...::KENT AKADEMİSİ | URBAN ACADEMY

Volume: 16 Issue: 3 - 2023 | Cilt: 16 Sayı 3 - 2023

ARTICLE INFO | MAKALE KÜNYESİ
Research Article | Araştırma Makalesi
Submission Date | Gönderilme Tarihi: 21.09.2022
Admission Date | Kabul Tarihi: 11.07.2023

CITATION INFO | ATIF KÜNYESİ
Korkmazyürek, B., Kahraman, S., Polat, E. (2023). Connectivity of Urban Spaces Typology and Urban Mobility Topology, Kent Akademisi Dergisi, *16*(3):1477-1496. https://doi.org/10.35674/kent.1177971

Connectivity of Urban Spaces Typology and Urban Mobility Topology

Kentsel Mekânlar Tipolojisi ve Kentsel Hareketlilik Topolojisinin Bağlantısallığı

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Öz

Mekân; sürekliliğin ve bağlantısallığın algılanabildiği ontolojik ve epistemolojik katmanlardan oluşan bir yapıya sahiptir. Bu yapıyı ve katmanlarını doğru anlayamamak, kentsel mekânı ve bu mekânda yaşanan sorunları da tam olarak anlayamamak ya da kalıcı olarak çözememek anlamına gelmektedir. Buradan hareketle çalışmada, mekânın tüm katmanlarıyla doğru ve bütüncül olarak anlaşılabilmesi için mekânsal katmanlar arasındaki bağlantısallığa dayalı kuramsal bir yaklaşım geliştirilmeye çalışılmıştır. Çalışmanın nihai hedefi; geliştirilen yaklaşımın mekânsal problemlerin çözümünde ve mekânı doğru ve bütüncül anlayamamaktan kaynaklanan eksikliklerin giderilmesinde destekleyici olup olmadığını sınamaktır. Bu amaçla örnek bir alan üzerinde kalıcı (hınzır) mekânsal bir problemin işleyişi gözlemlenmiştir. Örnek alan olarak bir yeşil alan belirlenmiştir. Kalıcı problem olarak günümüz kentlerinin en temel sorunlarından biri olan "Kentsel Ulaşım" seçilmiştir. Kentsel ulaşım kapsamında ise doğrudan mekânın deneyimlendiği insan ölçeğini ilgilendiren ''Sürdürülebilir Kentsel Hareketlilik'' olgusu üzerinde durulmuş ve geliştirilen yaklaşım gözlem yoluyla sınanmıştır. Yapılan gözlemler geliştirilen kuramsal yaklaşımın mekânın doğru ve bütüncül olarak anlaşılması ve kentsel hareketlilik gibi kalıcı mekânsal sorunların çözülmesinde önemli bir potansiyeli olduğunu göstermiştir. Bu yaklaşımın özellikle uygulama ölçeğinde daha işlevsel olduğu, planlama ve tasarım süreçlerine yön verebileceği belirlenmiştir. Yaklaşımın kentin ölçeği ya da kentsel işlevin türü farketmeksizin uygulama ölçeğindeki tüm sınamalarda etkin olabileceği anlaşılmıştır. Çalışma, kapsamlı bir saha araştırması olmayıp, çalışmada, mekânı doğru ve bütüncül anlayamamaktan kaynaklanan eksikliklerin kuramsal temelde yapılacak geliştirmelerle giderilebileceği üzerinde durulmaktadır. Gözleme dayalı analiz ve incelemeler geliştirilen kuramsal yaklaşımın anlaşılmasını kolaylaştırmayı amaçlamaktadır. Çalışmanın dayanak noktası ise; mekânın fiziki boyutundaki ölçümlerin, mekânın anlamı olarak ifade edilen diğer boyutları olmadan, planlama ve tasarımı başarısızlığa götürdüğüdür.

Anahtar Kelimeler: Mekân Katmanları, Topografya, Tipoloji, Hodoloji, Kentsel Hareketlilik Topolojisi

ABSTRACT

Space; It has a structure consisting of ontological and epistemological layers in which continuity and connectivity can be perceived. Not understanding this structure and its layers correctly means not being able to fully understand or permanently solve the urban space and the problems experienced in this space. From this point of view, in this study, a theoretical approach based on the connectivity between spatial layers has been developed to understand the space accurately and holistically with all its layers. The ultimate goal of the study is to test whether the developed approach is supportive in solving spatial problems and eliminating the deficiencies caused by needing to understand the space correctly and holistically. For this purpose, the operation of a permanent (wicked) spatial problem on a sample area has been

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observed. A green area was determined as a sample area. "Urban Transportation", one of the most fundamental problems of today's cities, has been chosen as a permanent problem. Within the scope of urban transportation, the concept of "Sustainable Urban Mobility", which directly concerns the human scale in which the space is experienced, was emphasized, and the developed approach was tested through observation. Observations have shown that the developed theoretical approach has significant potential in accurately and holistically understanding space and solving permanent spatial problems such as urban mobility. It has been determined that this approach is more functional, especially at the application scale, and can guide the planning and design processes. It has been understood that the approach can be effective in all tests at the application scale, regardless of the scale of the city or the type of urban function. The study is not a comprehensive field research, and it is emphasized that the deficiencies arising from the inability to understand the place correctly and holistically can be eliminated with developments to be made on a theoretical basis. Observational analyses and scrutinies aim to facilitate understanding of the developed theoretical approach. The mainstay of the study is; is that the measurements in the physical dimension of the space, without other dimensions expressed as the meaning of the space, lead to failure in planning and design.

Keywords: Space Layers, Topography, Typology, Hodology, Urban Mobility Topology

INTRODUCTION:

Space; has a structure consisting of ontological (topographic and typological) and epistemological layers of knowledge (topological and hodological), in which continuity and connectivity can be perceived. Space emerges as a condition for the existence and knowledge of objects. In this respect, it has both ontological and epistemological value (Kahveci, 2017). In the context of the ontological approach, while the dimension of meaning associated with physical space comes to the fore, epistemologically, the transfer of knowledge and the known, that is, relational interactions, gain importance (Ersal, 2013). The spatial layers described later in the study were developed based on this assumption. These layers represent the physical and semantic components of the topography (ontological) and the worlds of perception woven from relations (epistemological). Cities are the right place to look to understand this structure, which consists of complex dynamism between layers. Spatial layers exist separately in the complex (Polat & Dericioğlu, 2020) urban structure with their ontological and epistemological information, and at the same time, they display an integrated one within the other. Defining this structure and its layers incompletely or not understanding it correctly means not being able to understand or permanently solve the urban space and the problems experienced in this space.

For example, approaching the urban space, which exhibits a multi-layered structure, only from the physical dimension has resulted in both being unable to understand the space and not solving its problems permanently. However, there are also studies that approach the space topologically from semantic and relational dimensions and examine its relationship with urban morphology (Kürkçüoğlu and Ocakçı, 2015; Tsiotas and Polyzos, 2017 etc.). Dealing with urban space only with its physical or several different dimensions is not enough to solve some spatial problems such as "urban mobility (and urban transportation)," which Tekeli defines as "wicked problems." Such problems are ongoing problems that may arise again as soon as they are thought to be fully resolved (Tekeli, 2021). The most accurate examples are transportation problems that continue to increase in urban space. At this point, it is understood that understanding the space with all its layers correctly and handling it holistically by using connectivity between them may be the keys to producing permanent solutions to wicked problems. The study aims to investigate whether the above switch can be effective in intervening in existing permanent problems. In addition, it is desired to question the role of reflecting the connectivity between spatial layers on another layer in understanding the space correctly and holistically.

From this point of view, the scope of the study is as follows; First of all, a theoretical approach has been tried to be developed from a different perspective to understand the space accurately and

holistically with all its layers. Afterward, the functioning of a wicked problem was observed to understand the effectiveness of this theoretical perspective in solving spatial problems. Urban mobility and, therefore, urban transportation has been chosen as the wicked problem, and the reasons for this choice are explained at the end of the introduction. The unique aspect of the study that distinguishes it from classical urban morphology and topological approach studies is that it deals with a permanent problem with theoretical development, observes this problem and its effects through a sample space, proves the effectiveness of the key theoretical solution it claims in this way and offers solutions (the quality of the selected sample space and why it was chosen is explained in the following sections). Although it is thought that this situation will limit the generalization of the results declared by the study, it is understood in the conclusion section that there is no obstacle in interpreting the results obtained for the entire urban structure.

From this point of view, the operation of the study, which is understood to proceed in two stages, is as follows; In the first stage, the developed theoretical approach is presented. This approach has fiction based on the reflection of the connectivity and information between the spatial layers on one another to understand the space accurately and holistically. The spatial structure in this fiction is a total of four layers, two of which are topographic and typological, physical, one topological, perceptual, and the other hodological, cognitive. These layers, which aim to deal with the space holistically and include the physical, semantic, intellectual, relational, perceptual, and cognitive dimensions, are explained in detail in the following study sections. It is known that spatial problems cannot be solved permanently due to the only physical layers being taken into account when considering space. For this reason, this study it is aimed to reach a holistic and accurate space analysis by reflecting to physical layers the connectivity and knowledge between perceptual and cognitive spaces that are often ignored or not known at all.

After understanding and analyzing the spatial layers, in the second stage, the connectivity between the developed theoretical approach and the permanent solution of urban mobility problems is tested with observations on the sample area. As a result of the observations, the developed theoretical approach effectively understands space accurately and holistically and has an important potential in solving permanent spatial problems such as urban mobility. It has been determined that it is more functional, especially at the application scale, and directs the planning and design processes.

In addition, the reason for focusing on urban mobility as a permanent (wicked) problem in the study is that physical concerns usually shape the analysis of urban mobility. Semantic components based on individual and social perception and cognition are ignored. This traditional method cannot solve the increasing transportation problems, and new developments from different perspectives are needed for a permanent solution. This situation is similar to developing a theoretical approach from different perspectives to understand the space accurately and holistically. In addition, transportation and mobility systems, intertwined with the layers of urban space, are one of the main reasons for the user's perception and reading of the city.

1. Methodology

In the study, which is explained in the introduction to consist of two stages, a dual method was followed. First, It is a literature search for theoretical development based on the use of connectivity between spatial layers, which is designed to understand spatial layers accurately and holistically. After the method section, the literature obtained from this study is presented in four separate sections (2-5). The chapters begin with an essential discussion of space, place, and spatial distinction and continue by examining the connectivity between the physical space layers (topographic and typological) and the perceptual space (topological) layer. At this stage, a triple spatial diagram development based on the

isometric representation technique is presented between these layers. All schematic representations in the following sections are given with the same technique and in connection with each other.

The next section questions the connectivity between the topological (perceptual) dimension and urban mobility. As a result of the inquiry, the triple diagram and urban mobility are integrated into each other in a theoretical dimension, and when read holistically as such, urban mobility evolves to a "trans-mobility" dimension. This whole process is explained using the quaternary theoretical diagram developed over the triple diagram. The next section deals with cognitive (hodological) space. It is explained that this spatial layer is a fifth and different layer, influenced by the previous quadruple structure but beyond them. This situation, expressed as trans-topology, is presented with the theoretical five diagram developed from the quadruple diagram. Looking at the whole, all new conceptualizations developed in the mentioned four chapters are explained with diagrams.

This research; does not address a comprehensive philosophical discussion within the space, ontology, and epistemology framework. While the spatial distinctions and layers are being discussed, the holistic context has been preserved with the meta-philosophical concepts of epistemology and ontology, with the concern of not losing the holistic meaning of the space. From this point of view, the concepts of ontology and epistemology have been interpreted from different angles to support the context of the study. The situation expressed as the reflection of the epistemological dimension of the space to the ontological dimension is that the meaning of the space should be handled by harmonizing the relational, psychological, individual, and social perception dimensions with the physical space. From this point of view, in the study, space within the framework of epistemology and ontology; has been handled in 3 different dimensions pragmatic (physical), perceptual (intellectual), and cognitive (social), and these have been examined in 4 different layers as topographic, typological (pragmatic), topological (perceptual) and hodological (cognitive). The place of urban mobility, explained in the following sections and linked to spatial layers, is also questioned within this framework. Thus, it is aimed to reveal the relation of urban mobility with spatial layers. After all, From topography to urban space typology, from topology to hodological space, it is aimed to establish a theoretical spatial bridge over urban mobility sampling.

After the theoretical part is completed, the test on the sample area is started. Observations were made in the sample area to investigate the effectiveness of the developed theoretical approach in solving permanent (wicked) spatial problems. These observations were made at random intervals and at varying times in 2019-2020. The reason for this is to be able to interpret the social traces created by the user's perception of mobility and the awareness of using the space without basing it on any reason. Obtained inferences were schematized isometrically on satellite images using the technical field study method. "Isparta Belediye Park" (Coordinates: 37°46'56.91"N, 30°32'45.70"E), located in the city center of Isparta (Turkey) and one of the most intense urban mobility areas, was chosen as a sample area (Figure 1).

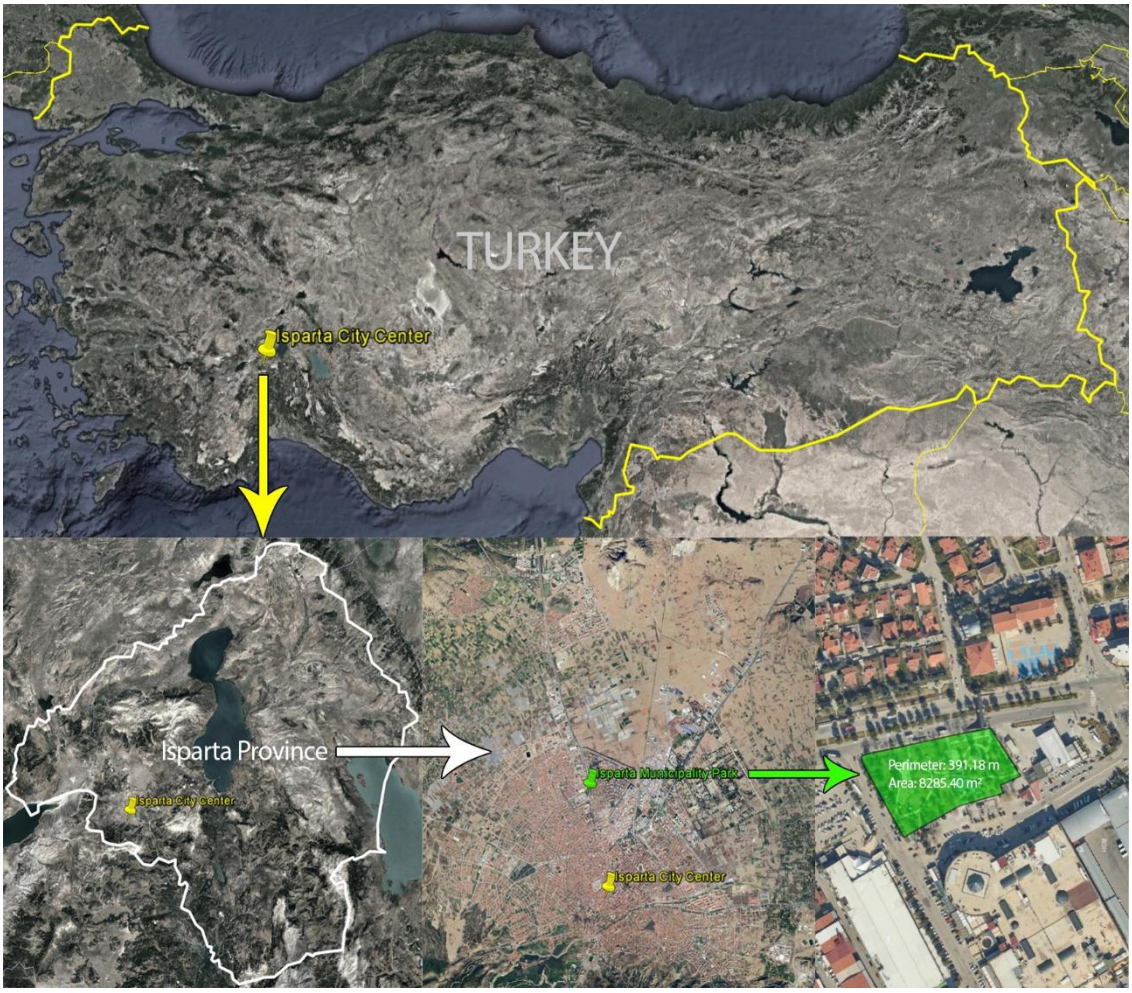

Figure 1. Sample Area and Location

The reason for choosing this area is that it is one of the nodes in the mobility network of the citizens. This medium-sized park has the potential to represent different spatial layers for urban residents when viewed with a focus on social and user mobility. This recreation area is a transition and pause area with a high perception of mobility, accessibility, and witnessing social life. In addition, the technical proximity between the research institution and the sample area ensured the continuity of the observations. Because the same test can be made on any city and any urban function, regardless of the selected sample area, all areas of mobility and space will be able to present observations for this questioning. The findings are presented and discussed in the sixth section, and the study is completed by interpreting and evaluating all the inferences in the last section.

Research on the sample area should not be read as an accessibility study. Due to the scope of the research, some imperatives focus the study on urban mobility rather than accessibility. The most important of these is to focus not only on physical space but also on the multidimensional relationships between "things." Also, the main factors are the desire to examine the consequences of genetic and instinctive spatial experience and to observe the ability to create mobility by conscious choices compared to accessibility. For these reasons, quantitative measurement methods were not used in the sample areaThe mainstay of the study is the argument that the measurement results obtained in the physical layer, without other dimensions expressed as the meaning of space, lead us to failure in planning and design. In addition, considering the dimensions and infinity of the hodological space, it would be more rational to observe the preferences filtered from the individual and collective social mind instead of measurement. The results obtained from the selected sample area also support this

situation. In the study, it is accepted that mobility is under urban transportation, and the explanation of the concepts of transportation, accessibility, and mobility is not emphasized. From this perspective, these concepts are open to study-specific interpretations.

2. Urban Space and Place: Spatial Distinctions and Layers

In many fields of science, space is defined as ontological or epistemological, and the components (layers) that make up space is tried to be understood. Harvey (1988) emphasizes the importance of understanding space by saying, "It is vital to define an appropriate concept of space to understand urban phenomena and society." For this reason, before focusing on the ontological and epistemological layers of space, examining the origin of the word "Space" and its meanings is worthwhile. Harvey (1988) about it; "Once we understand what space is and find a way to show it, then we can put our understanding of human behavior into a general concept of space and enter into the analysis of urban phenomena," he says.

The word "Space" originates from the Latin word "Spatium (empty area)" ("As of March 20, 2021, the online-latin-dictionary.com listed on its website"). Space is an important concept that aims to indicate the ontological and epistemological layers of living environments (Zlatanova et al., 2019) and can be defined as "Physical boundaries existing in the material world, immaterial mental dimensions, and perception and experience over time." (Karadede & Yavuz, 2018). In the dictionary, it is also defined as "Place, area, locus" ("As of March 15, 2021, the dictionary.cambridge.org listed on its website").

As the definitions show, space has different layers that qualify as place and time. Harvey (1988) says this; "Space is not absolute, relative or relational in itself, but it can be one or more of them depending on the situation." The meaning of space is often confused with "Place." Space is more abstract than a place. What begins as an undifferentiated space becomes a place as we get to know it better and care about it. Place and space can be distinguished because one is safe and stable (place), and the other is free and available to danger. Also, if we consider space as something that allows mobility, then the place is the pause; each pause in mobility makes it possible to transform the space into the place (Tuan, 1977).

In Western geography, space has been treated as absolute and conceived as a fixed, empty container where everything occurs. This type of space is directly understandable by measurement and calculation. However, space has other layers also, relative and relational, with their similarities and differences from absolute space. The most basic way to understand relative space is to think of space not as an empty container and as a volume with objects and relationships. Relational space, on the other hand, is not the space where processes occur but where processes determine their own space. In this regard, space is in the process. At the same time, space is not an isolated concept here but is together with "Time." In addition, social processes dominate space in relational space (Ankara University Online Open Courses. 2021. "Basic Concepts in Geography Lecture Notes." Accessed March 8, 2021. https://acikders.ankara.edu.tr/).

Soja (1996) states that space is in social reality, and social reality does not have an accidental spatiality. In other words, he suggests that space is both an instrument and a result of social life. Four main spatial distinctions exist private, semi-private, semi-public, and public (Figure 2). Under the basic spatial distinctions, the types of space are diversified. For example, natural/semi-natural, lost, residual, transition spaces, etc. (Carmona, 2010).

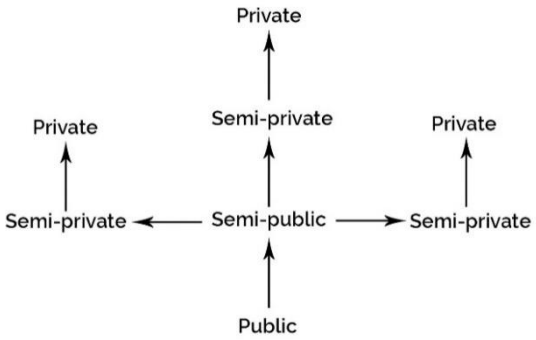

Figure 2. Urban Space Distinctions (Trancik, 1986)

Arefi and Triantafillou (2005) refer to Tuan (1977) and say, “Through daily experience, we transform geometric space into lived space by incorporating values, social and cultural meaning.” In other words, space is experienced both directly at a concrete level and indirectly through concepts and abstractions. Lefebvre, who conceptualizes space in a mental and material structure, refers to this situation as a “Concrete abstraction” or a “Realized abstraction” (Mommersteeg, 2014). Madanipour (2003), on the other hand, says that the body of an individual occupies a position in both physical and social space, and the connection between these two is direct and mutual.

These two dimensions are also found in the space theory developed by Norberg-Schulz (1971). The first is the “Euclidean (Geometric/physical),” and the second is the “Mental” dimension based on perception and observation. In addition, Norberg-Schulz (1971) classifies space as pragmatic, perceptual, existential, cognitive, and abstract. On the other hand, Soja treats the space with a triple classification. According to Soja, the real space (the first space) is the nature experienced in it, the physical space. The mental space, which includes logical and formal abstractions, is the imagined space (The second space). The perceived space (the third space) is the social (produced) space. Soja states that the primary space is real, the secondary space is imaginary (Çetin, 2010), and the third space is a social space corresponding to a different spatiality from the first and second space, that is, physical and mental space (Solak, 2017).

When the spatial distinctions above are examined, it is seen that the space is expressed in two main distinctions, physical and intellectual. However, Soja's triple classification aligns more with the study's aims. Based on this three-dimensional spatial classification, the study focuses on four spatial layers, pragmatic (physical-first space (topographic and typological)), perceptual (intellectual-semantic-second space (topological)), and cognitive (social-generated-third space (hodological)). Pragmatic space is the material space that exists with its physical dimension. Perceptual space is a sensual, emblematic, and impressionistically whole obtained by the perception of the data of the elements that make up the space by a person (Ak, 2006). Cognitive space, on the other hand, is the mental schemas created on the physical universe and spatial relationships (the main space in our minds).

3. Pragmatic Dimension: From Topography to the Typology of Urban Spaces

Although topography (topos) expresses the landforms and features, it is a complex concept that also represents etymologically "the narrative of a particular place." This expression refers to an intellectual rather than physical meaning but is not usually used in that sense. Because both our individual and occupational subconscious minds prioritize physical expression in our perceptions, causing us to imagine a place according to its geographical characteristics, just like a map (Yürekli, 2014). This perception of topography causes it to be seen as a natural plane and not sufficiently focused on its existence and meaning in the intellectual dimension. This means we cannot master the complex set of meanings that topography carries, and therefore we lack an understanding of space. Because

topography is a fundamental, physical, and intellectual space that affects, shapes, and makes sense of the space systems created on it in all its dimensions. Topography, the absolute and relative location of all spatial dimensions, is the main space of mobility also.

The basic element that takes the topography beyond a natural plane and creates its existence and meaning in the intellectual dimension is the relational movements (human mobility) and artificial components (human structures). These are shaped according to the state of the topography. How, where, and what organizes human structures (which make up physical settlements) directly depends on topographical conditions and features. Relational movements, which can be perceived as a straight line between two points under normal conditions, are projectively reinterpreted and created by being influenced by the topography and these physical settlements. Even if the destination does not change, there are intertwined connectivity between physical settlements and topography, with these relational movements whose route is changed and reshaped due to the pragmatic dimensions of the space.

The complex and variable structure of the topography causes the physical settlements formed by being influenced by it to be differentiated and shaped into various types. To understand and analyze this complex existence of physical settlements in an orderly manner, it is necessary to classify these types according to their specific characteristics. Types refer to urban abstractions derived from social conceptualizations related to spatial information, and the typology they create is buildings, streets, neighborhoods, etc. it represents the physical inventory (Stojanovski, 2019). “Typology” refers to studying types and classifying objects based on physical or other characteristics (Güney, 2007). To understand the typological dimension of space, the study focuses on urban typology shaped and directly influenced by topography because urban spaces are the campus of relational movements (topological dimension) that will be formed by being influenced by topography and typology.

Understanding the typology of a city is the topography of that city and its physical components (buildings, squares, roads, parks, etc.) are to understand. In addition, it is possible to read the users and their relational mobility (topologies) that make this typology a living space. Although urban typology studies the urban space by dividing it into physical parts, the parts cannot be isolated from each other and the whole. To ensure dynamism and connectivity between parts, the need for relational actions reminds us that space is a system.

After this system's topography and typology dimension, the topology dimension transforms the space into a meaningful whole by providing connectivity, just like the mortar that unites the bricks. The projections and nodal points that the mobilities between two points (A-B) re-created by being influenced by topography and typology are perceived in a topological dimension representing the relational actions of space. From the outside, space's topographic, typological, and topological dimensions are like a whole perceived together. But it also has an isometric structure formed by overlapping layers inside themselves, with connectivity between them. This isometric structure developed by the authors and called the "3T (topography, typology, topology) diagram" is in Figure 3.

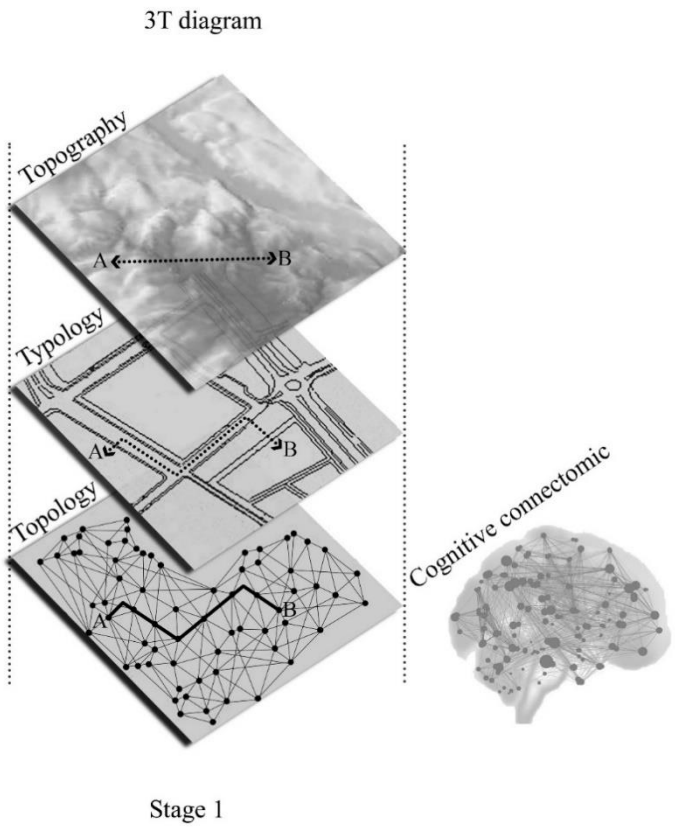

Figure 3. 3T Diagram (developed by the authors)

The 3T diagram assumes that topographic space is the first layer that can be physically perceived within the spatial structure in the process extending to cognitive space. In this layer, the relationship between two points (A-B) can be read in a two-dimensional plane, the semantic dimension of which is ignored. In the next step, a typological layer emerges, shaped by topographical realities and where relational interactions become more meaningful. This layer is the second of the physical layers. The space shows the meaningful wholes and relations that have begun to transform into places together and in an orderly manner. In this layer, relational interactions are shaped in different projections with the effect of topography. Buildings of different heights, uphill roads, trading units that follow the shape of the riverbank, etc., can be given as an example.

In this layer, the relationship between A-B is established in three dimensions, and the determined tracks must be followed to reach the destination. It is also possible to develop many alternatives to going to the destination. When these two physical layers are read together, it is seen that a third and semantic layer, namely "topology," emerges where regular and reproducible networks (mobility network system) are established on them thanks to individual and social perceptions. Nodal points are formed at the intersections of these. Although the relationships in this layer are affected by the physical layers, they are mainly knitted from knots, intersections, perceptions, conscious or genetic, individual or social perceptions, and stories. Not all of them can be read as a whole by individual or social perception, and these relationships are often not fully mapped. For example, the probability of the roads to be used by someone who will leave the house in the morning and go to work by car is sufficient to estimate the size of this complex and dynamic structure.

From this point of view, it is not wrong to define these network relations and actions in the topological layer as an urban mobility system that connects concrete or abstract components. This situation will be easier to explain if exemplified by the concept of “Connectomics”, which means the study of structural and functional connections between brain cells. Connectome means visualizing connections

in the brain, mapping the connection topology of the brain. This is a network map were all relational actions between cells can be described and studied into a meaningful whole (Figure 3). As in the example of mortar between brain cells and bricks, urban mobility is the component that shows all connections and actions in a meaningful whole in the city.

The topology of urban mobility, on the other hand, is the relational dimension of all concrete and abstract actions and meaningful mobility in urban space. For example, a product obtained by putting a mortar between two bricks does not make sense alone, while the structure obtained by combining them gives a new meaning to the whole, just as relational actions between geometric forms turn spaces into living spaces. Proceeding from this, the fact that the actions taking place on topography and typology and the new and holistic meaning that arise from their combination are intertwined but different shows the importance of the topological dimension in understanding and analyzing space.

4. Perceptual Dimension: Urban Mobility Topology and “Trans-mobility”

Although geometric space and living space are the unifiers of human life, the reason why social processes dominate space more is mobility (Osti, 2005). Because space is not just a thing, it is a series of relationships between things (Mommersteeg, 2014). The component that best represents these relationships is urban mobility, which can be produced individually or socially. Movement is the displacement of people, objects, capital, ideas, and other information (Kaufmann, 2012). Mobility is the totality of movements created by elements that gain momentum for displacement. Urban mobility, on the other hand, is part of physical mobility; it means displacement in urban space, which is fed by social mobility also. However, the dimension of urban mobility that feeds from social mobility and forms the meaning of perceived space is often overlooked. Harvey (1988) draws attention to the negativity in this regard by saying as follows;

...the urban planner, when making a planning decision on a particular piece of land, was hardly benefited from the collected and hardly provable generalizations of the district scientist, economist, or sociologist. He was painting the plots on the planning map red or green according to his intuitions about the spatial form, evaluating the economic and social factors roughly as far as he knew...

In the urban mobility approach, if space is treated mainly with its physical dimension by ignoring the social dimension, it will not be able to realize its goal of understanding, predicting, and managing the mobility created as a result of relational interactions with optimal benefit. Because urban mobility is an approach focused on managing spatial relationships that include user mobility created by individual perception and the mobility of society formed as a result of social perception. The realization of this goal will not be possible by ignoring the semantic dimension of space and focusing only on physical space. Harvey (1988) said about this, “If we see space as an absolute concept, it becomes a 'thing-in-itself' independent of matter and has a structure where we can distinguish and classify phenomena.” In the sequel, he says, unlike absolute space, “The relative view of space, on the other hand, requires that space be understood as a relationship between objects that exist only through the existence of interconnected objects.” The topological dimension of urban mobility expresses the whole of these relations that can be perceived in the space, the meaning of the space, its social dimension, and its intellectual component.

Etymologically, topology refers to the logic of space; that is, it is more semantic than a geometric understanding of space (Cerrato, 2020). In this regard, Harvey (1988) uses the concept of "Sociological imagination," which refers to the mobility occurring in relative space. Emphasizing the logic of space, this concept is defined as "An individual's understanding of the role of space and place in their own life story, associating it with the spaces they see around them, and understanding how the processes between individuals and various organizations are influenced by the space that decouples them."

Heidegger too, he sees the understanding of physical space as secondary to more existential concepts (Malpas, 2006).

Topology is a spatial framework that studies how spaces, substances, and objects are generated through mobility, transformations, events, and relational occurrences (Baxter, 2021). Topological thinking suggests that the distance between spaces is less important than the relationship between items (Hoffman & Thatcher, 2019). A topology is essential for understanding city connectivity and spatial relationships between street and infrastructure networks with buildings and public spaces. The semantic relationship of topology with urban mobility is that it associates it with the necessary functions, just as the substances in the blood reach the cells of the corresponding organs (Brelsford et al., 2018).

Recent research on road networks and topologies of cities with different geographical features using complex network analysis has shown similarities between these cities' road networks. This similarity between the road networks of other cities can be explained by the "Organic space" concept, which Harvey describes by reference to Cassirer (1944). Harvey (1988) defines this space, which also refers to the topological dimension, as "It is related to the spatial experience that seems to be transmitted genetically, that is, biologically determined. Many behaviors that ethologists study (instinctual direction finding and migration, instinctual habitat acquisition, etc.) fall into this category," he explains. In the continuation of the spontaneous direction-finding situation, Harvey (1988) states;

...each person lives in the network of spatial relationships he weaves in his geometric system. All this could have been a depressing sight from an analytical point of view, but people and groups form largely similar ideas in the face of the space that surrounds them and take similar paths in their assessments and behavior within the space…

All this proves how decisive the topological dimension consisting of the meaning of spatial relations, is in the development of urban mobility (Tsiotas and Polyzos, 2017). Proceeding from this, the necessity of considering the urban mobility approach with its social dimension and physical dimension obliges us to look at this approach from a new perspective. Because current perspectives consist of voluntary or involuntary subconscious outputs that highlight physical applications, prioritize physical perception even in the intellectual dimension.

At this point, looking at urban mobility from a more accurate perspective is to consider it in a new and fourth layer different from the spatial dimensions mentioned in the 3T diagram (Figure 3) but also covers them (spatial container). Thus, the urban mobility approach will not be exposed to actions that prioritize neither the space's pragmatic nor the perceptual dimension alone. The fourth dimension positions mobility, between the pragmatic and perceptual dimensions of space. Thus, space's physical and intellectual dimensions can be considered together in the context of mobility. The fourth dimension is a spatial container containing transitions and integrations between dimensions, but beyond that, it is a permeable and new dimension. This new dimension, developed by the authors and based on the 3T diagram, is called "Trans-mobility (T4)," and the sequence of space layers is shown in Figure 4.

This spatial container gives the space a holistic effect with all its dynamism. Connectivity between layers integrates with urban mobility, facilitating and providing meaning to physical and intellectual readings. Perceptually, it is seen that the layers are no longer distinguished one by one; only meaningful relationships and the desire to link them are essential. This layer, called trans-mobility, is multiple layer conceptualized with mobility and showing beyond the particular relations between the layers of space.

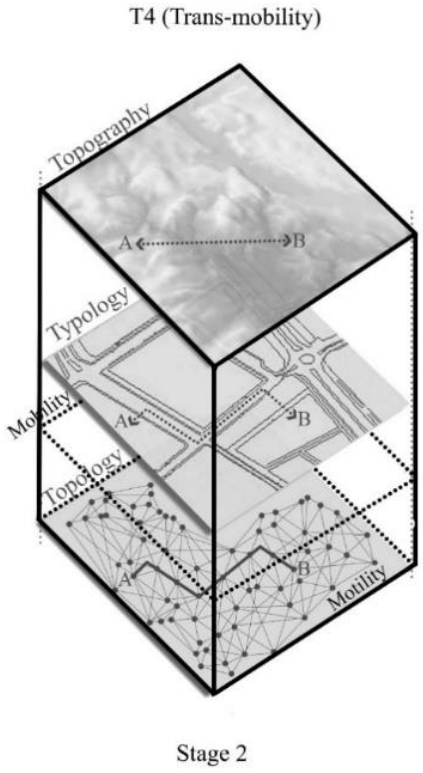

Figure 4. T4 (trans-mobility) Diagram (developed by the authors)

5. Cognitive Dimension: Hodological (trans-topological) Space

According to Lewin's equation of behavior ($B = f(P, E)$), each personal behavior (B) depends on the person's condition (P), as well as on the environment (E). This postulate is directly related to the "Field Theory," which focuses on the idea that a person determines the behavior of his living space (Qi, 2021). Cognitive dynamics in Lewin's formulated field theory; phenomenological (he uses the "Hodological" word), a movement in space, a "Living space" or the person's values, needs, goals, motives, moods, hopes, concerns, and ideals that contains a space is represented as (Wlodzislaw, 2017). Phenomenology argues that the physical world is not a "Real" world that never changes and is the same for everyone. It is a relative world depending on people's interpretations or the meanings they attach to it (Eyce, 2011). From the phenomenological point of view, space is considered the raw material of life and, therefore, a quantity. Because space is the anecessary equipment and raw material for human actions and activities, each entity occupies and consumes a space already existing. For this reason, space is considered the raw material of existence and action (Bilgin, 1990).

One of the examples given by Lewin to understand this living space, that is, the hodological space, is the example of a prisoner-prison. The prisoner is confined to the prison area, which is the area of his bodily movements. But he can think about what is happening outside the prison and mentally act there. Therefore, as long as they think about something outside the prison, it can be said that prisoners' mental and social living spaces are not as limited as the space of their bodily movements (Skowron and Wójtowicz, 2020). The content of this living space, according to Lewin, consists of; the individual's physical surroundings (in this example, the cell where the prisoner is located, the prison, and even the city), relationships with other people (the location of the individual, personality, place in society and social environment) and psychological existence (fears, thoughts, ideas, and dreams). Suppose the first two components are seen together as the physical and relational environment and the third as the psychological environment. In that case, the living space can also be seen as the totality of the physical and psychological worlds. In this sense, hodological space is a psychological space in which human

behavior occurs. Within this space, a person and the environment are considered a dynamic whole (Qi, 2021).

Soja (1989) on hodological space; "As indicative images and cognitive mappings, thoughts, and ideologies, these representations play a strong role in shaping the spatiality of social life. The existence of this humanized mental space, which is a spatialized way of thinking, cannot be denied," he says. Mitropoulos (1974) refers to also Lewin's term "Hodological space" as "The space of possible motion" in reference to Schulz's 1971 studies. The space of possible motion; is described as the shortest, most acceptable, least energy-demanding, and purpose-dependent motion space. In short, he states that hodological space is defined by the activity of movement within the space. This movement is not only towards the targets that appear physically but also the targets on a mental map. With this, in his 1938 studies comparing some features of hodological space and Euclidean space (geometric/physical), Lewin states that direction is the connection between two points in Euclidean space, whereas between two regions in hodological space. While the linkage determining the direction is a straight line for Euclidean space, it is a chosen/determined path for hodological space (Mitropoulos 1974).

"Mind maps," which represent the cognitive structure of hodological space and are the abstract product of a spatialized way of thinking, in Soja's words, can be produced in various sizes and complex systems because the perception of space of individuals or groups is different. There are thousands of topographic, typological, and topological components in the urban structure that will affect the construction of these maps. Hodological space also touches on topography and typology and is influenced by topology's relational situations. This situation is so complex and dynamic in cities that the perception of individuals or groups is not at the level to dominate this entire situation. The perception of individuals or groups is as much as the boundaries of their horizon in topographic, typological, and topological dimensions. This means that their mind maps are limited to a certain level.

Rather than a state of chaos, learned and tried similarities are more functional in finding directions on mind maps. For example, in a city where you are going for the first time, you can think about your first experience achieving the destination you are looking for. No matter how difficult it is for you to accomplish this goal, even if you find out that there is another easy way to achieve it, your second experience will most likely be the same as your first one again. Because this aspect, which has been learned and finalized for you, although troublesome, is easier than adding a new line to the mind map. Proceeding from this, to simplify this complex situation in cities, some stereotyped movements and memorizations can also be seen in numerous hodological spaces formed with different influences. Harvey (1988), based on the statements of Smith, Bruner, and White (1956) on this subject, says;

...in any public, one can see big differences in the ability to read maps, the sense of direction-finding, etc. Considerable diversity can also be found in the way individuals or groups construct mental schemas. Perhaps the easiest way is to learn relationships by heart…

Hodological space, where mind maps are depicted with abstract traces woven with spatialized thought, is influenced by all layers in the spatial container called T4, but it represents another dimension beyond them. Hodological space is a trans-topological space formed beyond the topological dimension, which includes, in particular, the perceptual meaning of space and its relational components. This area, where cognitive behaviors occur, refers to a fifth and different dimension where perceptual components filtered from T4 accumulate. Because space expresses a complex of things that exist simultaneously and are thought to live together (Madanipour, 2013). This structure, which explains how this complex works and is named by the authors as the trans-topological layer (T5), is presented in the diagram below. This diagram shows the relationship between hodological space and the spatial layers of T4 (Fig. 5)

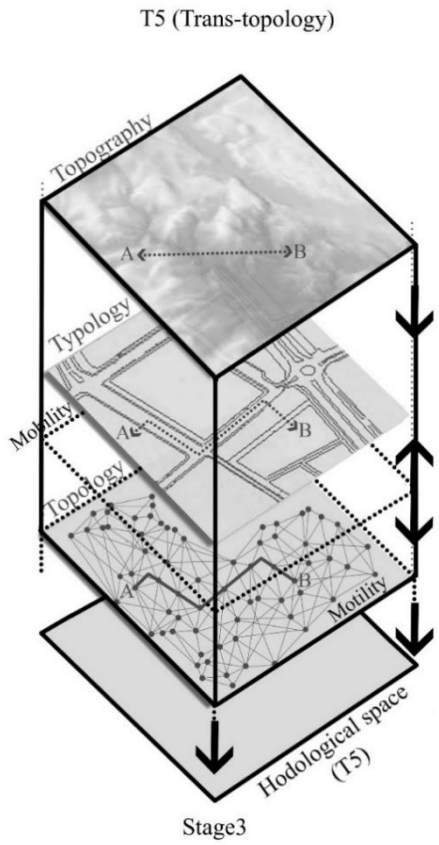

Figure 5. T5 (trans-topological) Diagram (developed by the authors)

The main source of spatial relationships that an individual or groups weave in their geometric system and mental map in modern cities is not only their intellectual state. Urban mobility systems and land use also influence an individual's geometric system and mental map, directing their spatial relationships. This aspect is often also directly related to the locations of the functional uses that the planner creates in the urban space. For example, the decision of the planner or designer can determine where the entrance to a shopping center will be located. Despite this, the location of the entry may only partially coincide with the perception of all individuals and, therefore, society. But in some cases, the opposite can also be considered. The planner can use the perception of the individual and society to select and design some functional uses. Harvey (1988) draws on the studies of Lynch (1960) in this regard also, saying;

...it states that individuals construct topologically connected spatial schemas. This means there are large physical spaces that are unknown and untouched by individuals. This study shows that we need to think about the organization of the city, not in Euclidean geometry but in the analytical tools of topology. Lynch also argues that certain features in the physical environment create certain 'edges' beyond which the individual never goes…

In this case, the planner can use individual and social perception together with their perception when making piecemeal corrections in existing urban parts. For example, when planning a green area, in Lynch's words, it can be considered with the analytical tools of topology. Relationships formed due to individuals' geometric systems and topologically connected spaces can be used to determine, in Lynch's words, unknown, untouched edges. While relational states (Mobilities) follow the route chosen by the common topology of the society, the spaces intended to be used or not designed to be disrupted can choose a place on the untouched edges outside these routes. Again, with the same situation, on a larger scale, the principle that the urban mobility approach can provide the most efficient

transportation at the shortest distance with the correct land use can be supported. Thus, the edges that are not touched and not overstepped will be a potential place for functional land uses, while the axes of urban mobility that promise optimal transportation at the shortest distance will also be uninterrupted.

Up to this part of the study, the understanding and analysis of spatial layers have been emphasized. In addition, the relationship between spatial layers and urban mobility is also explained. The following chapters present sample field observations and inferences to test the connectivity between the developed theoretical approach and the permanent solution to urban mobility problems.

6. Findings and Discussion

Observations were made in the sample area to investigate the effectiveness of the developed theoretical approach in solving permanent (wicked) spatial problems. These observations were made at random intervals and at varying times in 2019-2020. Isparta Belediye Park" (Coordinates: 37°46'56.91"N, 30°32'45.70"E), located in the city center of Isparta (Turkey) and one of the most intense urban mobility areas, was chosen as a sample area (Figure 1). Obtained inferences were schematized isometrically on satellite images using the technical field study method.

The following method was followed in the technical field observations; First, the axes of mobility and the untouched edges (Lynch) were determined by considering the functional land uses in the parcels adjacent to the park. The park is surrounded by shopping centers in the north and west direction and the city bus station in the southwest. There is a fuel station and a cafeteria to the south, a school to the east, and the most important of the city's main transportation axes (Figure 6). The current mobility axes in the park during the relevant period are shown in Figure 5.2. These are the pedestrian axes that the local government unit has planned and implemented for in-park use. If this situation, which is an administrative practice, is described as "de jure (legal, according to the law)," these pedestrian axes can also be called "de jure mobility" axes specific to the study. The axes expressed in Figure 5.1 are topological axes shaped according to the perception and hodological purposes of individuals and groups using the park. Contrary to the previous situation, these axes can also be called "de facto (in practice, in practice) mobility" axes.

With the observations made, it has been understood that individuals and users who want to access critical urban functions around the park faster and easier take similar roads with social consciousness and create these axes by exhibiting repetitive mobility patterns. As can be seen from the diagrams, there is a serious difference between the existing mobility axes and the topologically formed axes. It is understood that while planning the pedestrian axes organized by the local government unit for use in the park, the social attraction and orientation created by the uses near the park and the patterns of individual traces formed hodologically are not taken into account and analyzed. This arrangement, made on a two-dimensional plane without considering the spatial layers containing social data, failed. The areas where the tracks pass, which are used as the axis of mobility by the citizens, have been arranged as green areas due to the incomplete planning of the administration. This situation, in Lynch's words, caused the green sections, which were planned to remain as non-woven edges, to deteriorate due to the use of individuals as the axis of mobility. Thus, these green sections have lost their qualified and usable size and have been divided into small parts.

In addition to the economic loss, the real axes (Figure 5.1) used are not arranged with hard ground, while the areas that should be used as green areas are unnecessarily covered with hard ground. The connection between the functional uses in the environment and the pedestrian axes has not been discussed in detail, and the pedestrian overpass on the main road front of the park and the main public

transport stop have yet to be adequately evaluated in terms of relational interaction. Topological axes destroyed the sections arranged as green areas over time; these axes were closed with the hard ground by the local government to rectify the situation, and a radical planning solution was not implemented. These unplanned actions, taken without considering the current problems, have caused the park to almost wholly lose its function as of 2023 and be used only as a transition area. The existence of green regulations in the area has decreased to the point where the citizens cannot benefit from this area properly. From this point of view, it is understood that the city organization should be handled not only with Euclidean geometry but also with the analytical tools of topology.

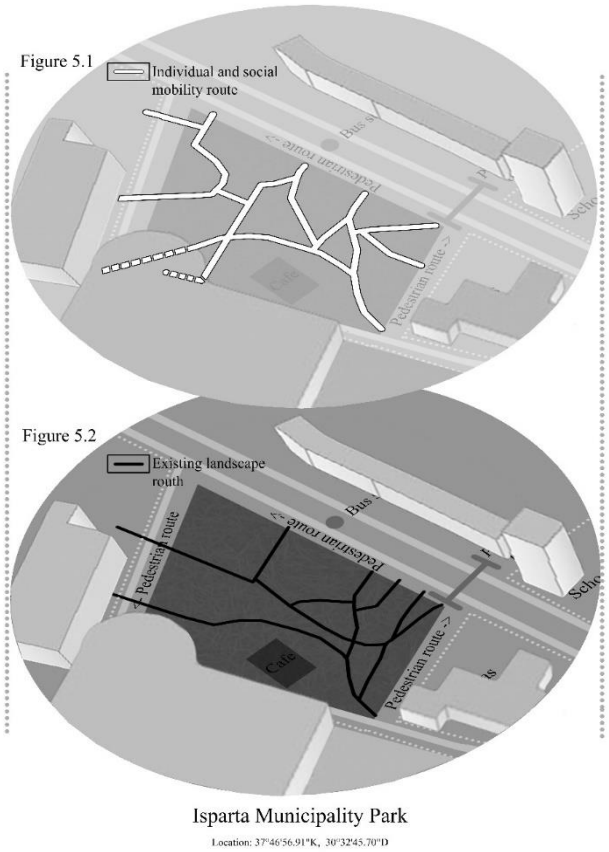

Figure 6. Sample of Isparta Municipality Park (developed by the authors)

We generally live in cities created by the planner and, in Harvey's words, where the individual adapts to this space. In these cities, based on Harvey's discourses, some spaces created/to be created by the planner can be reproduced or entirely arranged by taking into account the perception of the individual and society (with mobility resolutions). However, it should be noted that the planner is also responsible for the holistic decisions that must be made for the entire city. With this, for the whole city, which has a complex and dynamic structure, it still seems impossible to reveal the individual and social perception holistically and scientifically in a spatial sense.

CONCLUSION AND EVALUATION:

Observations made to test the developed theoretical approach have shown that connectivity between spatial layers is effective in solving permanent (wicked) problems such as urban mobility. Considering the space not only with its physical dimension but also with its semantic, intellectual, relational, perceptual, and cognitive dimensions and carrying out planning studies based on the collective memory created by individual and social behaviors filtered from these dimensions will increase efficiency and accuracy. In this sense, using the analytical tools of topology and dealing with spatial

dimensions entirely and accurately, especially in studies involving connectivity data such as urban mobility, are effective in the implementation stages of planning studies.

With the current example, it is seen that the developments in the topographic, typological (physical), topological, and hodological (intellectual) dimensions of the space can be used as a means of intervention to the functional problems caused by urban mobility. If the local government unit had carried out the study in this direction and analyzed the field accordingly, it could have produced implementation decisions aligned with individual and social perceptions. In this way, the expenses incurred due to unnecessary applications could be avoided, and the users could still use this field for recreational purposes.

From this point of view, it has been seen that space should be considered multidimensional in terms of epistemology and ontology and that space is meaningful physical and social experiences lived in these dimensions. Physical and intellectual spatial dimensions are both the cause and source of existing deficiencies as they constitute the spatial structure. To be able to solve permanent problems such as urban mobility is to seek the solution at its source, that is, to understand the dimensions of the spatial structure. Cities are the most concrete structures that show the physical and perceptual reflection of these chaotic dimensions.

The physical reflection of spatial dimensions is affected by the intellectual dimensions of space, which Schulz (1971) refers to as “Mental” and Soja as “Social (produced)” (Solak, 2017). Physical space gains meaning through perception and experience at the mental level. Space is shaped topographically and typologically in the physical dimension and is experienced topologically. However, the trans-topological (hodological) dimension, which defines a spatiality different from physical and intellectual space, is learned consciously and developed repetitively until the most logical way is found. All individual and social life components are filtered through these spatial dimensions, and understanding and solving the problems permanently experienced in the space depend on this.

The success of the outputs obtained through planning practice will be limited unless the space's topographic, typological, topological, and hodological dimensions overlap. When the dimensions of the space do not overlap, for example, In urban mobility, it cannot coincide with the space, and relational situations turn into a conflict situation, and eventually, chaos is reached. Suppose the 3T, T4, and T5 diagrams can overlap with urban mobility. In that case, the hodological space, obtained by filtering spatial dimensions and shaped by individual and social perception, can be "Real space" urban space can only be "Place" in this way.

On the other hand, the urban planner is responsible for making holistic transportation and mobility decisions in practice at the lower and upper scales. Higher-scale urban areas contain dynamics that are too complex to be analyzed, as in the green space study above, using the analytical tools of topology. From this point of view, individual and social perceptions can be taken as a basis to increase the effectiveness of planning studies in original sub-scale applications containing connectivity data. Sub-scale application principles can be shaped by normative methodologies to be created in this direction. However, new development areas and functional land use in the city periphery, expected to adapt to the city, cannot be planned solely in this direction.

As a result, it is necessary to understand the space correctly and to read the interconnectivity between spatial layers and their interaction with urban problems to establish the solution of permanent problems on solid foundations and to increase the effectiveness of planning studies in the implementation phase. In addition, the space must be handled multidimensionally and holistically, its relational interaction with individual and social perception should not be ignored, and the planner's role should be accurately and redefined in this context.

Compliance with Ethical Standard

Conflict of Interests: *There is no conflict of interest between the authors or any third party individuals or institutions.*

Ethics Committee Approval: *Ethics committee approval is not required for this study.*

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