. For that reason, it is possible to mention that children living in diverse parts of Istanbul today have different behavioural patterns and urban experiences in terms of using the public spaces of the city. Prominent Turkish architect Turgut Cansever (1994) states that even in the 90s, children began to be deprived of playing in front of their houses, in their gardens, and on the streets of their neighbourhoods, and especially as of the 2000s, gated

communities, which started to dominate the urban fabric, further distanced children from the public spaces of the city.

However, many children continue to play on the street in some of the districts of Istanbul where the land is informally shared and built. In these districts, children still actively play on the streets and freely experience the public spaces of the city. But it is unfortunately not possible to observe the existence of adequate parental control and surveillance of children in such neighbourhoods where play equipment for children is rare and the physical appearance of the city is not developed enough (Ayata and Ayata, 1996). On the other hand, although these informally planned areas where the physical appearance is unqualified cannot provide social and recreational facilities appropriate for their physical, social, and psychological development, the children living in these neighbourhoods live more closely with the outdoors and public spaces to use the spontaneous potentials offered by the environment for play. According to the findings of a study (Author, 2011) conducted in one of the informally planned settlements of Istanbul, it was stated that these children who cannot find suitable recreational facilities and play equipment who lack adequate positive stimuli produce their own solutions; they set up their own play scenarios and adapt whatever they find and see around such as soil, sand, mud, construction waste materials, and street animals. Thus, the children living in these informal housing areas somehow experience a close relationship between the urban lands and their residential domains.

Besides, in another region called Nişantepe in which informal housing is the dominating land use, it was observed that children, regardless of their age, often play at the entrances of their homes and on the streets usually without any parental supervision (Canakcioglu, 2021). These children's play materials were observed to be consisting of almost everything, including construction scraps, stones and sticks, and animals such as geese and chickens they keep. Although there is a playground with fixed playground equipment in the area, it was observed that most of the children prefer the random play potentials offered by the street and sidewalks.

Another opportunity for children to actively participate in the city and experience the urban environments closely is due to their active school travels. When it is considered in the context of children's walkability on the streets in Istanbul, according to a study conducted by the Istanbul Metropolitan Municipality Department of Transportation (2012), 68.8% of transportation to school is carried out on foot while the physical mobility of children has been gradually decreasing (Ozbil et al., 2021). Considering the barriers against active school travel in Istanbul, it is noticed that the increasing distance between school and home is the main obstacle for children to walk to school.

Other factors, on the other hand, are the increase in the crime rate on the streets, heavy traffic, bad weather conditions, and the low number of other children walking to school (Ozbil et al., 2021). However, it was mentioned in the study of Ozbil et al. (2021) that students' physically active travel to school is also important for the struggle against obesity in children and the contribution of a sustainable environment. In this study, in which space syntax was used as a method, it was stated that the connectivity value of the built environment contributes to the active school travels of children. In this context, it is emphasized that especially the regions where poverty is dominant have the potential to be developed in terms of walkability. Moreover, it was underlined that this improvement can be possible by intensifying the street network and improving the pavements and thus contributing to more walkable, sustainable, healthy environments with a high level and perception of safety.

## METHODOLOGY

In the study, the analysis of the Nisantepe region was examined through the space syntax method.

In this context, an axial graph of the street network was prepared through DepthMapX (2017) software. Besides the global integration and connectivity values, R3, R5 and R7 *local integration* values and R3, R5 and R7 *choice* values were revealed. In addition to that, to better analyse the walkability potentials of the school route, isovist graphs and agent analysis of the region were prepared and the walking inclinations of the agents that are randomly scattered on the streets were tried to be determined through the algorithm embedded in the software.

However, before mentioning the results of the analyses, it is intended to include two subsections under this section to better comprehend the rationale of the study. In the first sub-section of this section, the sociodemographic and physical structure of Nisantepe Neighbourhood and its historical background will be given. In the second subsection, the space syntax method, which is the analysis technique of the study, and especially the infrastructure of syntactic analyses such as the axial graph, isovist and agent analysis used in this study and the reasons for their use will be given. So, it is aimed to include a brief theoretical background of the space syntax theory specifically in urban studies and the quantitative method developed by the scholars working in this field.

## Case Study Environment

Nisantepe, which is a neighbourhood of seventeen neighbourhoods in the Cekmekoy district (Figure 1), is a settlement with 150 streets, a surface area of 3.065.304 square meters and a population of 4.580 (Space Syntax Online Training Platform, 2022). The relative cheapness of the lands located in the periphery of the city encouraged

many primary and secondary private schools as well as mass housing companies to establish their new campuses in this neighbourhood over time. The northeast progression of the city of Istanbul and the construction of the third bridge are other factors that cause the land values in the region to increase gradually. Therefore, it can be considered that the physical and socio-demographic structure of the region has been continuously changing day by day. The large parcels are adjacent to the highway and main routes of the settlement host new mass housing estates (Figure 2a) that appeal to the middle and upper class, while the campus of a university, which was established in 2011, has also been a factor that has increased the interest of other educational institutions and dormitories to be established in the region.

When the sociodemographic pattern of the region is considered, the Nisantepi settlement is a neighbourhood where workers from the southeast Anatolian region, as well as the families of workers from the Black Sea region, were settled first. Today, another significant group of the population is comprised of the Roman people who are among the disadvantaged groups of society and live in deep poverty. In addition to the problems of education and housing, the Roman population is one of the communities in Turkey that have problems with integration into society. In her article, Bahadır (2020) draws attention to the disadvantages of this marginal group through the vagueness of the settlement and its distance from society that there are four streets with the name *Unknown Street* in the neighbourhood. Moreover, she states that although new schools and housing has been built in the region, there are still serious problems with the right to education and housing where there is deep poverty today (Bahadır, 2020).

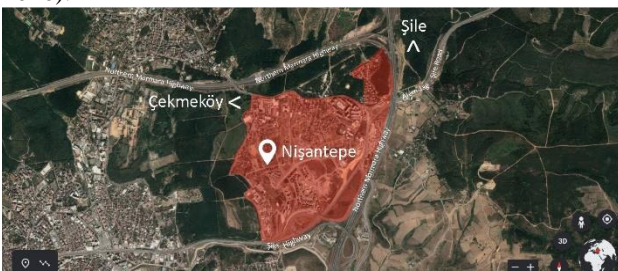


Figure 1. Nisantepi Neighbourhood as an aerial map (Google Earth, 2022).

In a social project carried out under the leadership of the *Sustainability Platform* of a university through which the instructors together with the students at the university brought the problems of the people in the region to light, it has been noticed that the household population is well above the average of Istanbul. Especially Roman families work in informal jobs, their children drop out of education due to income problems, their tendency to be involved in crime is high and even a significant part of them has a criminal record, and the women have difficulties in finding a formal job. In addition to the newly established private

schools in the region, there are two governmental school buildings, one primary school-secondary school and one high school, which mainly appeal to the people of the region. Since most of the local people living in the region are in deep poverty, the amount of automobile ownership is unsurprisingly negligible. Therefore, almost all the children who attend the public school go to school on foot (Figure 2a). For this reason, it can be asserted that the individuals who use the public spaces of Nisantepi, pavements, streets and the empty lands of the settlement are the children of Nisantepi.

In the observations made by the author in the region between 2016 and 2020 (Canakcioglu, 2021), it was noticed that although there are two playgrounds in the region, the children have actively been using the front porches of their houses and the streets for play instead of playing in the playgrounds available in the neighbourhood (Figure 2b and 2c). For this reason, the Nisantepi settlement, where children dynamically use the public domains and actively walk to school, has been chosen as the focus of the case environment of this study. In the next section, it is explained how the street network is analysed to reveal the walkability potential of the region through the morphological structure of the region.



Figure 2a. Children going to school on foot.



Figure 2b. Children playing on the street.



Figure 2c. Images from the daily life of children in Nisantepi Neighbourhood.

### Space syntax in urban studies

Space syntax is a theory and method through which Bill Hillier and his colleagues at UCL put forward as a research area on the morphology of urban and architectural space beginning in the 1970s (Van Nes and Yamu, 2021). Space syntax, which was first used in the spatial analysis of the small city and building networks, has become to be widely used in the analysis of larger cities and even regions over time. According to Hillier et al. (2007), space syntax method has four dimensions in urban studies (Van Nes and Yamu, 2021). First, each unit of spatial units is defined individually, secondly, space syntax deals with the city as a street network and serves to distinguish the categories and differences within this network. Thirdly, it has the potential to reveal various relations such as land use, migration, crime distribution, and pedestrian movements in urban space through relations with the morphological characteristics of the urban domains. Fourth, the syntactic information, which is revealed by syntactic analysis, provides benefits in the formation of better functioning and generative urban networks by revealing new social, economic and cognitive information in the establishment of new cities (van Nes and Yamu, 2021).

According to Hillier (2007), every unit in space and every value that this unit is associated with syntactically has a relationship with each other in terms of “to movement”. Thus, there is a spatial and functional movement potential created by urban land uses such as commercial or residential uses and building densities. Hillier (2007, p.127) describes that vividly lived urbanity is not difficult to create; and he claims that the space used will be a good place. In this sense, he asserts that the use is directly related to movement. What he means by movement is “through movement”, not vehicle traffic at all, but direct pedestrian movement, and it is defined as (Hillier, 2007, p.127): “the by-product of how the grid offers routes from everywhere to everywhere else.” Hillier emphasises that (2007) the

relationships in many informal settlements are also movement-based, and the land use, the functions and the densities of buildings are also shaped by the movement potentials offered by the urban grid. Therefore, he states that the density and activity of the pedestrian movement in a settlement are caused by the land use and functions arising from these relations together with the syntactic relations created by the urban network. Moreover, he states that the diversity and increase in functions create a “multiplier effect” that increases mobility and liveliness in the city over time. In other words, since a certain land use that creates mobility in that region increases pedestrian movement, similar land uses that reinforce this mobility over time also generate in the region creating a multiplier effect.

This theoretical background, revealed with the space syntax, has encouraged many case studies to be conducted on issues such as walkability in cities, land use, pedestrian mobility, distribution of crime, and density analysis. In this context, the concepts of walkability, mobility, and wayfinding in public use, which this article is related to, are among the most studied topics among space syntax studies (Ozbil and Peponis, 2007; Ozbil, Peponis and Stone, 2011; Kubat et al., 2012; Koohsari et al., 2019; Garau et al., 2020; van Nes, 2021). It has been supported by many pieces of research that the connectivity of the street network and the changes in the orientation of the streets are effective on pedestrian movement (Ozbil, Peponis and Stone, 2011).

To sum up, space syntax can be considered as a method used at various scales to analyse transportation, land use, people's presence in public spaces and their behaviours on an urban scale to create safer and lively neighbourhoods. In this context, van Nes and Yamu (2021) state that the space syntax method can also be used as a design tool for the improvement of urban environments in which deep physical and social poverty prevails in many cities around the world since the 1950s. In line with this view, this study questions the effects of the urban network on the potential of children to be more active and safer in the public space and to reach school safely in Nisantepi neighbourhood, which is one of the regions in Istanbul where deep poverty is experienced.

In this context, first, the axial graph of the region was prepared over the street network obtained from the OpenStreetMap (Open Street Map Foundation, 2022) in order to perform the syntactic analyses (Figure 3).

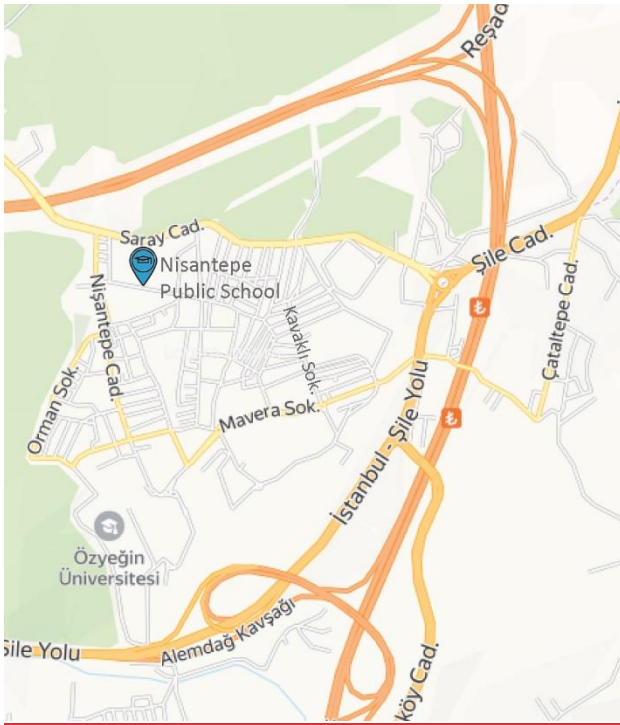


Figure 3. OpenStreetMap of Nisantepi Neighbourhood (Open Street Map Foundation, 2022).

In the first stage, the two-dimensional map obtained by drawing following the middle axis of each street was then inserted into DepthMapX and the axial graph of the region was revealed. The global integration and connectivity values of the urban grid together with the R3, R5 and R7 local integration values and R3, R5 and R7 choice values were revealed via the axial graph. With the help of the axial analysis, it was noticed how the street network affects the density and mobility of the area where the Nisantepi governmental school is located on the northwestern part of the region (Figure 3).

As a second step, the parcels were drawn as polylines to reveal the difference between the parcel areas and private areas of the region and to obtain the isovist map. In the DepthMapX, this time, the streets were designated as public areas and the effect of the visibility of the area on the walking potential was tested with an *agent analysis*. Considering what the agent analysis conveys is that this type of analysis is a DepthMapX application based on a computer algorithm that predicts that the longest and widest street axis generates the densest walkability potentials (Turner, 2007). With the help of this analysis, it was noticed on which streets the pedestrian movement density in the region increased every minute for 10 minutes (Figure 4).

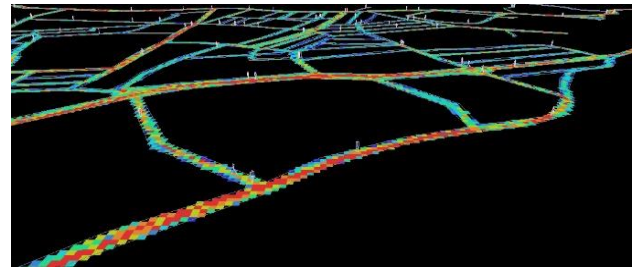


Figure 4. Agents moving.

## RESULTS

In the axial analysis, the connectivity values were obtained (Figure 5a). Connectivity, which "measures the number of spaces immediately connecting a space of origin" by Hillier and Hanson (1984, pp.103; Bafna, 2003), shows the street with the most intersections in urban space and is represented in the reddest colour on the graph. As can be seen from the connectivity graph in Figure 5a, the street represented in red belongs to Kavaklı Street (as shown in Figure 3) right next to the park to the east (the reddest line on Figure 5). The part of the street, which is located in the northeast of this street and is also represented by red, is the street that comes from the main circular intersection towards Nisantepi District and mainly constitutes the beginning of the trade axis of the region. Since the circular intersection is a route mostly used by motor vehicles, the main axis in this graphic is the street right next to the park, and this street, which heads west, is located on the school route as a street that leads directly to Nisantepi School.

Another data revealed in the axial analysis is the global *integration* value (Figure 5b). Integration is defined as "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." by Klarqvist (1993). When the global integration graph is taken into account (Figure 5b), it is noticed that the area to the northwest of Kavaklı Street next to the park is closer to the reddest and orange colours of the graph. According to the space syntax, areas with these warm colours are integrated spaces that have the potential to attract more pedestrian movement, due to their longer and higher visibility axes. Thus, in other words, it has been revealed that this region that leads to school is the region with the highest mobility potential in terms of walkability. In addition, it is in an intense integration relationship with the axis where the commercial units located in the northernmost part of the region are currently located. In other words, the school road route and the trade axis have integration values that reinforce each other's pedestrian density. When the west and south sides, where the cold colours are predominant towards the blue, are examined, the presence of a cemetery bordered by the forest in the west and the fact that the roads reaching the university campus in the south are in one direction cause these regions to be deep.





Figure 5a. Connectivity graph.

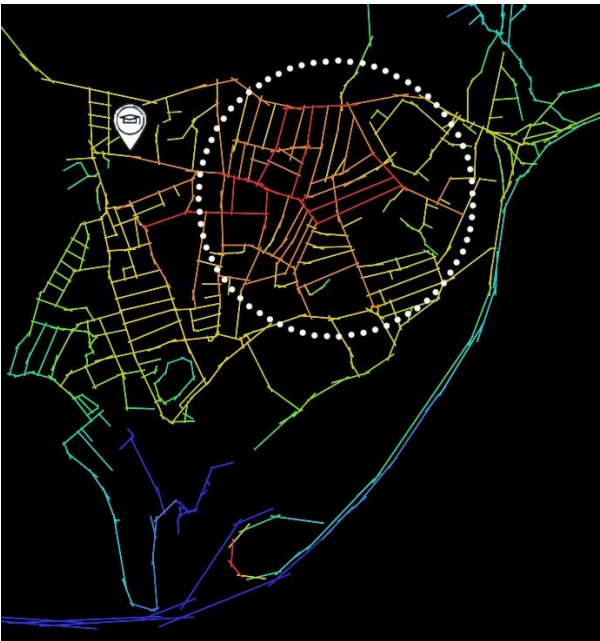


Figure 5b. Global integration graph.

The axial graph of Nisantepi Neighbourhood was examined through local integration values as well as global integration values. In this context, while the global integration value shows the large-scale movement network and its impact on land use, the local integration values show the features and potentials at the micro-scale (Bafna, 2003; Hillier, 2007). Therefore, the R3, R5 and R7 local integration values of the region were expected to demonstrate the micro-scale mobility potentials of the urban grid. When the related analyses are examined (Figure 6a, 6b, 6c), the R3 local integration graph shows that the street networks with parks in the east and west have a potential for mobility by becoming increasingly dense as observed in the R5 and R7 graphs.

When the relevant analyses showing R3, R5 and R7 *local integration* values are examined (Figure 6), it is observed that the streets right next to the parks in the east and west generate a centre of attraction for their nearby environments and has a potential for mobility by gradually intensifying in the R5 and R7 graphs. In other words, although these two streets with playgrounds are the areas with the highest pedestrian density in the region, other streets that intersect and are adjacent to these streets also have the opportunity to make these areas pedestrian-dense on a local scale.



Figure 6a. Local integration R3 graph.



Figure 6b. Local integration R5 graph.



Figure 6c. Local integration R7 graph.

In the space syntax theory, the value of global choice is defined as “a dynamic *global* measure of the “flow” through a space. A space has a strong choice value when many of the shortest paths, connecting all spaces to all spaces of a system, passes through it” (Klarqvist, 1993), and choice value “measures how likely an axial line or a street segment it is to be passed through on all shortest routes from all spaces to all other spaces in the entire system or within a predetermined distance (radius) from each segment.” (Url 1). Thus, since the *choice* value has the potential of indicating the most easily accessible main streets of the region, choice values in R3, R5 and R7 degrees were also revealed (Figure 7a, 7b, 7c) in addition to the local integration values.

In this framework, the streets of the region that are expected to be the main routes were sought. When the *Choice R3* (Figure 7a) graph is examined, it is observed that the streets adjacent to the park in the east and the park in the west stand out as attractive and preferable streets in terms of walkability. Kavaklı Street, which is syntactically representer as the reddest line in the east, integrates with the retail axis in the northeast direction, increasing the frequency of being the preferred street of the region. Besides, this street integrates with the school route on the northwest axis increasing the frequency of being the chosen street of the region (Figure 7b and Figure 7c). In other words, when the local integration and choice values are examined one by one, it is revealed that while providing valuable data on a micro-scale, these local values feed the global integration value that supports the school route and the active school travel potential of children on foot.



Figure 7a. Choice R3 graph.



Figure 7b. Choice R5 graph.



Figure 7c. Choice R7 graph.

In the analysis stage of the study, visibility graph analysis (VGA) of the Nisantepe Neighbourhood was also carried out based on agent-based analyses to be able to reach the right data about pedestrian movement and generate effective predictions and right strategies to increase the walkability potentials of the region. When the theoretical infrastructure on which agent-based analysis is based is considered (Turner and Penn, 2002; Turner, 2007), this analysis tool, embedded in DepthMapX, creates a simulation environment in which virtual people, called agents, move by choosing where to move within a defined environment according to a certain algorithm. The need for an agent-based analysis in this study is because street widths are not taken into account in axial graphs. However, in the preparation of CAD drawing for the agent-based analysis, the blocks are drawn as closed polygons, thus ensuring that not only the lengths of the streets but also the street widths are taken into account as public space by the software. Because, according to the space syntax theory, not only the visible street length but also the visible width of the street affects the concept of visibility. As a matter of fact, according to the logic of convex space, human movement in one space is considered to depend on the movement and visibility of another. In this context, seeing one another in a convex space creates a *convex isovist* and increases movement. Therefore, the wider the width of a street, the greater the potential for convex isovist formation and the potential to attract pedestrian movement and a “group will collectively define a space” (Hillier, 2007, p.115).

Therefore, considering that the new street network shaped by the lately built housing estates in the region may have an impact on the walkability potentials of the region, the effect of the convexity of the streets has been revealed through agent-based analyses (Figure 8). It was revealed that the main road in the east-west direction, which is located in the north of the region and forms a border with the forest, has a potential for mobility due to both its width and relative linearity. This is not a surprise, as this street already constitutes the commercial axis of the region and is an area where small-scale markets, restaurants, butchers, and workshops are located. The interesting part is the potential for increased mobility from this commercial axis south towards the school road. The situation that creates this flow is also related to the width of the street extending to the south. Furthermore, the second important issue that emerges in Figure 8 is about the street in the south of the region and extending in the east-west direction. The construction of commercial spaces planned within a gated housing community located just south of this wide street and appealing to the middle-upper income group continues. Therefore, this current situation is assumed to provide a pedestrian acceleration that will probably create another important pedestrian movement in the region due to both the commercial use initiative of the construction company and the width of the street.

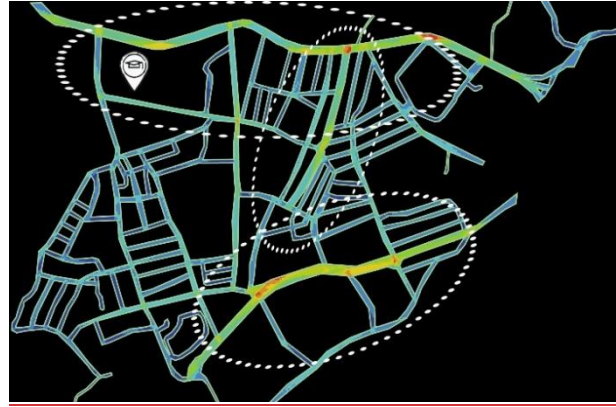


Figure 8. Visibility graph analysis (VGA) of the region generated by agent-based analysis.

Therefore, as a result of the pedestrian mobility of different income groups in the north and south, other vertically connected streets, including the school route, which is located between these two axes, also have the potential to transform into regions with increasing integration value and pedestrian movement, as confirmed in the connectivity and global integration graphs (Figure 5). To demonstrate this situation, while the agent-based analysis simulation was going on in DepthMapX, a screenshot was taken every minute for 10 minutes (Figure 9). In this way, it has been shown how the convex isovist value of the two main axes located in the north and south has changed, and at the same time how the integration value of the intermediate axes intersecting with these two main arteries gradually increases (Figure 8).



Figure 9a. 1<sup>st</sup> minute of the agent analysis.



Figure 9b. 2<sup>nd</sup> minute of the agent analysis.



Figure 9c. 3<sup>rd</sup> minute of the agent analysis.



Figure 9g. 7<sup>th</sup> minute of the agent analysis.



Figure 9d. 4<sup>th</sup> minute of the agent analysis.



Figure 9h. 8<sup>th</sup> minute of the agent analysis.

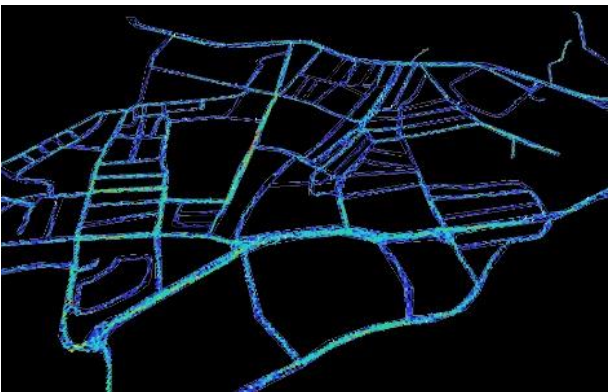


Figure 9e. 5<sup>th</sup> minute of the agent analysis.



Figure 9i. 9<sup>th</sup> minute of the agent analysis.



Figure 9f. 6<sup>th</sup> minute of the agent analysis.



Figure 9j. 10<sup>th</sup> minute of the agent analysis.

According to the results obtained, the movement activity in the region and the *eyes on the street* (Jacobs, 1961) seems to increase gradually over time. But how will these results, which emerged in the axial and agent-based visibility analyses, affect the public space use of children living in the area, which is the main subject of the study, and especially the walking route to school? How will the new housing estate developments and the formation of new commercial axes in the region affect the walkability potential? Moreover, what kind of strategies can be suggested in this construction process by the local authorities, which is the main hypothesis of the study, which can effectively improve the safe and free outdoor play and walking to the school of local children living in the region? But how can the public use of local children be affected as the density of a higher socioeconomic group in the region increases? In the conclusion, some suggestions are given to support the active public use of children living in the region.

## CONCLUSION

The outcomes obtained in the study showed that the changing morphological structure of the Nisantepi Neighbourhood has some potential that supports children's outdoor public use and safe school travel. Therefore, the public spaces and streets of this informally planned housing area where the street is used so actively by children can be improved to support children's safe participation in the urban domains and their experience of walking to school. This environment, which already has a high potential for walkability, can contribute to the physical and social development of children with on-site urban interventions and new sustainable strategies that can be implemented with the support of local and metropolitan municipal authorities. Moreover, with the integration of a largely applied social and urban project with the participation of residents, the region can be comprehensively addressed on behalf of the physical, social, and economic sustainability of the region, as well as supporting the physical and social development of children. Therefore, within the scope of this study, the morphological urban characteristics of Nisantepi Neighbourhood, which is an informally planned housing settlement in the Çekmeköy district, were discussed in terms of the walkability potentials of the streets leading to the school.

It is a subject worth considering and researching that children prefer the sidewalks, tree stumps, sandboxes, puddles, and natural mounds offered by the urban topography although they are generally motivated to play in the *intentionally* designed type of play areas as it is stated by Chawla (1991). The information to be obtained from such research can help to obtain a database that sheds light on how the built environments can be made more suitable or improved according to the competence and skill

levels of children. On the other hand, it can contribute to the creation of guidelines on the design of more inclusive and sustainable housing areas that affect new decision-making processes regarding public spaces in all size and scale used by children. In this context, this study also focuses on how the public use of children of Nisantepi, who produce unintentional play scenarios, can be developed in a safer way and in a manner that supports their physical, social, and cognitive development.

Urban intervention strategies that have been developed to be applied especially to streets with high integration and connectivity leading to schools are described. Syntactic analyses revealed in this study based on the morphology of the urban grid can shed light on how land uses can be improved in areas with the walkability potential of the region. Increasing connectivity, global integration, local integration, choice, and visibility values, especially towards the school route, demonstrate that this already rising potential of the walkability of the region may encourage local governments to take new decisions regarding child-centred land uses in the region.

Considering the regulations in Turkey that some of the children go to school in the morning and some in the afternoon, it can be considered to provide the region with places where children can spend their time more efficiently and support their education and development. Buildings where free courses, workshops, and activities such as a children's library, and a children's cultural centre are held, seminars where children can attend with their parents, and a new land use planning where activities such as playgroups can be organized in the region may be among the future strategies of the local municipality. Soup kitchen, community centre, where not only children but also their families can benefit together, life-long education centres where certified training are organized, and vocational courses for women to join the formal workforce can have positive effects on the education and development of not only children but also the new generation growing up in the region. Therefore, the increase in pedestrian movements may not only support the safe use of outdoor public use by children, but also new land uses may support the revitalization of the area by increasing the pedestrian movement on the one hand, and the formation of a lively and sustainable housing community that is socially and economically self-sufficient on the other.

## Disclosure statement

No potential conflict of interest was reported by the author.

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