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Article

Physical changes and pedestrian dynamics in public space: The Beşiktaş case

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ABSTRACT

Urban squares are crucial for urban life, enhancing city attractiveness and livability; nevertheless, many in Istanbul lack pedestrian-oriented design and sufficient infrastructure. Relatedly, several projects have been implemented in urban squares to overcome these issues. However, designing urban squares leads to both improvements and controversies, reshaping not only the physical environment but also how individuals engage with public space, and understanding pre/post dynamics of interventions provides comprehensive feedback and helps municipalities to resolve further needs. This study explores the impact of spatial changes on pedestrian behavior in Besiktas Barbaros Square (Istanbul/Turkey) and its surroundings. With a three-stage methodology, this research first identifies physical transformations by analyzing satellite imagery, street views, and field studies. Second, pedestrian flows and stationary activities are observed via manual video recordings (10 minutes, weekday/weekend, 2022-2024), capturing the site both before (once the steel overpass was removed and before the site was redeveloped) and after interventions. These observations are mapped and analyzed using QGIS. Third, perspectives from professionals (n=31) in spatial fields -urban planners, architects, and landscape architects- are gathered through surveys and open-ended responses. The findings focused on the eastern part of the square due to observational constraints, which reveal that adding urban furniture impacts dynamic/stationary activities and enhanced social interactions. The new eagle sculpture also emerged as a focal point. According to professionals' evaluations, interventions contributed to partial improvements in several aspects between pedestrians and the space. However, considering location-based potentials, green space use and the spatial connection with the urban coastline still need to be improved.

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INTRODUCTION

Public spaces and urban squares are critical terms that significantly impact urban vitality, quality of life, and human behavior, so numerous discussions have been conducted on these topics. Especially after the 60s, well-known experts in urban planning, such as Jacobs (1961), Whyte (1980), and Gehl (2007; 2010; 2011) highlighted its importance in urbanized environments, and they expressed different perspectives through civic and political, or behavioral approaches related to human behavior and public space usage. Accordingly, public spaces and urban squares, as important representatives, are the beating heart of the city, and all of them have their own dynamics due to their historical background, functions, activities, and the possible encounters they create.

Relatedly, Beşiktaş Barbaros Square and its surroundings are unique spaces used not only by local communities but also by residents from across Istanbul; however, despite their historical background, locational dynamics, coastal views, and functional uses, they did not offer a human-friendly environment for many years (IMM, n.d), and created a chaotic image for users' perception based on its visual appearance, infrastructural inadequacies, limited pedestrian activities etc. (Yeşil İstanbul, 2024). With the Besiktas Square Landscaping Project -as called by the design office-, a large-scale public space transformation was launched under the initiation of Istanbul Metropolitan Municipality (IMM) and BİMTAŞ and designed by the architectural office CM Architecture (CM Architecture, 2020). As defined by the local government and the design office, the project objectives include enhancing pedestrian circulation, improving pedestrian-vehicle interaction, integrating monumental structures and squares as a part of the urban image, improving coastal relations of squares, and so on (IMM 2023; Türkay 2024; Cansız 2025). As can be seen in the upper statements, different actors may use other names to define the square. For instance, the designer office prefers the "Besiktas Square" term as well as local architectural news (Cansız, 2025; Mimarizm, 2023); whereas Çınar et al. (2021) and Zafer & Erdönmez (2021) use the "Besiktas Pier Square" in their academic studies. However, during the presentation of its project, the IMM described the area between the Besiktas pier and Besiktas Avenue as Besiktas Barbaros Square (IMM, n.d.; Yeşil İstanbul, 2024). On their website, they defined the interventions proposed for the coastal front within the framework of 'the separate yet interrelated redesign of the squares' (Barbaros Hayrettin Pasha Square and Besiktas Barbaros Square). Accordingly, this study adheres to the terminology used by the IMM.

In line with this, this research aims to understand the spatial and behavioral patterns that changed with physical interventions in the urban square. It explores the analysis of professional insights on the implemented project to identify the future requirements of the space. In terms of temporal aspects, this study has identified three stages: The pre-project stage, dominated by the steel overpass (before 2021); the transition stage, after the removal of the overpass but before the completion of the landscaping (2022–2023); and the post-project stage, after the implementation phases of the new design (2024–2025). Based on these objectives, this paper seeks to answer the following questions:

RQ1: How have contemporary spatial changes in Besiktas Barbaros Square and its surroundings influenced their public space functions and pedestrian dynamics?

RQ2: How have pedestrian behaviors and activity patterns evolved between 2022 and 2024, considering removing the steel overpass, adding urban furniture, and landscape design?

RQ3: How do urban planning and design professionals evaluate the spatial changes in Besiktas Barbaros Square and its surroundings regarding accessibility, social interaction, and pedestrian experience?

REVISITING PUBLIC SPACE DESIGN: GLOBAL APPROACHES AND LOCAL CHALLENGES ON BESIKTAS BARBAROS SQUARE

Global Approaches to Public Space Design and Evaluation Process

The city has always been a space of connection between people and functions. The '60s was a turning point for urban planning studies that focused on public space and public life, with the impact of Jacobs's (1961) famous book The Death and Life of Great American Cities; subsequently, Appleyard's (1980) ideas about livable streets and Whyte (1980) observatory studies related to social life and urban open spaces, as well as Gehl's public space and public life understanding. They all open new perspectives regarding urban design and give essential proofs and empirical arguments to future planners to show what matters in human-centric spatial design in terms of the outdoors. As one of them, Gehl's (2011) outdoor activity classification creates a systematic coding approach for behavioral research; in that study, necessary, optional, and social activities and their relation with the quality of the environment are defined in his book "Life Between Buildings (1971)". In general, necessary activities [waiting for someone, shopping, going to school/work/bus stop (primarily utilitarian walking)] cover daily tasks and are less related to exterior environments; they are conducted in almost all conditions, while optional activities are more related to favorable conditions both in terms of weather and environment. Notably, the quality of the physical environment is a significant factor for optional activities (Gehl, 2011). Relatedly, urban squares serve as meeting points that host a range of necessary, optional, and

social activities, bringing people together for various purposes (Acar et al., 2021).

Since 1975, Project for Public Spaces (PPS), an interdisciplinary team, has also tried to understand parameters that make a place great through four main categories: "Sociability, uses & activities, access & linkages, comfort & image", and still conducting several works related to placemaking (PPS, 1975). Based on the principles of urban squares highlighted by PPS (2005), successful urban squares include the following features: They are an important part of the formation of image and identity in cities; they include various attractions (such as outdoor cafes, bandshell performances, etc.); they have amenities (such as lighting, benches, pathways, etc.) that enhance people's use and comfort. Squares with flexible designs (movable chairs, tables, umbrellas) are more capable of responding to different times of day/month, and spatial uses must be supported through seasonal strategies. A successful square should be easily accessible; approaches such as active outer squares and inner squares can boost accessibility and use of the square. Accordingly, good squares begin a block away, are visible, and should have entrances and support pedestrian safety. In addition, the management of good squares oversees the processes of comfort, safety, and maintenance (PPS, 2005).

During the 80s, Whyte (1980) conducted a comprehensive observational study to understand socio-spatial dynamics in small urban open spaces, such as human-human interaction, sitting spaces, wind-water-urban space relation, what is desirable in an outdoor environment, and so on, which also became a guideline for people who have studied public spaces for decades, and highlighted that people attract people. Also, Gehl (2011, p. 62) noted that physical arrangements are an essential way to promote contact in public space; for instance, no walls, short distances, low speeds, one level, and face-to-face orientations can support visual and auditory connections. Relatedly, as Andersson (2016, p. 5) highlights, there are several reasons for local governments to invest in better public spaces, such as improving the quality of life, which contributes to a sense of civic cohesion, enhancing safety in the city, and enhancing well-being, mobility, and public health.

Methodologically, observation is one of the most prevalent tools for studying public space. Techniques such as counting, mapping, tracking, photographing, and test walks—outlined by Gehl & Svarre (2013) — can be used alone or in combination. Also, questionnaire surveys, interviews, and trip diaries contribute to resolving human behaviors by capturing data about individual habits, preferences, intentions, etc. (Millonig & Gartner, 2008). Lately, technological developments have also supported the analysis of human behavior in public spaces, and new techniques and tools have automated processes, increased accuracy, and handled large amounts of data (Hanzl & Ledwon, 2017; Millonig & Gartner, 2008). As a widely used spatial representation method, behavior maps are important visual tools to present behavior data; they can be used for marking and recording behaviors or trajectories, and they may involve information about duration, activity types, traces, etc. Time-lapse videos and GIS techniques have also come to the fore in space-time behavior research (X. Zhang et al., 2021). Accordingly, several studies use these approaches with different data sources to reveal activities, cumulations, and social interactions in public spaces. As seen in the work of Marušić (2011), who combines GIS and behavioral mapping techniques to illustrate the relationships between the physical characteristics of open space and usage types, he conducted his research in two European cities, identifying occupancies, contacts, and buffer zones in urban parks. On the other hand, Petrtýlová & Jaššo (2022) use behavior mapping to analyze public space (activities, proportion of gender, space distribution, and age groups) before making decisions about its development in the waterfront of Bratislava. As another example, Ceccarelli et al. (2023) use deep learning techniques with video analytics to understand changing behavior patterns due to the intervention of street experiments during this research observation process designed for both pre- and post-intervention.

Building upon these methodological developments and theoretical frameworks, several approaches for evaluating public spaces such as streets, urban squares, etc. have been proposed. These approaches focus on understanding how the spatial organization of public space influences user experiences, activities, and pedestrians' behavioral patterns, providing critical feedback for future design practices. Therefore, measuring an urban square's spatial or behavioral performance, understanding user satisfaction, and bringing practices and design requirements are critical aims of this kind of research. Accordingly, various researchers use public space evaluation techniques to understand users' behaviors/activities or satisfaction in their research (Gong et al., 2025; Kim et al., 2018; Ozbil Torun et al., 2020; B. Zhang et al., 2023; Y. Zhang, 2017; Zhu et al., 2011). For instance, Ozbil Torun et al. (2020) evaluated urban squares in the peripheral zones of Istanbul, incorporating behavioral mapping, direct observation, user questionnaires, space syntax, and spatial analyses. Gong et al. (2025) examined usage patterns through semi-structured interviews and public features and developed age-friendly renovation strategies for residential communities in Hangzhou. Zhu et al. (2011) defined post-occupancy analyses for public space under three main categories—descriptive, evaluative, and diagnostic—and, utilizing user feedback and observation, proposed transformation strategies for the Hubin Block in Hangzhou. Maisel et al. (2021) also assessed user perceptions regarding the before-and-after conditions of a project carried out along a main street corridor. Collectively, these contributions define how public spaces can be evaluated in

terms of spatial quality and user experience. While some focus on specific public spaces, others concentrate on the pre- and post-intervention. In any case, they all provide a methodological toolbox for public space studies, which also informs the three-step framework adopted in this study.

Local Constraints in Besiktas Barbaros Square and Its Surroundings

The historical background of the settlements in Besiktas dates back to permissions given to Ottoman captains, especially Barbaros Hayrettin Pasha, who became an essential figure for the zone; in the following period with the impact of movements of the palace boosted population in and around the area (Çağlayan, 2020), it turns out an essential attraction point for the Istanbul (Abay, 2021). During the Early Republican Period, several interventions were defined in the Prost plan. These include the creation of avenues and squares, the expansion of roads, the rearrangements of greenery, and monumental approaches that highlight Republican symbolism in the urban space. In the following time, relatedly to the field, the transformation process began on the coastal side of the city, and this progress also led to the design of Besiktas Square for ceremonial purposes (Çınar et al., 2021; Üresin, 2019). During the 50s, with the opening of Barbaros Boulevard, the district started to evolve into a more commercial zone (Abay, 2021), and some of the politics and transformative decisions with "Menderes operations" ended up changing the urban space (Giray Küçük, 2020). In general, green spaces decreased in time, and built-environment values (such as the Astro Tobacco Factory) in the area and surroundings that could support the cultural and coastal character of the city were lost at a certain level (Abay, 2021). At a later stage, the steel overpass constructed in the northern part of the square created a vehicle-oriented atmosphere that obstructed the square's visual potential and dominated the area's overall appearance. The impacts of the overpass and related uses in the square are detailed in the pre-project stage and serve as an important reference point for understanding subsequent spatial changes.

Since the 1990s, the Besiktas Square Project proposals have been a topic on the agenda to prioritize pedestrian use of the square and coastal side, and these issues are discussed periodically (Giray Küçük, 2020). Relatedly, the case study area -Besiktas Barbaros Square (Figure 1)- corresponds to the section located between Besiktas Pier and Besiktas Avenue. The site is associated with several registered and monumental structures, including Sinan Pasha Mosque, the Tomb of Barbaros Hayreddin Pasha, etc. (Cansız, 2025). In addition to the historical context, coastal, and transportation dynamics, another prominent dynamic related to the square is its significance as a key spot for skateboarders. This is highlighted in the article titled Skateboarding and Istanbul, where Turkey's national skateboarding team coach, Koçal, states: "Besiktas Barbaros Square is international. If a skateboarder truly lives the culture, the first place they go when visiting another country is that place's skate spot. In Istanbul, that place is Besiktas Square." (Abayhan, 2023).

Although numerous academic studies have been conducted on Besiktas Barbaros Square, to the best of the author's knowledge, no scientific research systematically examines behavioral changes related to the post-2021 transformation; however, previous studies offer valuable insights into the square's long-standing spatial dynamics. All of these studies discuss conditions before the overpass was removed and before the recent landscaping project. For instance, Zafer & Erdönmez (2021) evaluated the spatial quality of the square and mentioned that the primary usage characteristic comes from transit users. Even though space gives people some opportunities to socialize, it has evolved around public transportation and transit use instead of being pedestri-

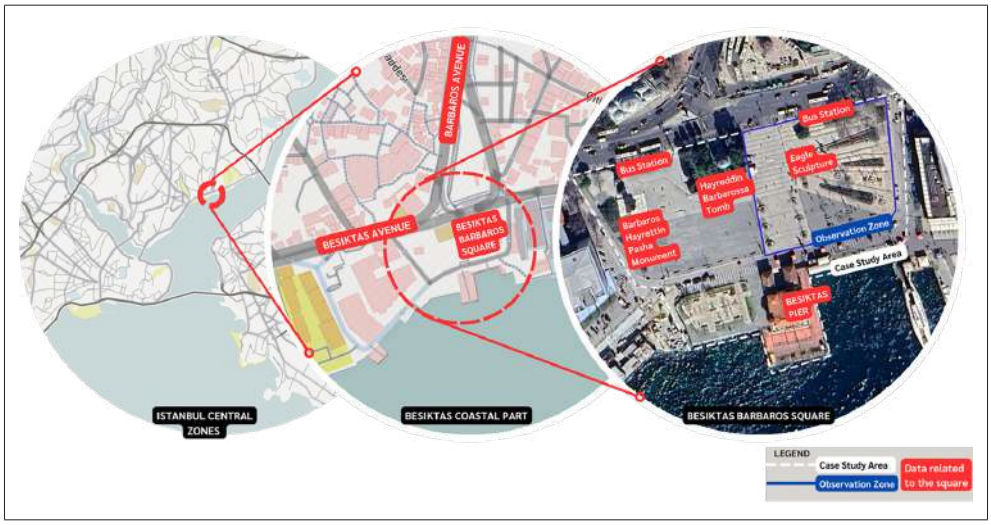


Figure 1. Location of case study area.

an-oriented, and coastal interaction is limited due to bus and ferry stops. Similarly, other scholars are also interested in the spatial quality of public spaces in Besiktas, and they address that urban equipment is insufficient, safety and perception of the square are inadequate, and the square is not accessible for disadvantaged groups (Uskan Demir et al., 2021). Çinar et al., (2021, p. 381) scored the spatial quality of the square and addressed the insufficiency of the recreation area and the need for revision of the square to highlight symbols and triangulation points to make it more memorable and distinctive. Also, Abay (2021) examined ideas related to the square, such as the urban design competition (1990) and municipal project (2007), and the project proposed in 2015. Üresin (2019) emphasized the reproduction of cities through spatial transformation and sampling this through Besiktas, and Özer & Kubat (2014) stated that the movement distribution in the Besiktas center is circular, and highlighted that there are numerous factors influencing pedestrian mobility, such as the bus stop in the southern part of Barbaros Boulevard, the main bus stop on the seaside, and the area around the pier. Considered collectively, these earlier contributions portray a square that is structurally important for mobility but qualitatively weak as a pedestrian-oriented place – a condition that the interventions explicitly set out to change. This lets the current study position itself as a follow-up that captures the latest phase of transformation.

METHODOLOGY

This research focuses on recent spatial changes in Besiktas Barbaros Square and its surroundings to provide an evidence-based examination of how pedestrians are affected by these changes and how urban professionals assess them. Accordingly, this study adopts a multi-layered methodological framework combining spatial, visual, and behavioral data sources based on three main steps. The three steps are designed to complement each other: (i) Spatial change analysis documents the physical transformation of the square over time; (ii) behavior mapping and pedestrian counting reveal how pedestrians move around and spend time in the square (2022-2024); and (iii) expert evaluations about these spatial interventions. First, satellite images, street view imagery, and visual data from field studies are comparatively used to detect changes in urban elements and facilities over time [the pre-project stage (before 2021); transition stage, after the removal of the overpass but before the completion of the landscaping (2022–2023); and the post-project stage (2024–2025)].

Second, pedestrian behavior is mapped based on video recordings taken from a fixed height (third floor) and identical locations in 2022 and 2024 under similar air temperatures and time frames (12:00–14:00), including weekday and weekend conditions (Figure 2). Each observation session consists of 10-minute video recordings. These recordings are analyzed to categorize pedestrian movements, standing behavior (durations / if any additional activities), and sitting behavior based on Gehl's (2011) approach. Traces of movement and spatial concentration of stationary activities are visualized, utilizing video-based tracking and QGIS tools for visualizing pedestrian coding. As a scope limitation, the pedestrian behavior analysis is restricted to the eastern section of the square—starting from the ending point of the pier-related transit axis and covering the first phase of the project—due to limitations in observation height, technical equipment, and visual obstructions. In addition, in manual pedestrian counting —especially in outdoor environments- counting accuracy may decrease depending on pedestrian volume and flow rates, resulting in under/over counting (Bauer et al., 2009; Greene-Roesel et al., 2008). To overcome this, this research uses the advantages of multiple reviews of video recordings by the author. However, errors may occur due to the number of people dispersed in the urban space and the use of perspective-based camera angles. Moreover, the 12:00–14:00 time period is limited regarding the representation of everyday uses. Considering the area's role as a central transport zone, it is likely that peak morning and evening flows will differ in volume and composition. This is therefore considered a temporal limitation of the behavioral analysis.

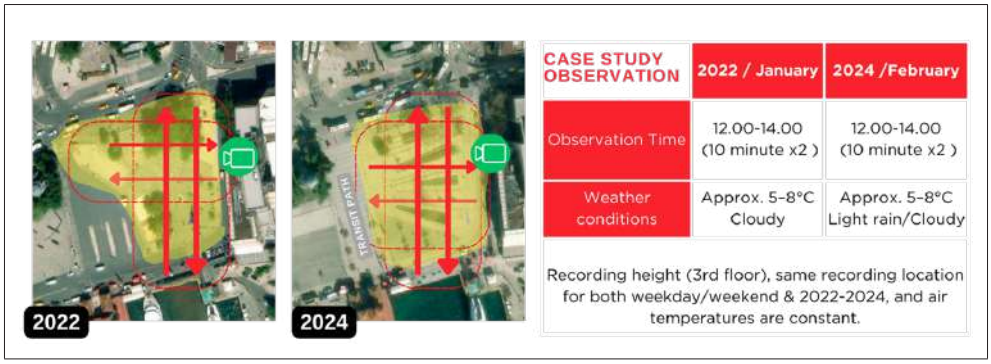


Figure 2. Observation systematic of case area.

Third, an online survey with supported visual documentation of a case study for spatial professionals was conducted to assess perceived changes before and after the interventions and reactions to the recent project. The survey was disseminated to expert groups through social media platforms and further shared via peer-to-peer referrals, resulting in responses from experts (n=31). Key indicators that shaped the evaluation matrix include pedestrian flow and movement, social interaction, usage of urban facilities and green space, aesthetic and spatial quality, coastal accessibility, and the relationship between pedestrians and vehicles. These indicators were selected to reflect the main categories emerging from the spatial change and behavior-mapping steps. There is no hierarchy between the criteria; this study adopts a comparative approach based on descriptive data, considering expert-based evaluations.

As an overview of this research, the integration of behavioral mapping of pre/post conditions and independent expert opinions about spatial changes of Besiktas Barbaros Square can be considered a design evaluation approach, giving designers and local government insights about what people need in this square for further interventions. However, it is important to assess user satisfaction beyond observed movement patterns; in that manner, this study is limited in its omission of direct user feedback concerning satisfaction levels. In addition, the defined observation boundaries cover only part of the overall design area, which limits the ability to comprehensively evaluate the newly introduced pedestrian routes.

THE SPATIAL AND BEHAVIORAL IMPACTS OF RECENT INTERVENTIONS

For many years, Besiktas Barbaros Square was characterized by dysfunctional uses that did not correspond to its urban significance. The high density of urban elements, spatial disorder, and the occupation of public space mainly caused these issues (IMM 2023; Yeşil İstanbul 2024). The urban square included a steel overpass that was used as a single-line parking area, as well as abandoned kiosks and a poorly maintained ornamental pool (Turkay, 2024). The implementation of the Besiktas Square Landscaping Project's first phase began in 2021. The area was pedestrianized with the recent project, covering nearly 29,000 square meters (IMM, 2023). One of the first interventions to achieve that was removing the steel overpass. Later, the bus stops were relocated to the northern part of the square, which contributed to the removal of vehicular traffic from the zone (IMM 2023; Cansız 2025).

In a published interview with Cem Sorguç, the founder of CM Architecture—the architectural office that actively took part in the project—he stated that one of the main goals of the design process was to bring order to the fragmented space. The project aimed to create a pedestrian-friendly, accessible square by softening level differences. He described the square as an 'urban ground' where people can spend time without being surrounded by built structures (Turkay, 2024). In addition, considering that skateboarders are an important part of the square's everyday flow, negotiations were conducted with skateboarders during the design process to support the creation of a 'skateable urban space'. So, the redesign process was developed through shared ideas of skateboarders, particularly regarding level transitions, and human ergonomics (Abayhan, 2023; Turkay, 2024). A contemporary eagle sculpture was designed by Prof. Dr. Bülent Çınar for the site, reflecting both the name of the neighborhood and the symbolic relation with Besiktas Gymnastics Club (Mimarizm, 2023; Turkay, 2024).

On the other hand, the project has been discussed during and after its introduction and implementation, particularly in online architecture forums. For instance, İzgi (2021) emphasized the need for a more participatory process and proposed suggestions based on architectural competition and public consultation practices. Cansız (2025), interpreted the project as an enhancement involving ground renovation, level adjustments, urban furniture, and lighting. Below, spatial and behavioral comparisons are detailed regarding the before-and-after conditions, as well as the perspectives of spatial professionals.

Spatial Change in Urban Square

In the previous chapter, the related spatial problems were defined by municipal officers and the design office. This chapter examines spatial changes in two- and three-dimensions using satellite images, street view, visual data collected during field trips, and project documentation. Starting from the pre-project condition, a detailed overview of the 2020 satellite imagery reveals that the steel overpass visually dominates the square, creating a chaotic and aesthetically unrefined appearance, particularly around the kiosks and seating units located beneath it. The bus stops contribute to confusion between vehicular and pedestrian flows. As an expected outcome, during this stage, the square is perceived primarily as a transit space for pedestrians seeking access to the waterfront or public transportation nodes. Stationary activities are confined mainly to seating areas associated with the kiosks and limited waiting behaviors.

Afterward, in 2022, satellite imagery revealed that the steel overpass and kiosques had been removed from the area. While the expanded open space allows for unobstructed pedestrian movement, the square lacks elements that encourage users to spend time or engage in activities. In the 2023 satellite imagery, the ongoing construction site in Besiktas Barbaros Square and around Barbaros Hayrettin Pasha Statue is visible; in this period, only limited parts of the square remain open to provide access to piers (Figure 3).

As stated by IMM, satellite images in 2024, the first and second parts of the intervention have been completed (IMM,

2023). The contemporary eagle sculpture has become a focal point by attracting public attention and enabling new forms of social interaction (Figure 4B). Together with the implemented landscape arrangements and newly introduced seating units, the urban furniture has encouraged longer stays and stationary activities, triggering a transformation in spatial dynamics. While the western part of the pier—associated with the façade of the Naval Museum—is still under construction, the elevation adjustments around the Barbaros Hayrettin Pasha Statue have been completed. The adjacent open space, designed to host temporary events, has already begun to serve various functions (e.g., temporary bazaar– Figure 4A). The inclusion of such temporary programs strengthens the square's role in civic life, rather than merely serving as a passageway. Field observations also indicate that the intersection of the transit path-

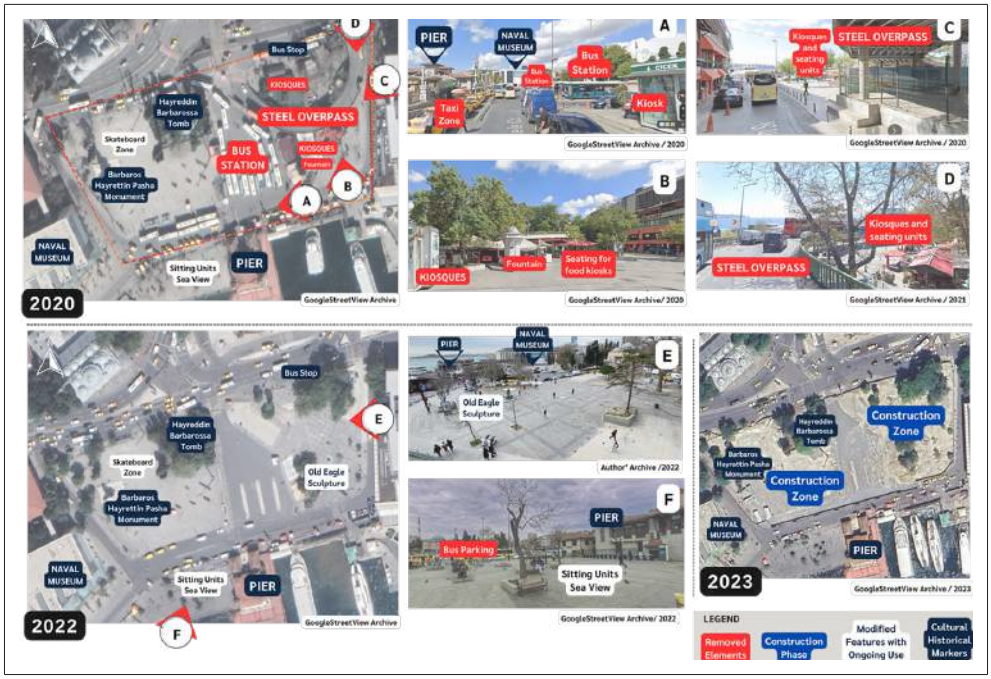


Figure 3. Pre-project conditions | Spatial changes in the urban square (2020–2022-2023).

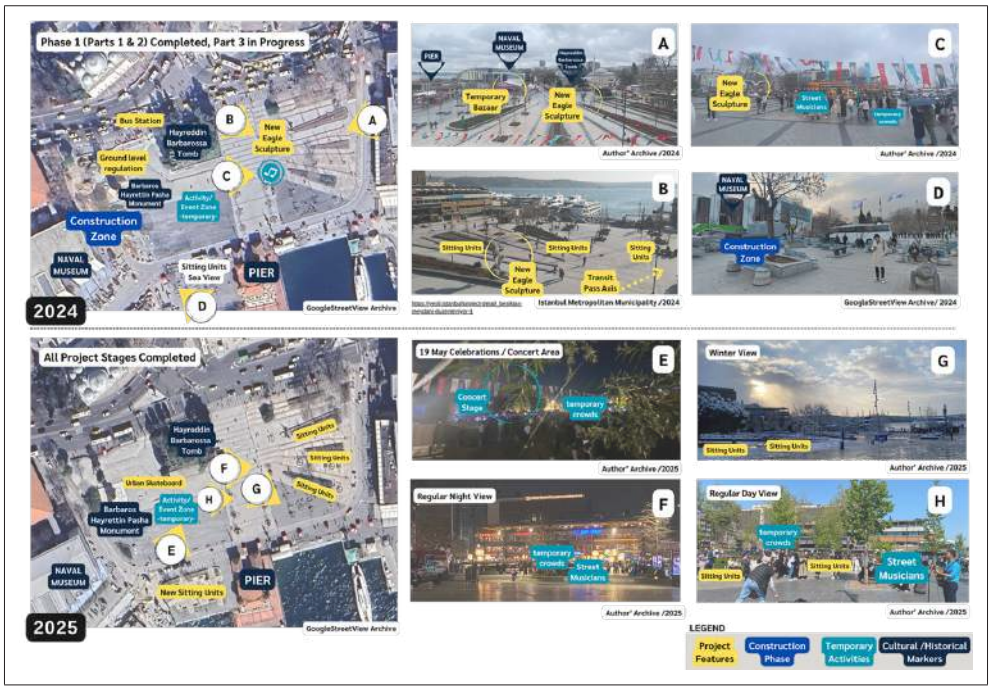


Figure 4. Post-project conditions | New dynamics in the urban square (2024-2025).

way and newly designed zones has become a performance area for street musicians, especially during noon and evening hours.

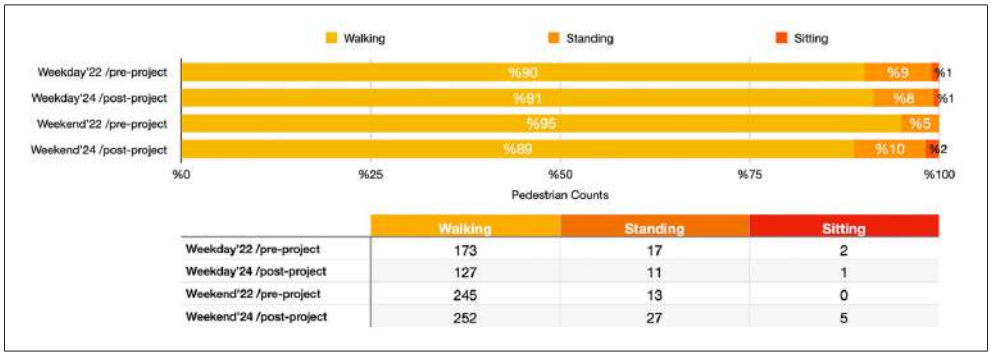
In 2025 visuals, the construction has been completed, and seasonal and time-based uses of the area—across both day and night—are detailed in Figure 4. The continued presence of street musicians has created temporary crowd formations and enhanced opportunities for spontaneous social interaction and standing activities. Additionally, changes in seasonal or event-based decorations and lighting schemes capture user attention and increase digital engagement with the square through photo and video sharing. Moreover, during festivals and public celebrations, a stage set up in front of the Barbaros Hayrettin Pasha Statue transforms the atmosphere of the square, facilitating collective urban experiences and vibrant public events that bring residents together. Accordingly, Figure 4, Image E illustrates the atmosphere of the square and event-based socio-spatial transformations observed during the Commemoration of Atatürk, Youth and Sports Day celebrations on May 19.

Video-based Pedestrian Behavior Analysis

To understand the impact of the new design project on pedestrian behavior, a total of 40-minute video analyses were conducted in a related urban square. The collected data contain comparisons of pedestrian movements in 2022 (transition stage) and 2024 (post-project stage): 2022 Represents the period following the removal of the steel overpass but prior to the initiation of landscaping; 2024 corresponds to the phase after the completion of the project's first stage and the subsequent changes in spatial use.

Accordingly, the related pedestrian counts are detailed in the graph above (Figure 5). In line with the literature and as an expected outcome, weekend usage remained higher than weekdays both in the transition phase and post-project conditions. Under the post-project condition in 2024, the decrease in weekday user numbers may be associated with light rain weather conditions or the relocation of the bus station in the urban square. Following the project implementation, a notable increase in stationary standing activities was observed on weekends. The observed decrease in sitting activities on weekday(2024) is likely related to the observation time and seasonal conditions. As shown in the upper section presenting satellite imagery and street-level views, the provided sitting units exhibit a good amount of use during peak hours and under favorable seasonal conditions (Figure 4F-4H).

As illustrated in the related maps (Figure 6), the physical space and landscape element changes between 2022 and 2024 directly influenced pedestrian flows and the locations of stationary activities. In particular, the open space configuration in 2022 facilitated diagonal crossings and concentrated stationary activities along the edge locations of the square and corners. In contrast, in line with the post-project conditions in 2024, the general pedestrian flow was shaped by landscape design, including the addition of



	Walking	Standing	Sitting
Weekday'22 /pre-project	173	17	2
Weekday'24 /post-project	127	11	1
Weekend'22 /pre-project	245	13	0
Weekend'24 /post-project	252	27	5

Figure 5. Pedestrian counts based on video recordings.

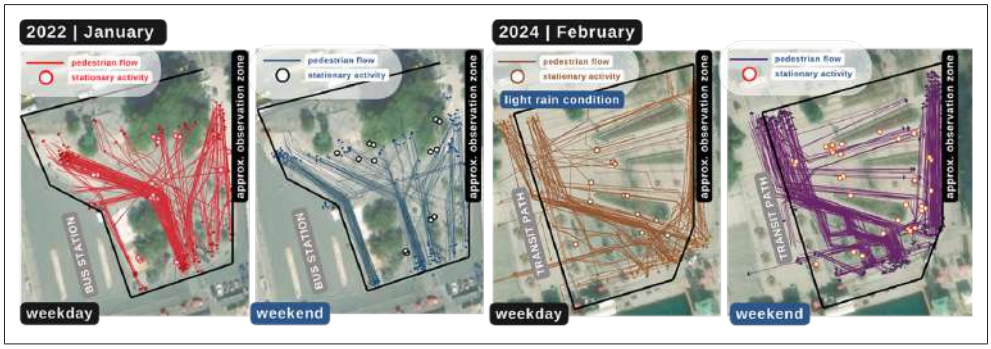


Figure 6. Behavior mappings based on video recordings.

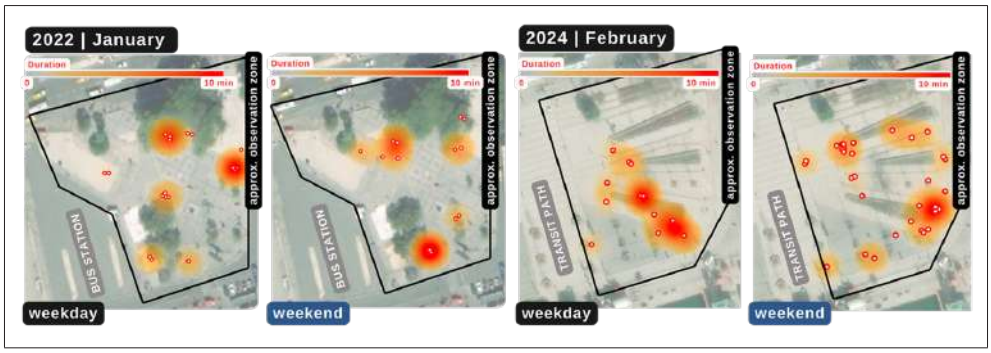


Figure 7. Stationary behavior location-choices & durations.

seating units, landscape elements, and the distribution area along the coastline to ferry/boat lines. Redesigned square contributed to a more defined and readable spatial organization compared to the spatially open yet undefined transition condition observed in 2022. While stationary and social-use patterns became more structured, pedestrians seeking rapid access to transportation corridors continued to follow desire lines, indicating that certain movement behaviors remain driven by functional needs rather than design alone. In general, in both cases, transit pedestrians tend to choose the shortest route and make diagonal crossings in the space based on their intended pier destination. On the other hand, pedestrians engaged in waiting activities have been observed to exhibit circular or exploratory behaviors in the form of circling or gazing around.

On weekends in 2024, the number of stationary activities (n=32) more than doubled compared to 2022 (n=13). While in 2022, due to the lack of dedicated seating elements, sitting activities were mainly concentrated on the stairs located under the trees (2022 total sitting count=2), in 2024, the newly introduced seating units provided through spatial design were actively used for sitting (2024 total sitting=6). Meanwhile, standing activities in 2024-post project conditions were positioned concerning the location of seating elements, landscape features, and specific focal points such as the newly installed sculpture. As illustrated in the heatmaps, medium, and long-duration activities became more prevalent in 2024 (Figure 7).

In the 2022 recordings, the most common external activities were gazing, meeting, and talking or socializing, and these activities continued under the 2024 post-project condition (Table 1). However, it was observed that the newly designed Eagle Sculpture created a significant new focal point in the post-project setting, increasing stationary activities while encouraging social and digital interactions. These interactions include taking photos with smartphones, creating new figures and urban experiences in public spaces (Argin et al., 2020). Notably, 11 people were directly observed approaching the sculpture, taking photos, or circling around it. Additionally, due to its role as a visual focal point and in line with the "people attract people" principle (Whyte, 1980), it was found that those taking photos around the sculpture encouraged others to do the same. This can be interpreted as further evidence that the new landmark supports follow-up actions. Furthermore, functional elements such as the visibly placed trash bins also supported their intended use in alignment with the square, and support daily activities. Finally, under the post-project condition, particularly during evening hours, street performers' presence influenced spatial occupation patterns, leading to larger crowd gatherings and an increase in stationary activities.

Insights from Spatial Professionals

As the third step of this research, an online survey was conducted to collect spatial professionals' opinions on the new square design and pedestrian experiences. The survey was

Table 1. Associated actions during stationary activities

	2022 | Associated actions during stationary activities	2024 | Associated actions during stationary activities
Social and interactive activities	gazing at or circling around (6) meeting someone (5) talking and socializing (4)	looking/ photographing the sculpture (11) gazing at or circling around (6) meeting someone (2) taking photographs (1)
Daily and functional activities	eating (2) feeding birds (1)	using a trash bin (3) eating (2) smoking (1) filling water (1) repairing a bike (1)

shared via online platforms, and responses were received from 31 spatial professionals. Among the participants [woman (n=23), man (n=8)], the age distribution was as follows: 18–24 (n=2), 25–34 (n=23), 35–44 (n=4), and 45–54 (n=2). Nineteen professionals were urban planners, eight were architects, two were landscape architects, and two participants directly identified their area of expertise as urban design. Most of participants (n=14) have been actively working in the field for 6–10 years. All experts had visited Besiktas Barbaros Square, and the majority (n=21) stated that it is a location they frequently visit. Most of them (n=19) indicated that they had followed the design and implementation process; only one expert reported not being aware of the spatial transformation process on the square (Figure 8).

In the next section of the survey, professionals were shown visual perspectives from the square: The 2020 state before the removal of bus stops and the steel overpass; the 2021 state after the steel overpass removal and prior to landscape planning; and images after the completion of the first and second phases of the project (2024). Based on these images and their personal experience, professionals were asked to evaluate and compare the old and new states of Besiktas Barbaros Square in terms of pedestrian movement and flow, potential for social interaction, urban facilities and related activities, aesthetic and spatial quality, green space usage, vehicle-pedestrian interaction, and coastal relation. Professionals, in general, indicated partial improvements in many aspects considering the before/after situations of square, as shown in Figure 9. Lastly, experts were asked to provide an overall evaluation of the square design on a scale of 1 to 5. The average score was 3.66, and the most of professionals (n=18) rated the developments in the square as 4 out of 5. However, considering green space usage and coastal relations, most professionals reported no significant improvement.

In the final part of the survey, in addition to the quantitative evaluations, open-ended responses provided by spatial professionals were systematically analyzed through content analysis. The main themes, sub-themes, and their occurrence frequencies are summarized in Table 2. As a general overview, it was detected that coastal usage, the need for shading elements, and limited greenery were criticisms. Social interaction, the atmosphere of new design, and pedestrianization-related implementations are positive aspects that reflect spatial evaluations. Additionally, experts' emphasis on the need for strengthening the square's relationship with its surroundings is critical for experiencing historical layers and coastal relations, as well as daily spatial experience. Observations from the post-project stage reveal overcrowding in certain time zones at the bus stops along the northern edge of the square. This situation indicates that spatial requirements are not fully met, considering some waiting activities.

Integrated Findings from Spatial, Behavioral, and Expert Analyses

This section brings together the findings derived from the three-stage methodological framework, structuring the results around the transformation phases of the space. Within this scope, the impacts produced by spatial interventions in Besiktas Barbaros Square are presented through intersecting outcomes across different methodological approaches.

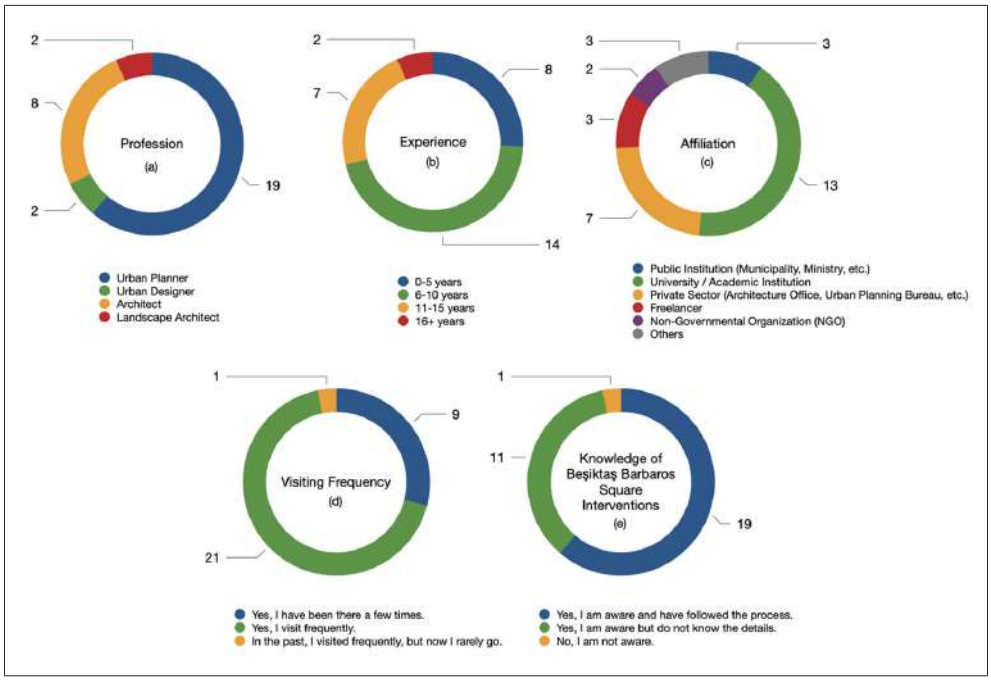


Figure 8. Spatial professionals' **(a)** profession **(b)** experience **(c)** affiliation **(d)** visiting frequency **(e)** knowledge about Besiktas Barbaros Square's redesign process.

This situation is related to the inherent complexity of researching public spaces, where relying on a single tool is often insufficient, making it necessary to combine various types of investigation (Gehl & Svarre, 2013).

Considering the observation area, aerial photographs of the pre-project stage prove that the space was dominated by the overpass structure and served primarily for transit users. Based on this, it is offering limited opportunities for stationary pedestrian activities. In this time zone, commercial kiosks generate visual pollution that covers a large part of the eastern area of the square. This finding is consistent with previous studies on the square's transit-oriented character, its limited active use (Zafer & Erdönmez, 2021), and the reduced capacity of the public space along the coastline to create spatial comfort (Abay, 2021).

Following the removal of the overpass, the transition stage introduced a release of pedestrian mobility; however, the newly formed wide and physically undefined open space became ambiguous in terms of activity management. While satellite images clearly indicate an increase in pedestrian movement areas as spatial openness expanded, behavior mapping data from 2022 support that pedestrians largely moved across the square without a defined route, predominantly choosing the shortest paths for transit. This transformation, associated with the removal of the overpass, was also positively evaluated by experts, who described the square's atmosphere as gaining a more "open and airy" character and mentioned this improvement, "view of the sea while descending from Barbaros Boulevard." At this stage, although the vista-enhancing effects of the early interventions generate a potential attraction for users (Carr et al., 2007), the absence of clearly defined structural elements in the public space limits the spatial anchoring and location choices of standing activities (Whyte, 1980).

With the completion of the post-project stage (Phase 1,2 – 2024), construction activities within the observation area were largely finalized; only a limited part of construction works around the Barbaros Hayreddin Pasha Statue were still ongoing. At this stage, supported by satellite imagery, an increase in urban elements facilitating staying and time-spending activities became evident. The square moved beyond its former role as a transit space, supported by spontaneously emerging activities [such as street musicians and interactions forming around the sculpture as well as municipal programs (e.g., temporary markets)], and acquired a physical form that more strongly accommodates stationary interactions. These types of events are a major attraction for public spaces, and they are also a popular management approach in many urban plazas and parks, providing a form of passive engagement with the space (Carr et al., 2007). In addition, Whyte (1980) remarks that "sculpture can have strong social effects" is likewise supported by the site-specific evidence. Furthermore, the behavior maps in 2024 provide direct evidence of the changes in pedestrian flows as a result of interventions in space and a rise in stationary behavior, on weekends. Similar to findings reported by Ceccarelli et al. (2023) after interventions the increase in dwell time indicates a shift from a passage space to one of stay, accordingly, a comparable situation is observed here. Although these maps do not cover peak hours, additional on-site observations indicate a clear increase in time-spent activities, especially during evening hours when use intensifies through the combination of social activities. This condition has been positively evaluated by the related experts, who noted that "the establishment of social interaction spaces has brought the area to a much better point." Taken together, as noted in the literature, improvements in the physical quality of public spaces enhance the space's inviting character, thereby supporting a broader range of standing activities (Gehl, 2011). In addition to that, celebrations, festive and events organized in the area (e.g., temporary bazaars, 19 May celebrations) support effective place management, and help deliver the sense of joy and

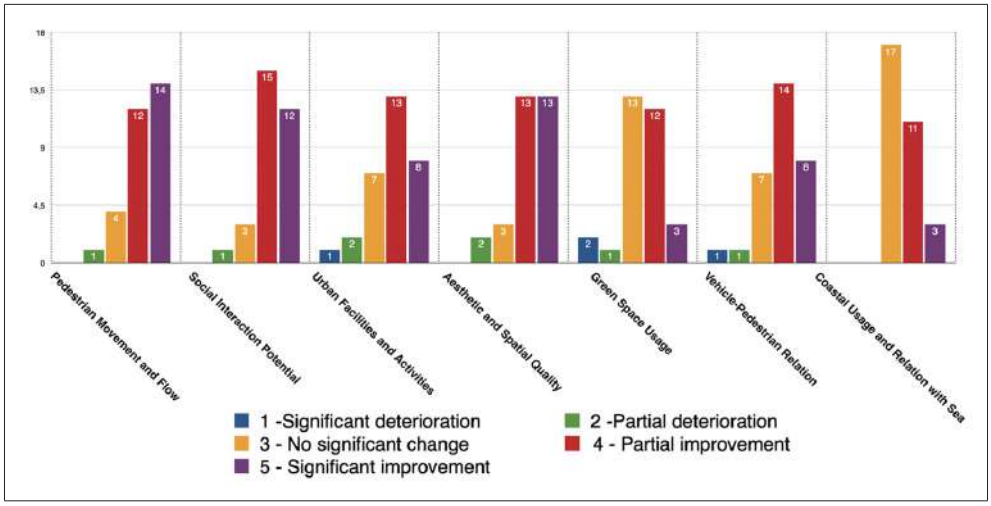


Figure 9. Spatial professionals' evaluation based on spatial-behavioral categories.

Table 2. Expert opinions on post-project spatial dynamics

Main Theme	Frequency of Theme	Sub-Themes	Selected Illustrative Statements From Participants
Coastal-Pedestrian relationship	n=10	• Limited interaction with sea and coastal use (-) • Enhancement of the sea view (+)	"*However, the parallel lines in the square design did not effectively enhance pedestrian movement or interaction with the sea and the piers. "* "*There has been no change in the use of the coastline. "* "*I think the most positive aspect of the project is the view of the sea while descending from Barbaros Boulevard. "*
Comments about new spatial design	n=9	• Enhanced Usability through Urban Furniture and Elevation Differences (+) • Pedestrian Flow and Circulation (+/-) • Insufficient Functional and Social Amenities, Stormwater Management (-)	*"The characteristic of the square being merely a transit space was partially reduced through the addition of urban furniture."* *"The elevation difference has been integrated into the design."* *"The spatial design could have been better resolved according to the primary pedestrian flow direction."* *"A design proposal considering the scale, hierarchy, material, and color compatibility with the building facades should have been developed for the square."* *"The area should be supported with functions such as food and beverage services to encourage people to spend more time there."*
Traffic/Public transportation and pedestrian-vehicle relations	n=8	• Removing the Steel Overpass (+) • Rearrangements of Bus Stops (+/-)	*"The oppressive atmosphere created by the overpass has been replaced by a more open and airy feeling."* *"Around the square, I experience problems due to congestion at the traffic lights and the crowded bus stop area for the Zincirlikuyu direction. I would have expected these issues to be successfully addressed within the scope of the project as well."*
Lack of Green Spaces and Shading Elements	n=5	• Insufficient Shading Elements (-) • Lack of Green Spaces and Trees (-) • Suggestion for further improvements (+)	*"Shading arrangements could have been made, and a greener design could have been implemented."* *"I think the biggest deficiency in the square is the lack of shading elements."* *"Although I generally find the project successful, I have concerns about the use of green spaces. Currently, I can say that the relationship between trees, their shade, and benches is quite functional, but it could be further improved."*
Integration of urban square with surroundings	n=4	• Insufficient Reflection of Historical Layers (-) • Spatial Disconnection from Surrounding Buildings (-)	"*I think the project could have improved its relationship with the Naval Museum, the surrounding piers, and the sea."* "*Traces that would reveal the historical layers of the square could have been incorporated into the design."* "*It also seems that its connection with the surrounding buildings has remained weak."*
Social interaction and pedestrian orientation	n=2	• Increase in Social Interaction Spaces (+) • Street Performers and Vibrant Atmosphere (+)	*"Street performers are using this area every evening. This really creates a pleasant atmosphere, and the seating arrangements support this design. Passing through this area in the evening is quite enjoyable."* *"Compared to a year ago, the establishment of social interaction spaces has brought the area to a much better point."*

everyday revitalization that public spaces are expected to provide (Carr et al., 2007).

Overall, expert evaluations further confirm improvements in post-intervention use patterns in terms of pedestrian movement, social interaction, urban activities, and vehicle–pedestrian relations. Nevertheless, experts also note that the rearrangement of bus stops resulted in the concentration of former transit users outside the square, reflecting management/usage-related shortcomings. In addition, insufficient functional amenities—such as food and beverage services—and inadequacies in green areas were highlighted. As Whyte (1980) notes, food vendors are a common feature of lively plazas, attracting people and supporting everyday social use, while successful squares offer diverse smaller settings—such as cafés, fountains, or sculptures—that sustain activity (PPS, 2005); therefore, in the case of Beşiktaş Barbaros Square, the introduction and strengthening of such amenities appear necessary to foster longer stays and a more diverse range of public activities. From architectural and urban planning perspectives, the new design was criticized for its weak relationship with surrounding buildings and its limited engagement with the historical

layers of the site. This reflects a wider criticism of Beşiktaş Barbaros Square, given its symbolic role within the city. As has been noted in the literature, successful urban design requires a balance between aesthetic and functional aspects while protecting the city's historical, natural and cultural asset (Çınar et al., 2021).

Considering the post-project stage (2025-satellite images), during which all construction works in the Barbaros Hayreddin Pasha Statue surroundings and along the coastal line were completed, the physical interventions implemented in this phase are more micro-scale compared to those of the first and second stages. Satellite imagery states that spatial improvements were conducted in the waterfront sitting areas. Regarding experts' criticisms of overall coastal relations, it can be considered as a starting point to strengthen coast-pedestrian relations. In addition to that, on-site observations indicate the continued active use of the area by skateboarders, level adjustments between different elevations, and physical improvements in the open spaces near the statue have contributed to improving the conditions supporting skateboarding activities within the site, which aligns with the design intentions reported during the project development process (Turkay, 2024).

Taken together, the transformation of Beşiktaş Barbaros Square demonstrates that large-scale interventions alone do not encourage diverse public use. Instead, it is the spatial definition, small-scale design, and programmed/spontaneous activities that are crucial to sustaining the square's vibrancy.

CONCLUSION

This research examined spatial-behavioral patterns in Besiktas Barbaros Square and its surroundings, a well-known urban square due to its geographic location, historical background and features, and its function as a transportation hub. It compares the pre-project, transition, and post-project phases using a multi-layered methodology, providing findings that offer insights into how physical changes affect pedestrian dynamics and public space functionality.

Overall, with the removal of the steel overpass, bus stops and the implementation of pedestrianization, the square moved away from its former transit-dominated character and began to function as an open public ground (RQ1); yet, the creation of openness by itself was not sufficient; without supporting design decisions, maintenance, and seasonal programming (Gehl, 2011; PPS, 2005). In this regard, the temporary events and interaction opportunities observed in the post-project stage appear critical for activating the space and encouraging repeated use. Observations from 2022 and 2024 showed that the new spatial arrangement and the addition of iconic elements changed how pedestrians move through and use the square. These supported triangulation (Whyte, 1980) and hybrid interactions (Argin et al., 2020). Expert assessments point to various partial improvements but also to remaining gaps in the square's wider urban and coastal integration, such as new density-related pressures around revised bus stops (RQ3). These results suggest that post-project evaluation is essential for tracing how design intentions translate into everyday use. These evaluations reveal differences between designers' potential environment and users' effective environment (Marušić, 2011), and long-term monitoring is crucial for assessing the performance of interventions (Ceccarelli et al., 2023).

Beyond the specific case of Beşiktaş Barbaros Square, the findings contribute to broader debates on the relationship between pedestrian spaces, their spatial requirements and usage patterns, and everyday public life. In line with Whyte (1980) and Gehl (2010, 2011) public use must be supported by edges, objects, and activity-supporting micro-settings that encourage staying. Similarly, PPS (2005), and Carr et al. (2007) emphasize that successful squares depend on the interaction between physical design, programming, and management, a pattern also observed here as temporary events, celebrations and urban elements began to anchor stationary use. Also, collective practices historically associated with Turkish urban squares (Acar et al., 2021). At the same time, the post-project phase needs to be reconsidered from a user-oriented perspective, especially given the criticisms of the process's limited participatory scope (İzgi, 2021) and the concerns raised by experts about how the square relates to the coastal–historic context and the new transport arrangements.

Taking into consideration the limitations of this study in terms of observational constraints, manual counting processes, and the lack of direct user satisfaction surveys, future studies can investigate long-term behavioral changes in seasonal uses, and benefit from simultaneous real-time data gathering using automated pedestrian counting processes to yield higher accuracy levels. Future studies can also use comparative approaches to transformed metropolitan squares, combined with perception-based methods, to improve our understanding of the long-term impact of spatial interventions on public spaces.

ETHICS: The questionnaire administered to spatial professionals has been approved by the Ethics Committee for Social and Human Sciences Research at Yildiz Technical University, and no ethical issues have been identified in the data collection tools and methods.

PEER-REVIEW: Externally peer-reviewed.

CONFLICT OF INTEREST: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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