A Proposal on Detection and Analysis of Threshold Public Spaces Using On-Site Observation and Behavioral Mapping Technique

Kamusal Eşik Mekânlarının Yerinde Gözlem ve Davranış Haritası Teknikleri Kullanılarak Tespiti ve Analizi Üzerine Bir Yaklaşım Önerisi

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ÖZ

Eşik mekânların niteliği, kullanıcı davranışını şekillendiren kritik ölçütlerden biridir. İyi planlanmış bir kentsel eşik mekân ana mekânlardan izler sunarak kullanıcıyı hazırlar. Bu sayede mekânlar arası süreklilik ve mekânın daha rahat okunması sağlanarak, verimli insan-mekân ilişkisi kurulabilir. Eşik mekânları, incelendikleri perspektife bağlı olarak değişiklik gösterebilir. Bu değişkenlikler de eşik mekânlarının tespiti ve analizi için bir yöntem geliştirmeyi zorlaştırır. Eşik mekânların diğer mekânlara göre yeterince çalışılmaması ve tanımlanmaması, bütünsel bir bakış açısının gerçekleştirilmesini, bütünün incelenmesini ve ayırdığı iki mekânın daha iyi anlaşılmasını engellemektedir. Çalışmanın amacı, literatürdeki bu boşluğu doldurmak için eşik mekânların tespiti ve analizi için bir yaklaşım önermektir. Örnek çalışma Adapazarı/Sakarya/Türkiye'de eşik mekân olduğu tespit edilen Gar Meydanı'nda gerçekleştirilmiştir. Bu çalışmada önerilen yaklaşımı ifade etmek için Gar Meydanı kamusal alanına ait örnek çalışma verileri kullanılmıştır. Geliştirilen yaklaşım önerisi, çalışma alanının ön araştırması-incelemesi, çalışmanın kapsamı ve üç aşamalı eşik mekânı tespiti ve analizi bölümlerinden oluşmaktadır. Çalışmada geliştirilen yaklaşımın örnek çalışma alanı üzerinde test edilmesi sonucunda temel iki sonuca ulaşılmıştır: 1. önerilen yaklaşımın eşik mekânlarının bütünsel olarak tespit ve analiz edilmesinde kullanılabileceği, 2. Mekânların "eşik" olma durumlarının kullanıcı davranışlarının analizi aracılığıyla yorumlanabileceği.

Anahtar Kelimeler: Kamusal Mekân, Eşik Mekân, Tespit ve Analize İlişkin Yaklaşım Önerisi, Yerinde Gözlem, Davranış Haritası Tekniği

ABSTRACT

The quality of threshold spaces is one of the critical yardsticks that shapes user behavior. A well-planned urban threshold space prepares the user by providing traces of the main spaces. In this way, an effective human-space relationship can be established by continuity between spaces and easier reading of space. Thereshold spaces may show a change on the perspective from which they are examined. These changes make it difficult to develop a method for detecting and analyzing threshold spaces. Failure to adequately study and define threshold spaces prevents the development of a holistic perspective and a thorough understanding of the spaces it separates. To address this, the aim of the study is to propose an approach for the detection and analysis of threshold spaces based on the gap in the literature. The proposed approach was applied to the Gar meydanı (Station Square) in Adapazarı, Sakarya, Turkey, which is specified threshold space. In this study, case study data from the Gar Square public space was used to express the proposed approach. The developed approach proposal consists of preliminary research on the study area as a threshold space, the scope of the study, and a three-stage approach for detecting and analyzing threshold spaces.

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As a result of testing the approach developed in the study on a case study area, two main conclusions were reached: 1. The proposed approach can be used to detect and analyze threshold spaces holistically, 2. the "threshold" status of the spaces can be interpreted through user behaviors.

INTRODUCTION:

In its broadest definition, the concept of threshold is defined as a(n) "entrance, door" (Ercilasun & Akkoyunlu, 2020). With this definition, the threshold can be interpreted as defining a "transition". The term "transition" emerges as a concept that encompasses both change and differentiation. When the most general meaning of the word threshold is interpreted in this way, it primarily refers to "change of space". While threshold is defined as "the weakest strong stimulus necessary to evoke a reaction in the living thing" in the dictionary of the Turkish Language Association (1998), in English, it is "the piece of wood, stone or timber under the door", "door, passage, end, limit", "the starting point of a psychological or physical element" (Merriam-Webster, n.d.). In addition to these definitions, the word "threshold" is used in different ways in a variety of disciplines. It can be said that these varied applications are mostly attributable to threshold's "change" and "transition" implications (Türkiye Cumhuriyeti Sağlık Bakanlığı, 2018). As a result of the literature review, it has been established that different approaches are followed to explain the concept of threshold as "threshold space". While some researchers characterize threshold spaces as a "border" that does not occupy space (Le Corbusier, 1981; Hall, 1990; Bhonsle, 2010), some define it as an intermediary space that takes up space (Benjamin, 2002). Hence the types of spaces used by the researchers while defining threshold spaces were evaluated and grouped. As a result of this, it has been deduced from the literature that characteristics of threshold spaces are explained through four distinct types of spaces:

- Transition space (Van Gennep, 1960; Turner et al., 1969; Kapstein, 1988; Dee, 2001; Chun et al., 2004; Ambroziak, 2005; Preamechai, 2006; Zimmerman, 2008; Deshmukh, 2009- as cited in Singh, 2015; Kaza, 2010; Bhonsle, 2010; Kray et al., 2013; Boettger, 2014; Singh, 2015; Perugia & Mancini, 2020),

- In-between space (Le Corbusier, 1981; Kultermann, 1993; Dee, 2001; Benjamin, 2002; Hasarlıgil, 2007; Thomassen, 2009; Turner, 2012; Boettger, 2014; Heidegger, 2017; Soderlund & Borg, 2018),

- Space of Change (Öymen Gür, 1996; Asiliskender, 2002; Von-Meiss, 2013; Boettger, 2014; Lefebvre, 2015),

- Liminal Space (Thomassen, 2009; Horvath et al. 2014; Szakolczai, 2017; Soderlund & Borg, 2018; Holloway, 2020).

These concepts can be used interchangeably with or instead of the concept of "threshold" when describing threshold spaces. However, in order to establish a connection between these concepts, they need to be examined under the concept of "threshold space", as they are otherwise disassociated and defined differently in the literature. When looking at threshold spaces from the perspective of urban design, in-between and liminal spaces (which are threshold spaces with the characteristics of being places of change and transition) are both a part of the spaces they separate and the parts that bring life to the space and create interaction between spaces (Norberg-Schulz, 1971). Threshold spaces initiate interaction by bringing together the interior of the space, the entrance, and other surrounding spaces. According to Şentürer (2003), the 21st century will be the century of reconnection and integration against the problems caused by the increasing pace of life and changing spatial scale. In this context, approaches to establishing connection and integrity for the space and daily life within cities, (which have the characteristics of containing many thresholds and being a threshold on a large scale thanks to their mixed structure and therefore cannot be easily analyzed), will always be the desired approaches. According to Lefebvre (2015), "people use the threshold as an architectural space

to regulate both their own perception and how they are perceived by others". They can imperceptibly adjust their visual, auditory, and physical impressions on others with small movements. This control of perception gives people the freedom to role-play. As understood from here, the quality of threshold spaces is one of the critical criteria that shapes user behavior. Analysis of these spaces will give the designer the opportunity to establish the space-user relationship and ensure the continuity of the space and its inclusion in daily life. The aim of designers should be to create a holistic design by establishing connections between spaces (Yılmaz, 2016). At this stage, a well-constructed urban threshold space prepares the user by presenting traces from the main space, thus providing continuity between spaces, enabling the space to be read more easily and establishing an efficient human-space relationship.

Threshold spaces may vary depending on the angle from which they are examined, making it challenging to develop a method for their detection and analysis. In addition, studies on "threshold space analysis" have been found to be insufficient. The lack of study and definition of threshold spaces in comparison to other spaces prevents the realization of a holistic perspective, the examination of the whole and a better understanding of the two spaces it separates.

As mentioned above, the analysis of threshold in the context of architectural space has mostly remained in the background until today. When it comes to the word 'threshold', analyzes have been made in areas such as natural threshold, ecological threshold, and threshold in macro planning, and these analyzes have mostly been carried out by concretizing the threshold space within itself and without establishing its relationship with the surrounding spaces. In addition to all these, threshold spaces were examined with analysis methods that usually ignore the unique characteristics of transition, in-between and liminal spaces, which are mentioned throughout the study, but analyze them as an ordinary space and therefore miss their general characteristics. In this study, the general characteristics of threshold spaces were first revealed as a result of the literature search, and an analysis approach that references them was produced and tested.

From this point of view, the aim of the study is to propose an approach for the detection and analysis of threshold spaces to fill this gap in the literature mentioned above. Furthermore, it is aimed to use threshold spaces as an input in the analysis of space, to investigate them in public space, and to include them in design/space organization.

In the next sections, a literature review was conducted on the studies on threshold spaces and the previous studies on "On-Site observation and behavioral mapping technique", which forms the basis of the proposed approach, and the developed approach is based on these studies or fills in the gaps.

1. Literature Review

1.1. Studies on Threshold Spaces

The examination of the spaces' variability and volatility has resulted in the study of the threshold spaces between the main spaces. While the majority of studies on threshold space are conducted at the urban scale, some focus on defining thresholds and others focus on measuring them. Following a survey of the literature review, it was established that the studies on this subject were carried out on either the distinct properties of the "threshold" or the examination of the threshold spaces using various methods. The threshold was explored in some of the studies using the intangible concept "perception" (Yılmaz, 2016), whereas in others it was examined through the concrete concept "wall" (Alkaya, 2015). In some research, thresholds are treated as a distinct main space (Güngen, 2018), while in others, they are seen as a side space that points to the main space while preparing the person for the main space (Zimmerman, 2008). According to some analyses, it was concluded that it is not a place, but merely a crossing and border point (Akartuna, 2017). In accord with the studies conducted on the investigated threshold space, the thresholds are viewed as the sites at which different elements (bus stop, vehicle, human, social equipment, etc.) congregate. This refers to the threshold spaces

discovered and processed on the map as density points. However, all of the aforementioned research agrees that the concept of threshold encompasses the concept of "change".

1.2. On-Site Observation and Behavior Mapping Technique

When studies on the threshold space are examined, it is observed that several common techniques are utilized, the most prevalent of which are the observation method (Danilina & Privezentseva, 2020; Akartuna, 2017; Şevik, 2018) and the processing of observation data on maps (Eltan et al., 2015; Akartuna, 2017; Şevik, 2018). The method of processing user observation data on the map is called the "behavior mapping technique" (Eltan et al., 2016; Akartuna, 2017; Sevik, 2018; Barker, 1968; Ittelson, Rivlin, & Prohansky ,1970; Goličnik Marušić, 2010; Guinther et al., 2014; Al-Maimani et al., 2014; Mandel, 2016; Karadeniz et al., 2018; Ozbil et al., 2018; Gharib, 2019; Onojeghuo et al., 2019; Istrate et al., 2020; Wang & Wu, 2020; Cosco et al., 2010; McQuilkin, 2016; Van der Spek et al., 2009; Valkenet et al., 2022; Milke et al., 2009; Cox et al., 2018; Arsan & Kepez, 2017; Liao et al. 2022). Behavior mapping technique was first developed at the end of the 1960s, by environmental and behavioral researchers such as Barker (1968) and Ittelson, Rivlin, & Prohansky (1970). Behavior mapping methods include systematically monitoring behaviors over space and time (Cosco et al., 2010). During the observation, the observers examine the actions of the users in the determined place directly or through observation devices (such as cameras, gps, etc.). Behavior mapping method, or tracking method, in other words, means following users' routines, observing their various activities and monitoring who they interact with, as mentioned in an article published by the National Recreation and Park Association (1993, p. 59) in Arlington. Behavior maps are generally observed on a chart or map to detect the location and activity of users and can be followed in places of interest such as parks, museums, squares, where users' activities can be monitored. In the article of the National Recreation and Park Association (1993, p. 60), it is mentioned that the research and extraction of behavior maps is done by researchers in two ways. These different styles include a. Space-oriented behavior mapping, b. User-oriented behavior mapping. In the space-oriented behavior map, how people position themselves in a certain space is examined. User-oriented behavior maps, on the other hand, examine the movements and activities of users within a predetermined period. Although the observation method to be chosen depends on the purpose of the observer, it is the most useful action to draw space-oriented and user-oriented behavior maps in tourism, recreation areas and parks (National Recreation and Park Association, 1993, p: 60). Table 1 provides a better understanding of the method's usage by giving the aim, scope, stages, outputs and limitations of some studies mentioned above using the behavior mapping method.

Table 1. Some of the studies on behavior mapping technique in the literature.

Study	Aim and scope	Stages	Output	Limitations
Goličnik Marušić, 2010.	Obtaining information about the quality and current status of the space and developing suggestions using the behavior mapping method in two different squares in Edinburgh, UK and Ljubljana, Slovenia.	**1.** Processing activities on the map with symbols, **2.** Processing of user age ranges on the map, **3.** Processing data in GIS program, creating graphics and interpreting them.	•Activity •Location •Itinerary (activity routes)	The data collection and analysis phase caused difficulties. Therefore, a long-term measurement could not be made and incomplete data was obtained.
Guinther et al., 2014.	Searching for solutions that will lead to better working environments for healthcare providers and a higher level of staff, patient and visitor satisfaction as a result of spatial analyzes performed in the hospital pediatric unit.	1. Observing user behavior, 2. Collection of survey data, 3. Observing users' activities and their durations/ routes and recording them on the map	•Activity •Location •Route	The analysis method was insufficient to measure the spatial and cultural character of the study area.

Al-Maimani et al., 2014.	Examining the spatial and socio-cultural aspects of Souq Mutrah market and developing its experiential evaluation through the application of observation and behavior mapping method.	1. Selecting three locations to observe, 2. Processing the users' ages, activities and routes on the map, overlapping the maps, 3. Creating and interpreting graphs.	•Location •Route	The analysis method was insufficient to measure the spatial and cultural character of the study area.
Mandel, 2016.	Conducting analyzes of library spaces and contributing to ongoing efforts to help determine how these spaces are used.	1. Multiple observers processing user locations on the map in the library, 2. Processing and interpreting the data in ArcGIS program.	•Location •Activity	Each observer processed the data with different techniques, resulting in incomplete data. The study was conducted in one university library.
Karadeniz et al., 2018.	Creating behavior maps for primary school students' use of school gardens in 5 primary schools selected from different regions in the city of Trabzon and conducting spatial-functional analysis.	1. Spatial situation determination through tables, 2. Creating a behavior map for each selected school, 3. Analysis and interpretation of activities in the context of space and function.	•Activity •Location •Different time intervals •Route	No limitations are stated.
Ozbil et al., 2018	Researching the usage patterns of outdoor spaces through the analysis of selected public sub-zones in Özyeğin University Campus and interpreting the factors affecting them.	1. Rendering of user locations on the map, 2. Examining spaces with space-syntax analysis, 3. Conducting user surveys, 4. Processing data in GIS program, creating graphics and interpreting them.	•Spatial integration values •Location •Activity	It was conducted on a university campus isolated from its surroundings, and the integration levels of outdoor spaces into the general urban fabric were not measured. Behavioral mapping was conducted for only one day in each season.
Gharib, 2019	Investigating the qualities and productivity of urban open spaces of two traditional markets in Qatar through behavioral mapping and observations.	1. Processing users' activities and functions on maps and determining their density, 2. Photographing observations, 3. Interpretation of the obtained data.	•Activity •Location	No limitations are stated.
Onojeghuo et al., 2019	Providing a practical and cost-effective approach to produce methods for analyzing children's activities by adding geospatial information to behavioral data collected in indoor play environments.	1. Dividing the plan into grids, showing the intensity of the activity on each grid with a gradient, 2. Activity-number of activities representation with pie charts by overlaying each separate plan.	•Activity •Location	The large number of bubble pie charts made it harder to determine how children interacted with major play equipment or areas in the room.
Istrate et al., 2020	Assessing the way main streets are perceived and used by pedestrians in an industrial, Central-European city—Ostrava in Czechia by surveys and observation of human activities.	1. Examining user activities on a map with symbols, 2. Supporting research with surveys, 3. Interpretation of the obtained data.	•Activity •Location •Route •User opinions	The study was conducted during COVID-19, small markets and restaurants were affected by the decreasing demand, and sufficient detailed observations could not be made.
Wang & Wu, 2020	Inverstigating usage patterns in Songhe, Liangcheng and Hutai parks, focusing specifically on visitors' activity levels supported by specific landscape features and attributes.	1. Recording users' location, gender, age and activities on the map 2. Processing the data in ArcGIS 10 program, creating graphics and interpreting them.	•Activity •Location •Demographic features	The method was time consuming and may not be suitable for monitoring park use in a large area, especially when the data are initially hand-recorded on the site.
Cosco et al., 2010	Introducing behavior mapping as a direct observation method on the basis of the theories of behavior setting and affordance and to demonstrate its sensitivity to gathering physical activity and associated environmental data at a sufficiently detailed level to affect built environment design policy.	1. Obtaining behavior mapping data including outdoor environmental characteristics and children's physical activity levels 2. Interpretation of the data obtained.	•Activity •Location •Spatial features	The method fails to reveal how user behaviors may work synergistically to support children's MVPA (Moderate to Vigorous Physical Activity).
McQuilkin, 2016	Examining the ways in which improved design of the built environment may benefit people with Alzheimer's disease, particularly with respect to navigational behavior, through behavior mapping method.	1. Conducting a literature review focusing on design features that are assumed to support wayfinding. 2. Documenting existing features in common areas, observing the behavior of residents in these areas, and conducting face-to-face interviews. 3. Interpretation of the obtained data.	•Activity •Location •Relationship between users	No limitations are stated.

Van der Spek et al., 2009.	Interpreting the value of GPS as 'sensor technology' measuring people's activities through behavior mapping analysis conducted in Almere, Flevoland, Netherlands.	1. Determining users' locations and routes with GPS. 2. Processing of locations and routes on maps 3. Interpretation of the obtained data.	•Location •Route	Technical problems caused by the monitoring method (GPS): Battery life monitoring, (initial) equipment repair time, data accuracy - preventing blur and pixelation, necessity of hardware improvement.
Valkenet et al., 2022	Describing hospitalized patient movement behavior and associated factors through the University Medical Center Utrecht, Netherlands.	1. Performing user-oriented behavior mapping analysis. 2. Describing participants' locations, physical and daily activities. 3. Examining the barriers to physical activity using linear regression analyses.	•Activity •Location	Participants were observed only during the day and only during their stay in the ward. Reasons for missing behavior mapping data were not recorded, and no data were available on patients who were ineligible or unwilling to participate.
Milke et al., 2009	Investigation of daytime activity types of patients and staff at five similar care centers for people with Alzheimer's disease.	1. Collecting and analyzing data through surveys, 2. Researching user behavior with the behavior map method, 3. Interpreting the obtained data through graphics.	•Activity •Location •Relationship between users •Different time intervals	No limitations are stated.
Cox et al., 2018	Researching children's play behaviors in outdoor playgrounds through analyzes conducted in the backyard of the Santa Barbara Museum of Natural History and creating a customized behavior mapping protocol.	1. Processing behavior and locations on maps using on-paper, digital and hybrid methods, and overlapping the maps, 2. Interpretation of maps.	•Activity •Location •Relationship between users •Demographic features	The method in its current form was not sufficient for behavior analysis, and a customized approach had to be created.
Arsan & Kepez 2017	Testing three technologies for error ranges in a classroom furnished with movable furniture and simulating the technology's applicability to real-time locations using behavioral data.	1. Revealing user locations using "Real-time location system" (RTLS). 2. Testing different technologies on site and comparing the results with each other.	•Location	Obstacles present in the space and errors that occur when there is no direct transportation area cause difficulties in location analysis.
Liao et al. 2022	Using behavior mapping to understand how patients and families use the waiting area in an outpatient surgery clinic at a safety-net hospital.	1. Monitoring the use of the waiting area for 2 months and observing the users. 2. Visualization of activity intensities with "Heat map". 3. Interpretation of the obtained data.	•Activity •Location •Different time intervals	Encountering problems in data collection techniques. (recording error).

As a result of the literature review, it was determined that the relevant studies revealed different approaches even though they used the same technique. When researchers did not find the behavior mapping model sufficient on its own, they supported it with surveys or interviews, and because of this approach, they analyzed different parameters. While the behavior map model allowed the researcher to measure the parameters of "location, activity, time, route", it was also able to measure "inter-user relations" with supporting analysis. However, according to the results obtained from the study, these parameters were not sufficient for space analysis and caused many limitations (Mandel, 2016; Goličnik Marušić, 2010; Al-Maimani et al., 2014; Guinther et al., 2014; Cosco et al., 2010; Cox, 2018; Onojeghuo et al., 2019; Istrate et al., 2020; Ozbil et al., 2018; Arsan & Kepez, 2017; Sommer, 2001; Liao et al., 2022; Wang & Wu, 2020; Van der Spek et al., 2009; McQuilkin, 2016; Valkenet et al., 2022). These limitations point to some deficiencies in the method and make it difficult to make a reliable determination and produce results.

In studies that analyze space by applying the behavior mapping model, it has been observed that spaces are often considered and analyzed by separating them from the surrounding spaces. However, this approach has been found to be insufficient for the detection and analysis of threshold spaces that establish relationships between spaces, prepare them for the main space and can change user profiles when entering the space. According to Van Gennep (1960), for a space to be a threshold space, rituals and user profiles (states) must change upon entering the space. For this reason, although measuring a

single space without considering surrounding spaces can be used for other space analyses, using it to measure threshold spaces will cause incomplete data to be produced. In line with these data and limitations obtained as a result of the literature review, it was concluded that adaptations should be made on the behavior mapping model for the detection and analysis of threshold spaces.

2. Methodology: An Approach Proposal On The Detection And Analysis Of Threshold Spaces

A threshold space detection and analysis approach proposal were developed by making use of the literature reviews in the section above (Figure 1).
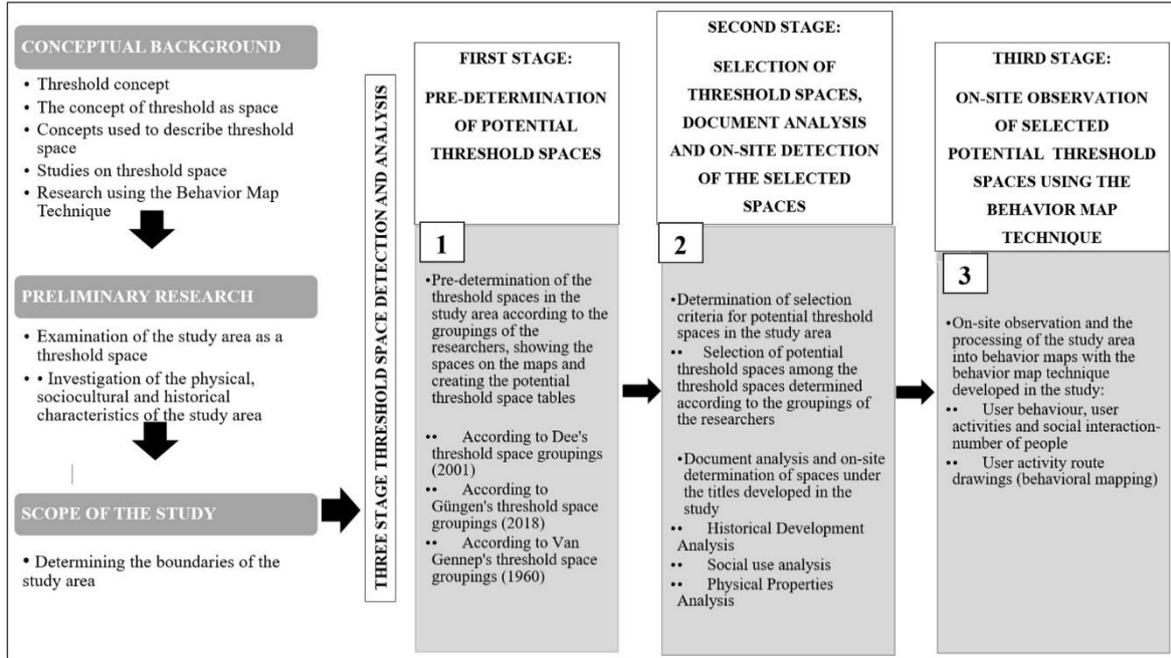
Figure 1. Approach proposal diagram for threshold space detection and analysis

- Preliminary research- During the preliminary research, the study area was carefully selected to possess threshold characteristics at both the city and regional scale (Figure 2; part 2.2.1.). It was essential for the selected area to exhibit clear thresholds that can be observed and understood within the study area. As an example, the city center of Adapazarı was chosen as the study area due to its qualities as a space of change and transition (It will be explained further in the next headings). Since this study focuses on user behaviors to measure threshold spaces, it is recommended to select a study area that encompasses multiple regions with diverse user activities for similar studies.
- Scope of the study: In order to establish the scope of the study, it is important to define the boundaries of the study area based on the insights gathered from literature reviews. For the specific case of the "Adapazarı city center," (Figure 3; part 2.2.1.) the boundaries of the city center were approximately determined by considering the various definitions of city centers found in the literature. During this stage, the literature was examined for terms such as "streets bordering the city center," "historical buildings that shape the city center," and "areas outside the city center". Based on these terms, a rough border was established to define the limits of the study area.
- Three-stage threshold space detection and analysis: This study utilized the criteria for defining threshold spaces developed by three scholars in order to establish its approach. Dee (2001) focuses on natural, artificial, landscape, and water thresholds in everyday life, while Güngen (2018) examines historical, architectural, social, and emotional/everyday thresholds. Van Gennep (1960) categorizes threshold spaces as transitional and divides them into three distinct transitional spaces. By utilizing the groupings and criteria of these scholars (Dee, 2001;

Güngen, 2018; Van Gennep 1960), this study was able to develop a systematic approach to examining and defining threshold spaces. Table 2 displays the groupings of threshold spaces proposed by each researcher, the criteria they used for grouping, and how those criteria informed the approach developed in this study.

Table 2. Dimensions developed for the study as a result of the studies of Dee, Van Gennep and Güngen

Scholars	Threshold space grouping	Criterion(s) for being a threshold space	Dimensions developed for the study
Dee (2001)	**1. Topographic thresholds:** a. Topographic gateways, b. Landings and staircases, c. Hollows **2. Vegetation thresholds:** a. Green threshold rooms, b. Green gateways, c. Windows and frames d. Tree canopies **3. Built thresholds:** a. Built gateways b. Built outdoor rooms, c. Pavement d. Terraces **4. Water thresholds** a. Inlets and harbors b. Decks and platforms c. Water in rest and entrance places	The space to have different physical characteristics (e.g., elevation difference, vegetation beginnings and endings, transitions, separating elements, etc.)	According to Dee's groupings, threshold spaces can be determined without the need for extra observation and analysis. For this reason, only Dee's groupings were used and no dimensions were developed from these groupings.
Güngen (2018)	1. Historical thresholds, 2. Architectural thresholds, 3. Social thresholds 4. Emotional/everyday thresholds	The features of the space discovered by document analysis and on-site detection to include certain differentiations (e.g. historical change, earthquake, differentiating architectural styles, social usage changes, etc.)	The following dimensions were developed and used during the document analysis carried out in the second phase of the detection and analysis approach proposal: 1. Historical development analysis 2. Social use analysis 3. Physical properties analysis
Van Gennep (1960)	1. Separation/ Preliminal 2. Transition/ Liminal 3. Incorporation/ Postliminal	Observable changes/differentiations in the intensity/type of activities in the space Observable user profile/density changes in the space	The following dimensions were developed and used during the on-site observation carried out in the third phase of the detection and analysis approach proposal: 1. User behavior 2. User activities 3. Social interaction-number of people

2.1. First Stage: Pre-Determination Of Potential Threshold Locations

In this section, spaces in the selected study area that meet the "threshold space criteria" of Dee (2001), Güngen (2018) and Van Gennep (1960), as shown in Table 1, were examined independently, and spaces that met the threshold space definitions of all three scholars were identified. The examination is preliminary in nature as it serves as a foundation for further extensive study. The location for further analysis and on-site observation will be chosen from among the common spaces that meet the criteria (for being a threshold space) of these three scholars.

2.2. Second Stage: Selection of Threshold Spaces, Document Analysis and On-Site Detection of The Selected Spaces

The second stage involved selecting a study area from among the potential spaces identified in the first stage for document analysis and on-site observations. In addition to meeting the three aforementioned scholars' criteria for being a threshold space, the space must also meet the following selection criteria:

• Being a public space,

• Including different types of activities that can be observed,

• Having minimal control mechanisms that will restrict or change the activities,

• Being accessible and observable on weekdays and weekends,

• As in the behavior mapping studies of Goličnik Marušić (2010), Al-Maimani et al. (2016), Karadeniz et al. (2018) and Wang and Wu (2020), the space having no visual restrictions, where users in the region can be easily observed from a single point.

Then, the study's "historical development, social use and physical characteristics developed with reference to the threshold space criteria of Güngen (2018)" analysis dimensions were used to investigate the selected places.

In the study, the findings of Adapazarı Station Square, one of the threshold spaces identified in Sakarya/Adapazarı city center according to the above-mentioned features, were used to explain the approach:

2.3. Selection of Threshold Spaces: The study area used as an example to explain the method approach: Adapazarı Station Square (Gar Meydanı)

Under this title, information is provided about the general characteristics of a public space (Adapazarı Station Square) which was used and tested with the proposed approach for better explaining the stages and techniques developed for the analysis and determination of threshold spaces. Adapazarı Train Station Square is located in the city center of Adapazarı, which is the district where the settlement process in Sakarya started (Aktaş, 2008). Adapazarı is strategically located on the Istanbul-Izmir industrial axis and the economically active Istanbul-Kocaeli-Sakarya axis (Göçer, 1968). It acts as a transition space between the highly developed Marmara Region and Anatolia (Beksaç, 2005), as well as a bridge between the Mediterranean and Black Seas in terms of climate (Pekcan, 1996). Furthermore, Adapazarı serves as an "in-between" space on the highway connecting Istanbul and Ankara. The economic vitality of the city center and the presence of the still-operational railway are examples of the changes and transitions that can be observed in this area (Figure 2). Additionally, the cultural richness and historical developments (being located in a late Ottoman city and having historically housed Greek and Armenian craftsmen, (Çetin, 2005), being known for its historic mosques and bazaars (Narin, 2017; Çetin, 2005) and serving as a center for services, history, and transportation in the city (Aktaş, 2008; Göçer, 1968), etc.) of the region provide abundant data for measuring the threshold space.

Figure 2: Sakarya transportation map (Sakarya Metropolitan Municipality, 2010)

The study area, Station Square (Gar Meydanı) is located adjacent to Atatürk Boulevard, which is considered the focal point of Adapazarı/Sakarya city center (outlined in red in Figure 3).

Figure 3: The location of Adapazarı city center on the Adapazarı district map (left) (AtlasBig, 2018) and the Station Square located here (the square's relationship with Atatürk Boulevard)

2.3.1. Document Analysis and On-Site Detection of The Selected Spaces Sakarya/ Adapazarı (Station Square -Gar Meydanı)

According to the developed analysis and determination approach, while analyzing historical developments, changes such as demolition, construction, and restoration, as well as the arrangement of important regions and buildings in the region were examined through literature reviews and archive photographs. During these examinations, it was seen that certain changes were more noticeable because they affected or directly caused other small changes. These major changes are referred to as "historical thresholds" because they serve as a threshold for the occurrence of several events/changes in the region. Changes discovered as a result of regional literature reviews are diagrammed as in the example in Figure 4, and the discovered historical thresholds are denoted by red circles.
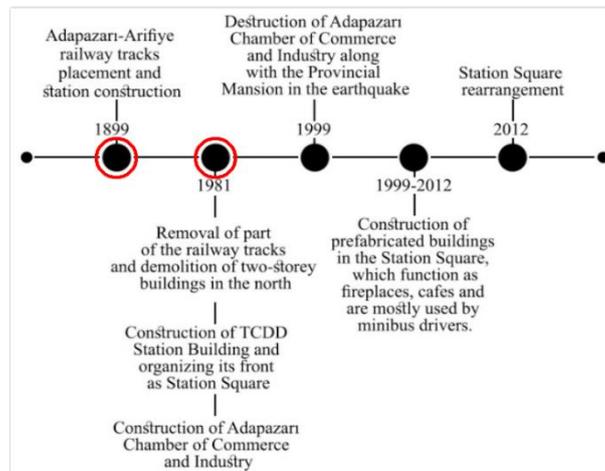
Figure 4. Diagram created as a result of examining the sample study area (Gar meydanı- Station square) in the dimension of "historical development analysis

"Social use analysis was conducted by investigating the changes in "function" and "user profile" caused by regional changes. A social change is said to occur when a historical development results in a change in the function or user profile of a region or building. As in the historical development analysis, the social usage changes that emerge this analysis and significantly alter the user profile in the region are called "social thresholds". Changes discovered through literature research in the region are diagrammed as in the example in Figure 5 -which is determined by adding the user profile to the historical analysis in Figure 4 and creating a social usage analysis- and the discovered social thresholds in social usage analysis are denoted by red circles.
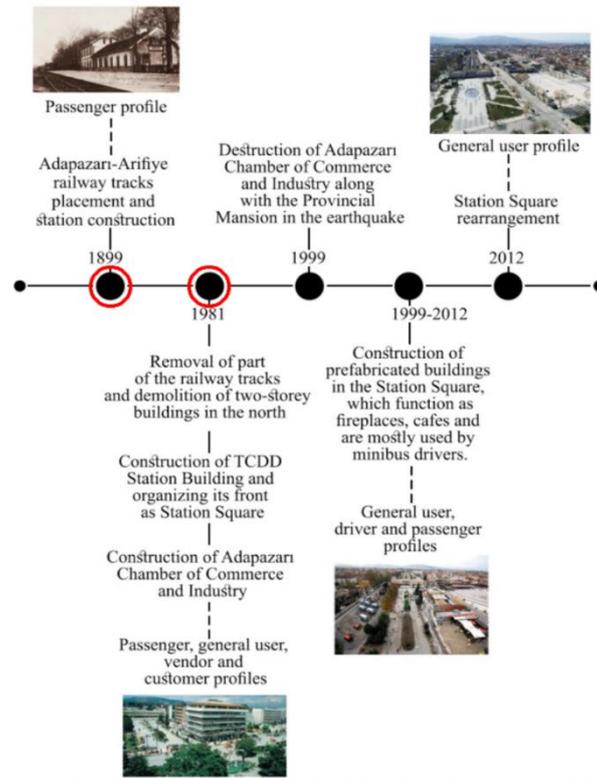
Figure 5. Diagram created as a result of examining the sample study area (Gar meydanı- Station square) in the dimension of "social use analysis"

Environmental elements in the region were observed in site under the heading of physical properties analysis. Environmental elements were examined under the main titles of "urban furniture" and "building / prefabricated structure". Under the title of urban furniture, elements such as benches, lighting, garbage cans, bicycle parking elements, and ornamental pools in the region were observed and their locations on the map were identified. Kiosks, important cultural buildings, and official buildings in the region are included in the map under the heading of building/prefabricated building. A subset of the furniture and buildings/prefabricated structures observed are shown in Table 3 as an example.

Table 3. A small part of the urban furniture and buildings/prefabricated structures observed in the study area (Gar meydanı- Station square) in the dimension of "physical properties analysis"

Physical properties	Location	Photos	Physical properties	Location	Photos
• 5, 3-person benches			Pumpkin sculpture (Not yet built at the time of viewing, only glass frame available)		
• 1garbage bin.			Bal 54		
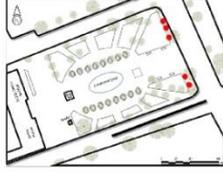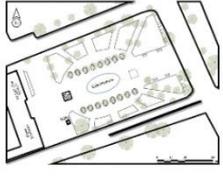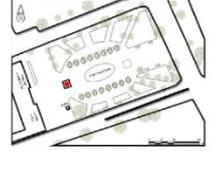
2.4. Third Stage: On-Site Observation of Selected Potential Threshold Spaces Using Behavior Mapping Technique

Within the scope of the third stage, analysis dimensions of "user behavior, user activities and social interaction-number of people, developed with reference to the threshold space criteria of Van Gennep (1960)" were developed in the approach proposal and on-site observations could be made in the study area through these dimensions. In order to examine the threshold situation of the space through the user behavior, the behavioral differentiations in the space should be identified. To reveal these differences, it was decided to determine two sub-regions as the "inside" and "entrance" of the space (Table 4), and to measure and compare user behaviors in these two sub-regions. The sub-regions were referred as "Station Square" for the inside and "its entrance from Atatürk Boulevard" for the entrance, throughout the study. This decision was made in response to another scholar, Van Gennep (1960), who assisted in developing the study's approach proposal. According to Van Gennep, for a space to be a threshold space, rituals and user profiles (states) must change upon entering the space. To measure this change, the activities occurring inside and at the entrance of the spaces, as well as the age groups of the users, were observed separately for each sub-region in this study. Following the literature review, it was decided to use the "Behavior Mapping" technique, which is a method for on-site observation of user activities.

Table 4. The study area sub-regions, Station square (Gar meydanı) and its entrance from the Atatürk Boulevard

Gar meydanı/ Station square	Station Square	The entrance from the Atatürk Boulevard
While determining the regions, it was decided to choose the first sub-region as the inside of the space, and the second sub-zone as the entrance from the eastern direction of the space (entrance from the direction of Atatürk Boulevard).		
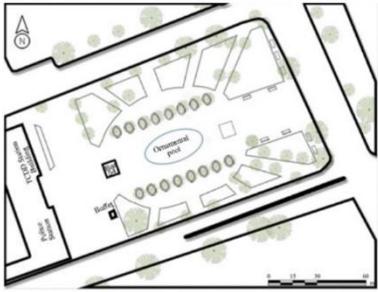
When observing the research area, the primary criterion is the accurate comparison of the sub-regions, namely inside and at the entrance of the selected public space. For this reason, observations made in sub-regions were recorded on identical types of maps and observation papers at the exact same time. For example, at the end of each day, a behavior map, a location-age map, and an on-site observation form are obtained for each sub-region of the study area. To enable comparisons to be made between the inside and entrance sub-regions of the study area, the physical and social conditions should be as similar as possible. Therefore, the sub-regions should be examined consecutively on the same day. On the basis of another scholar's method, Goličnik Marušić, (2010) who created a behavior map, it was chosen to study users for 10 minutes, five people in each sub-region. Additionally, a time interval of 10 minutes was established for the location-age map. As a result of these choices, a location-age map was created for 10 minutes in each sub-region, and five users' behaviors were manually depicted on maps and on-site observation forms during the next 50 minutes. Thus, one hour of observations were made in each of the sub-regions, for a total of two hours in the study area. The on-site observation form was created using the observation form from Malkoç True and Sönmez Türel's study, "Analysis of a Public Space Based on the Space Diagram of PPS (Project for Public Spaces)" (2017). The designed on-site observation form is shown in Table 5. Table 6 details the scopes of the titles supplied on the observation form.

Table 5. On-site observation form.

Observer's Position		Behavior map		Age group and location map (10 minutes observation)		User activity images		
Urban furniture								
Sitting element				Lighting element		Shade		
Date				Period		Weather		
	User Data			User activity				
	Number of people	Age group	User behavior	A	B	C	D	E	F	G
1										
2										
3										
4										
5										

Table 6. Scopes of the titles in the on-site observation form

Observer location map	Behavior map	Location-age map
Displaying where the observer is located in the region on the map	Displaying the activity letters (A, B, C) and activity routes of the five users whose activities were depicted on the map	Displaying the location and age groups of all users using the space within 10 minutes on the map
User activity images	**Urban furniture**	**Number of people**
Activity photos of the five observed users (In the behavior observation form, when associating the photos with the activities, the person performing the action is indicated with a number and the action is indicated with a letter: For example, the photo of the 4th user's action of talking on the phone standing up, which is action B on the observation form, is shown as 4B)	Elements offered to users (Example: benches, shade and lighting, signage, etc.)	Number of people performing the activity (If the number of people who did the action increased later, it was shown with "-" among the numbers. For example: If a person who performs sitting action meets with two people and continues the action, the number of people is written as 1-3)
Age group	**User behavior**	**Activities**
Age group of users performing the activity (If there are several users in the same age range, the age range is written only once in on-site observation form)	General nature of user activities (The users are accepted having "observer" behavior if they are observing the surroundings and aren't busy with anything while standing, sitting, etc.; "self-focused" behavior if they complete their activities without any interaction with the outside (cycling, taking care of the phone, eating and drinking, etc.); "verbal interaction" if they are talking to the users around them, and "mobile user" behavior if they use the area for circulation or if most of their activities involve movement)	Noting of the different activities that the user performs in succession within 10 minutes

The "user behaviors" extracted from the on-site observation form and the location of this behavior are displayed separately on the maps, with symbols for each sub-region. These general user behavior maps are given before the user activity maps and serve as a preliminary to the user activity map by explaining the behavior types of the users in the regions. User behavior (general) symbols used in the maps are given in Table 7.

Table 7. User behavior (general) symbols

Symbol	User behavior type	Symbol	User behavior type
■	Self focused user	◧	Verbal interaction
◙	Observer	◆➤	Mobile user

The "user activities" section of the on-site observation form contains information about the type of activity performed by the user, while the "behavior map" contains information about the location of said activity (Table 5). The user activities coded in this manner in the on-site observation form were processed on the map with certain symbols (Table 8) and distinct maps were produced for each sub-region. The symbols were developed by the authors, taking reference from the activity symbols used by Goličnik Marušić (2010) in his work.

Table 8. User activity symbols

Symbol	User activity types	Symbol	User activity types	Symbol	User activity types
♨	Sitting	◉	Observing the environment	▣	Chatting while walking
▶	Standing	♂	Smoking	⊖	Eating/ drinking
◆▶	Walking	⛵▶	Cycling	▶	Eating/drinking while standing
♟	Talking on phone while sitting	●●	Chatting while sitting	♨	Eating/drinking while sitting
▶	Talking on phone while standing	▶◀	Chatting while standing		

The symbols used in the maps processed in the "location-age map" section of the on-site observation form are given in Table 9. These symbols were developed using age distribution ranges and symbols referenced from Goličnik Marušić's (2010) study.

Table 9. Location-age symbols

Symbol	Age group	Symbol	Age group	Symbol	Age group
🔴	0-5	🟢	20-34	🔵	50-64
🟣	5-12	🟡	35-49	⚫	65+
🔵	13-19				

On the "user data number of people" section of the observation form, information on the number of people using the space, and in the "behavior map" section, the locations of the mentioned users can be found (Table 5). The number of users encoded in this way on the on-site observation form was depicted on the map with specific symbols (Table 10) for each sub-region. These symbols were developed referencing the symbols used by Al-Maimani et al. in their studies (2016).

Table 10. Social interaction – number of user symbols

Number of users	One person	Two people	Three people	Four people	Five people
Symbol	⊘	⊘	⊘	⊘	⊘

Within the scope of the techniques used for behavior mapping, a specified number of users should be observed for a certain period of time in each sub-region, their activities documented in the on-site observation form, and their routes recorded on the behavior map. For this reason, the activities observed using the developed observation technique were first noted on paper and subsequently depicted on maps using the symbols described above (Figure 6).
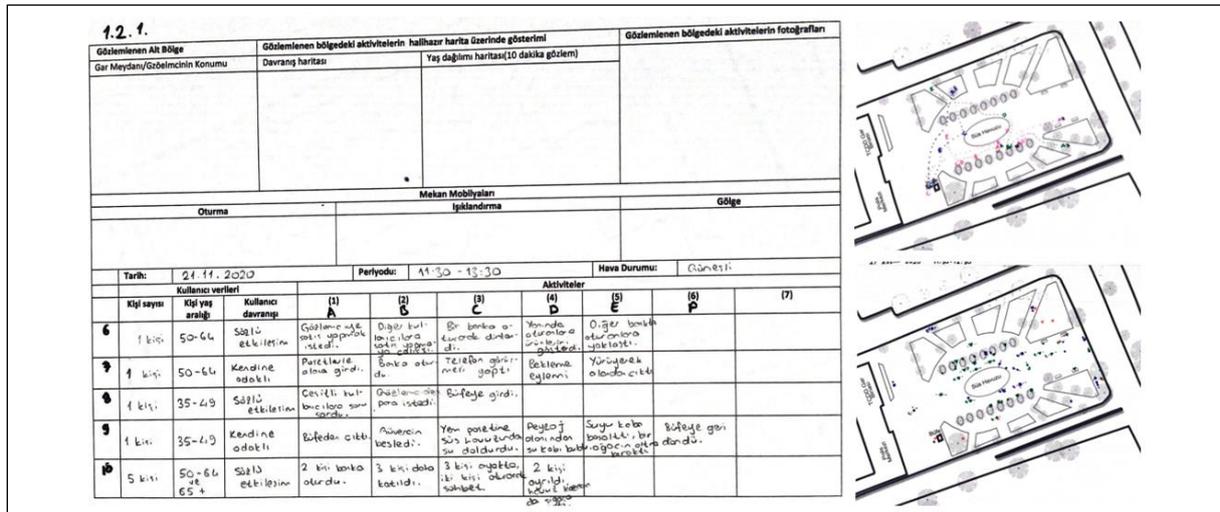
Figure 6. Noting the monitored activities on the on-site observation form (left), Noting the tracked user age groups and user activity type/routes on the map (right).

During the on-site observation, the activities noted on the blank observation form and the age groups - activity routes shown on the map were modified and processed digitally in the appropriate locations on the observation forms, as seen in Table 11.

Table 11. Case study area: Gar meydanı (Station square), 19th of November 2020, observation sheet.

Observed Sub-Region: Gar Meydanı (Station Square)	Display of activities in the observed area on the map		Photos of the activities of the users observed in the area
Observer's Position	Behavior map	Age group and location map (10 minutes observation)	

Urban furniture		
Sitting element	Lighting element	Shade

Date:	19.11.2020 - Thursday	Period:	11:30-12:30		Weather:	Cloudy

	User Data			User activity						
	Number of people	Age group	User behavior	A	B	C	D	E	F	G
1	4 at first, then 6 people	20-34 20-34 6-12	Observer - Verbal interaction	Whistled to the pigeons.	Waiting, looking left and right.	They met and became 3 people	3 person chatting	They separated and became one person. Sitting.	Whistled to the pigeons.	
2	1 person	35-49	Self-focused user	Entered the space on a bicycle	Parked the bike.	Sat on the bench.	Was busy on the phone.	Got on the bike.	Left the space on the bicycle.	
3	1 at first, then 2 people	35-49 35-49	Verbal interaction	Talking on the phone while standing	Greeted his approaching friend.	They sat on the bench together.	They watched the ornamental pool together.	They waited for the minibus.		

| 4 | 1 person | 50-64 | Observer | Entered the area with a market cart. | Resting on the bench | Left the area with the market cart. | | | | |
| 5 | 1 at first, then 5 people | 50-64 | Verbal interaction | Sat on the bench. | Met his friends. | Chatting while standing. | Eating seeds while standing | Pigeon feeding | | |

As a result of the interpretation of the observation papers, the findings of the third stage were obtained. Using the "behavior map" and "user activities" sections in the observation papers, the observed activities are depicted on separate maps for each sub-region. "User behavior", "user activities" and "social interaction-number of users" maps were created for each day monitored in each sub-region. Table 12 shows three maps created for the same day inside a sub-region.

Table 12. Case study: User activity (left), general user behavior (middle), and social interaction-number of users (right) maps created by observation on 19th of November 2020 in Gar meydanı (Station square).
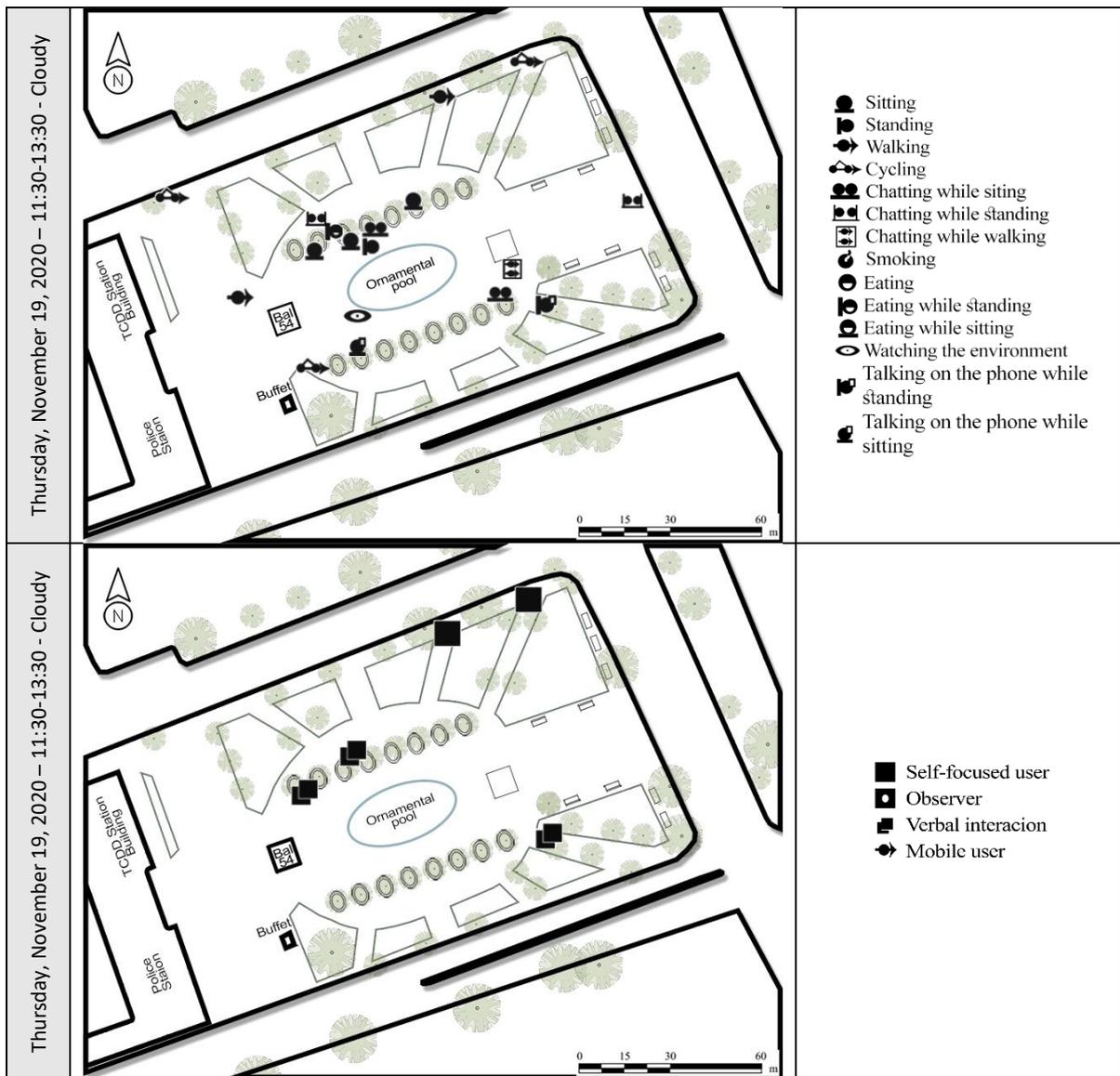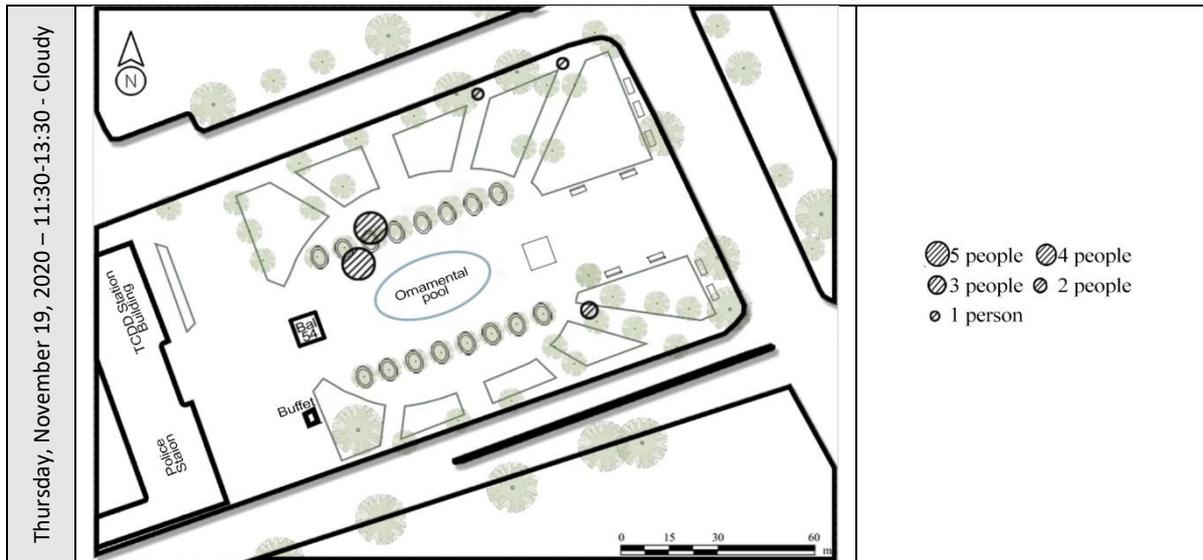
As a result of the observations made on the specified days, all maps prepared separately for the 1st sub-region (Station Square) and the 2nd sub-region (the entrance from the Atatürk Boulevard) overlapped under the headings of "general user behavior", "user activities" and "social interaction-number of people". As a result, one "general user behavior", one "user activities" and one "social interaction-person number" map was obtained for each region. Figure 7 illustrates an example of overlapped "user activities" maps of the inside (1st sub-region) and the entrance (2nd sub-region) of the study area.
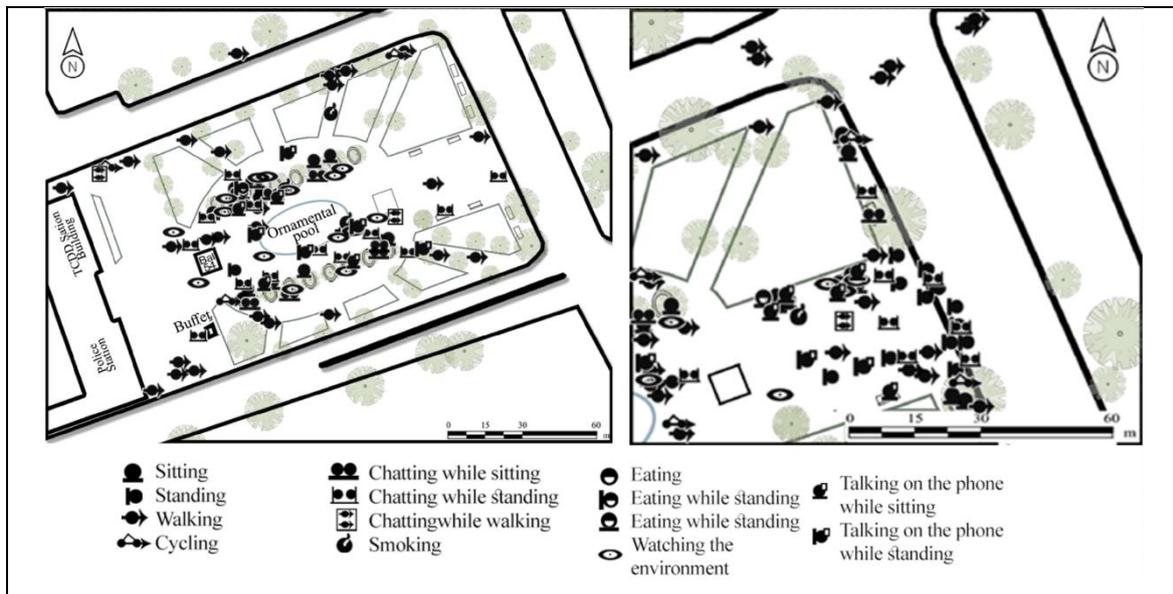
Figure 7. Case study: Maps created by overlapping user activities observed over eight days in Gar Meydanı (Station square) (left) and the entrance from the Atatürk Boulevard (right).

Graphs were created using the data obtained by comparing the overlay maps of each sub-region (Figure 7). User behavior inferences for the two sub-regions can be made on these graphs. Table 13 shows a graphical comparison of the overlay "general user behavior" maps of the sub-regions.

Table 13. Case study: Comparison of general user behavior findings of Gar meydanı (Station square) and its entrance from the Atatürk Boulevard.

| | 1st sub-region Gar meydanı (Station square) | 2nd sub-region Gar meydanı (Station square) entrance | Comparison of general user behavior findings |

Comparison of general user behavior findings:

	Self focused user	Mobile user	Verbal interaction	Observer
Inside	5	7	18	10
Entrance	13	11	12	3
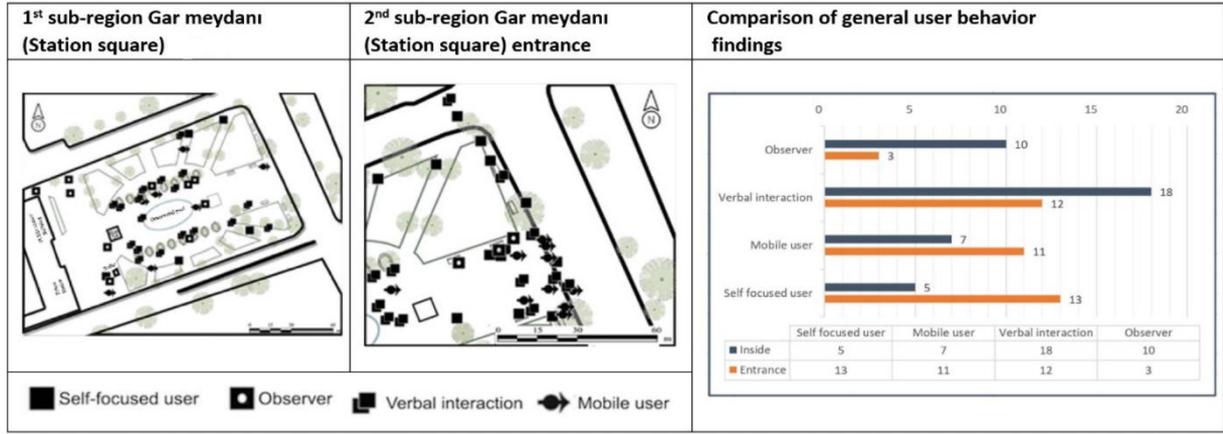
According to the results, differences in the findings of "general user behavior", "user activities" and "social interaction-number of people" were observed between the sub-regions. If a certain degree of variation in findings between the sub-regions was observed (Table 14), the space was accepted as a threshold space. Because a space can be accepted as a threshold if an activity that occurs frequently within a space is not carried out or occurs less frequently at the entrance to that space, according to the inferences made from Gennep's (1960) studies.

Table 14. Case study: Comparisons of the Station Square (Gar Meydanı) and its entrance from the Atatürk Boulevard.

Comparison of general user behavior findings

	Self focused user	Mobile user	Verbal interaction	Observer
Inside	5	7	18	10
Entrance	13	11	12	3

There are significant differences between regions in the type of self-focused and purely observant users. According to general user behavior observations, it can be concluded that the area is a threshold space.

Comparison of user activities findings

	Observing the environment	Talking on the phone while sitting	Talking on the phone while standing	Eating and drinking while sitting	Eating and drinking while standing	Smoking	Chatting while walking	Standing and chatting	Sitting and chatting	Cycling	Walking	Standing	Sitting
Inside	15	4	5	0	1	3	2	13	9	3	26	2	12
Entrance	6	5	3	1	0	1	1	8	4	4	24	12	10

In some activities, critical differences are observed between the inside and the entrance of the space. This difference was most observed in the activities of standing and watching the environment. Critical activities differences that can be examined in the user activities graph indicate that the region is a threshold space.

Comparison of social interaction- number of people

	5 people	4 people	3 people	2 people	1 person
Inside	4	2	6	5	23
Entrance	0	0	3	14	23

According to social interaction-number of people data, the region is a threshold place.

According to Table 13, when comparing the general user behavior diagram in the Station Square (Gar Meydanı) area, significant differences can be observed between the self-focused and purely observational user types within different sub-regions. Based on the observations of general user behavior, it can be inferred that the area serves as a threshold space. Regarding user actions, the observation indicates that eating and drinking while standing is only witnessed in Station square (1st zone), while eating and drinking while sitting is observed exclusively in the entrance from the Atatürk Boulevard (2nd zone). The most significant difference in action intensity is noticed in standing and observing the surroundings. Although not as critical as these two actions, other actions also display variations in their counts. In the context of the findings on user actions, the region can be identified as a threshold space. In terms of the type of social interaction and number of people, although the number of individuals who use the area alone is equal, groups of 4 and 5 people were not observed at the entrance but were observed in sufficient numbers (allowing for an interpretation of differences between two sub-regions) Station Square (Gar Meydanı). The fact that groups of 4 and 5 people are only seen in one of the sub-regions and that 2-person groups are much more common at the entrance

from the boulevard indicates that the Station Square (Gar Meydanı) provides a threshold in terms of social interaction and the number of people involved.

CONCLUSION:

Threshold spaces are both a part of the spaces they separate and the parts that bring life to the space and create interaction between spaces. Approaches that reveal the space-user relationship by establishing the connection between space and daily life in cities, which cannot be easily analyzed due to their mixed structure, are very important in this context. In particular, the nature of threshold spaces and how they are positioned around/at the entrance of the main space is one of the critical criteria that shapes user behavior. A productive analysis of these spaces will give the designer the opportunity to establish the space-user relationship and ensure the continuity of the space and its inclusion in daily life. After the analysis, a well-constructed threshold space will enable the space to be read more easily and create an efficient human-space relationship.

Here, it would be useful to emphasize again the purpose of the study and discuss the findings accordingly: the aim of the study is to propose an approach for the detection and analysis of threshold spaces based on the gap in the literature. Furthermore, it is aimed to use threshold spaces as an input in the analysis of space, to investigate them in public space, and to include them in design/space organization.

As a result of the study, two types of results revealed:

1. Conclusions on the development of the approach created in line with the aims of the study: As a result of testing the approach developed in three stages in line with the study's objective on sample study areas, it was understood that the suggested approach could be used to detect and analyze threshold spaces holistically, and that the "threshold" status of the spaces could be interpreted through user behaviors. While we know the importance of studying and understanding threshold spaces, literature reviews made it clear that most of the existing analyses on threshold spaces have focused solely on their internal characteristics, failing to consider their relationship with the surrounding spaces (Yılmaz, 2016; Arsan & Kepez, 2017; Cosco et al., 2010; Mandel, 2016; Goličnik Marušić, 2010; Al-Maimani et al., 2014; Guinther et al., 2014; Liao et al., 2022). Additionally, these analyses often overlook the unique qualities of transition (Van Gennep, 1960; Turner et al., 1969; Kapstein, 1988; Dee, 2001; Chun et al., 2004; Ambroziak, 2005; Preamechai, 2006; Zimmerman, 2008; Deshmukh, 2009- as cited in Singh, 2015; Kaza, 2010; Bhonsle, 2010; Kray et al., 2013; Boettger, 2014; Singh, 2015; Perugia & Mancini, 2020), in-between (Le Corbusier, 1981; Kultermann, 1993; Dee, 2001; Benjamin, 2002; Hasarlıgil, 2007; Thomassen, 2009; Turner, 2012; Boettger, 2014; Heidegger, 2017; Soderlund & Borg, 2018) and liminal spaces (Thomassen, 2009; Horvath et al. 2014; Szakolczai, 2017; Soderlund & Borg, 2018; Holloway, 2020), treating them as ordinary spaces and disregarding their distinctive characteristics. Furthermore, because threshold spaces can vary depending on the angle from which they are examined, it is challenging to develop a comprehensive method for their detection and analysis. Unfortunately, the studies on "threshold space analysis" have been insufficient, resulting in a lack of research and understanding of threshold spaces in comparison to other types of spaces.

   As a result of the literature review, it was determined that the behavior map method was used in many studies, but was found insufficient by the researchers for some reasons (Table 1). Some studies found the method inadequate and used different methods such as surveys and face-to-face interviews (Guinther et al., 2014. Ozbil et al., 2018; Istrate et al., 2020; McQuilkin, 2016; Milke et al., 2009) and data acquisition and processing techniques such as GIS, GPS and RLTS (Goličnik Marušić, 2010; Mandel, 2016. Ozbil et al., 2018; Wang & Wu, 2020; Van der Spek et al., 2009; Arsan & Kepez, 2017) to support the method. Additionally the use of the behavior mapping model had many limitations and caused the studies not to achieve the desired results (Goličnik Marušić, 2010; Guinther et al., 2014; Al-Maimani et al., 2014; Mandel,

2016; Ozbil et al., 2018; Onojeghuo et al., 2019; Istrate et al., 2020; Wang & Wu, 2020; Cosco et al., 2010; Van der Spek et al., 2009; Valkenet et al., 2022; Cox et al., 2018; Arsan & Kepez, 2017; Liao et al. 2022). As a result, a holistic perspective on threshold spaces has not been achieved. These revealed limitations also make it difficult to achieve the desired results in threshold space detection and analysis. For this reason, in this study, a customized approach was developed on the detection and analysis of threshold spaces, and the approach is compared with the existing behavior mapping model in Table 15.

Table 15. Comparison of the behavior mapping model and the proposed detection and analysis approach.

	Behavior map model	Recommended approach for detecting and analyzing threshold spaces
Aim	Revealing critical design data by establishing the relationship between built environment features and observed users (user behaviors) (Barker, 1968; Ittelson, Rivlin, & Prohansky, 1970; Arsan & Kepez, 2017) .	Detection and analysis of threshold spaces from an integrative perspective with user behavior and sub-region examinations, thus revealing critical design data about the space.
Scope	Monitoring behaviors over space and time (Cosco et al., 2010) Examining the actions of users in the designated place directly or through observation devices (such as camera, GPS, etc.) (Sanoff, 1991).	Observation of threshold spaces through the main space and its entrance with data such as user behavior, locations, routes, numbers, etc.
Stages	**1st stage:** Preparation of plans and observation papers, making observations and recording them on observation maps. (Goličnik Marušić, 2010; Guinther et al., 2014; Al-Maimani et al., 2014; Mandel, 2016; Karadeniz et al., 2018; Ozbil et al., 2018; Gharib, 2019; Onojeghuo et al., 2019; Istrate et al., 2020; Wang & Wu, 2020; Cosco et al., 2010; McQuilkin, 2016; Van der Spek et al., 2009; Valkenet et al., 2022; Milke et al., 2009; Cox et al., 2018; Arsan & Kepez, 2017; Liao et al. 2022). **2ndd stage:** Processing user locations, activities and routes determined as a result of observation on maps. At this stage, some studies made only location an activity marking, (Mandel, 2016; Ozbil et al., 2018; Gharib, 2019; Onojeghuo et al., 2019; Wang & Wu, 2020; Cosco et al., 2010; McQuilkin, 2016; Valkenet et al., 2022; Milke et al., 2009; Cox et al., 2018; Arsan & Kepez, 2017; Liao et al. 2022) while others made all the markings (Goličnik Marušić, 2010; Guinther et al., 2014; Al-Maimani et al., 2014; Karadeniz et al., 2018; Gharib, 2019; Istrate et al., 2020; Van der Spek et al., 2009). **3rd stage:** After collecting several behavior maps in plan order, creating a "general map" by overlapping the maps (Al-Maimani et al., 2014; Onojeghuo et al., 2019; Cox et al., 2018).	**1st stage:** Pre-determination of the threshold spaces in the study area. Examination of the study area as a threshold space by investigating the physical, sociocultural and historical characteristics of the study area. **2nd stage:** Selection of potential threshold spaces among the threshold spaces. Conducting document analysis and on-site determination of spaces under the titles developed in the study. Conducting historical development, social use and physical properties analyses. **3rd stage:** On-site observation and the processing of the study area into behaviour maps with the behaviour mapping technique developed in the study. Processing user behaviour, user activities and social interaction-number of people on maps. Drawing user activity routes. **4th stage:** After collecting several behavior maps in plan order, creating a "general map" by overlapping the maps. **5th stage:** Interpretation of threshold spaces by creating feeder data (tables, graphs, etc.)
Outputs	•Provides the opportunity to measure some parameters such as "location, activity, route" (when used on its own) •Can be used to develop design policies and standards for use in the design process (Goličnik Marušić, 2010; Guinther et al., 2014; Mandel, 2016; Karadeniz et al., 2018; Gharib, 2019; Onojeghuo et al., 2019; McQuilkin, 2016; Cox et al., 2018; Arsan & Kepez, 2017; Cosco et al., 2010)	•Provides the opportunity to measure some parameters such as "location, activity, time, route, demographic characteristics, relationships between spaces, types of user behaviour, number of people using the space" (when used on its own). •Can be used to develop design policies and standards for use in the design process.

Limitations	•Each observer processes the data with different techniques, resulting in incomplete data (Mandel, 2016) •The data collection and analysis phase is difficult (Liao et al. 2022; Goličnik Marušić, 2010) •Insufficient to measure the spatial and cultural character of the study area or the activities performed (Cox et al., 2018; Cosco et al., 2010; Al-Maimani et al., 2014; Guinther et al., 2014) •Space observations are carried out in isolation from its surroundings, the integration levels of outdoor spaces into the general urban fabric are not measured (Ozbil et al., 2018). •Although new technologies are used in the method, they only work for managing and visualizing data and do not offer any innovation for collecting data (Arsan & Kepez., 2017) •The method causes waste of time and resources due to errors in the method and/or prejudices of the observers (Wang & Wu, 2020; Onojeghuo et al., 2019) •Producing incorrect results because the data collection method used is not sensitive enough / errors in the data collection technique (recording error) (Liao et al., 2022; Van der Spek et al., 2009; Valkenet et al., 2022; Arsan & Kepez, 2017). Where the method was found wanting, other supporting methods were used. These supporting methods were generally the survey technique (Guinther et al., 2014. Ozbil et al., 2018; Istrate et al., 2020; McQuilkin, 2016; Milke et al., 2009) and various other data processing programs (GIS, GPS, RTLS etc.) (Goličnik Marušić, 2010; Mandel, 2016. Ozbil et al., 2018; Wang & Wu, 2020; Van der Spek et al., 2009; Arsan & Kepez, 2017).	•In the analysis approach proposal, the number of places to be observed has been increased to at least 2. In order to make a precise observation and comparison, the study areas must be observed within the same time period. Therefore, there must be as many observers as the number of places observed, which makes it difficult to carry out the analysis approach with a single observer. •In order to measure threshold spaces integrally, not only the entrance and inner areas but also the surrounding area must be measured by dividing them into sub-regions.

2. Results on the public space (Station Square- Gar Meydanı) where the developed method is applied: In the case of the approach developed with this study, in the second stage of the approach, a document analysis and on-site inspection was carried out according to the dimensions determined (historical development, social use and physical features dimensions) in the case of the example area. It was thus established that Station Square (Gar Meydanı) had two critical historical thresholds and two social use thresholds. In the third stage of the approach, the activities and social interaction-number of people observations performed in the places allowed to examine the activities carried out in the square, critical differences between the square and its entrance from the Atatürk Boulevard could be observed and interpretations could be made on the status of being a threshold place based on these differences. Therefore, with the application of the developed approach in the context of Station Square (Gar Meydanı) and the comprehensive interpretation of the documents analysis, on-site inspections, observation sheets and observation maps and the results obtained from these, it was possible to determine whether this place meets the criteria of being a threshold space or not (Table 16).

Table 16: An example of the "threshold space" result data of the space examined with the proposed holistic approach (document analysis, on-site detection, behavior-mapping technique)

		Gar Meydanı (Station Square)
Document analysis and on-site detection	Historical Development	**1st Historical Threshold: 1899** Railway and station construction in the area, **2nd Historical Threshold: 1981** • Removing the railway tracks and making the area square • Being changes in the field triggered and/or influenced other historical developments • Construction (1999) and demolition of prefabricated buildings with different functions in Station Square (2012)

	Social usage	**1st Social Usage Threshold: 1899.** The general user profile in the area transformed into a passenger profile with the construction of the railway line. The housing function was replaced by the transportation function. **2nd Social Usage Threshold: 1981**. The passenger profile in the area was replaced by the general user profile. The transportation function was replaced by a square function that meets the functions of gathering, resting and meeting.
	Physical properties	**It does not meet the criteria of being a threshold space in terms of physical properties:** • **Th**e minibus stops located at the entrance to the Gar Square from the Atatürk Boulevard direction -from the east- and the benches in front of these stops added a different function to the square and separate the entrance of the square from the inside of the square • Again, for this reason, different types and intensities of user activities occurred at the entrance and inside of the space.
On-site observation using behavior mapping technique	**General user behavior**	There are significant differences between regions in the type of self-focused and purely observant users. This difference can be seen especially in self-focused and purely observant user types. According to general user behavior observations, it can be concluded that the area is a threshold space. Therefore, the region provides the criterion of **being a threshold place in terms of general user behavior.**
	User activities	In some activities, critical differences were observed between the square and the entrance of the square. This difference was most observed in the activities of standing and watching the environment. Critical activities differences that can be examined in the user activities graph indicate that the region is a threshold space. Therefore, the region provides **the criterion of being a threshold space in terms of user actions.**
	social interaction- number of people	While groups of 4 and 5 people could be observed inside the square, none were observed at the entrance of the square. There is critical inter-regional differentiation in groups of 2 people. However, observing groups of 4-5 people in one region and not in another indicates differentiation in terms of user profiles. The region provides the criterion of being a threshold place in terms of social interaction and number of people

With this study, the aim of demonstrating the utility of threshold spaces as an input to space analysis and their detection in public spaces has been achieved. In this context, researchers who are interested in spaces and space transitions; in analyzing the relationship between spaces; in observing the activities that define the spaces and developing a design in line with these activities; and researchers who aim to discover the types of activities that can be observed in public spaces and incorporate these data in the design process / analysis that will provide input to the design can benefit from the study.

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