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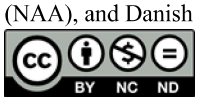

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Spatial Transformations Effect to Soundscape: The Case of Istanbul Land Walls

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Abstract

Sound atmosphere gives cues about environmental perceptions and memories. Istanbul's land walls play an essential role in Istanbul's historical, cultural, sensory, and spatial memory. With the establishment of the Ottoman Empire, land walls began to lose their defensive function and became a part of civil life.
The transformation of the land wall has been detached from the positive perception and cultural context of open green spaces. This perception replaced them with unplanned and uncontrolled spatial transformation. As a result of highways and uncontrolled constructions, the sound atmosphere of the district around the Istanbul land wall was adversely affected. Especially in the region between Yedikule and Topkapı, it intensified the population and transformed the demographic structure.
In this article, the contemporary sonic perceptual environment around the Istanbul land walls is studied. This research aims to contribute sonic perception and experience of the people in the field. The effect of the determined spatial transformation on the sonic landscape comfort in the adult user group is investigated. While defining sonic landscape comfort and perception, the standard methodologies described in ISO/TS 12913-2 were used. Methods of surveys, on-site sound recordings, and listening to volunteers under special conditions were used. Many types of data gathering methods were used. The obtained data were separated with the help of analysis programs. The spatial acoustic comfort was obtained; hence the outcome was evaluated by classifying the survey data. The result was evaluated based on the identified sound source, affective quality, perception and overall sound environment.

Keywords: Soundscape, Istanbul Landwalls, Space Perception, Outdoor Perception

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1 Introduction

Individuals' relationships with the environment are shaped by their impressions, experiences, and perceptions. People's environmental perceptions and experiences in the outdoors are shaped by their hearing senses. The concept of soundscape is used to identify and systematize the auditory perceptual relationship that individuals establish with the environment. The soundscape is a concept that has been investigated and discussed by many disciplines from the past to the present[1]. Sound influences the livability of people through disciplines such as psychology, engineering, and architecture.

Schafer[2] developed the earliest studies about the soundscape. He categorized the soundscape into three categories: natural sounds, human sounds and technological sounds. According to Zhang and Kang's model, four essential components determine the soundscape of the outdoors; the sound source, space, person and environmental factors[3]. Characteristics define the sound source; it is determined by its location, sound pressure level, social or psychological features and whether the source is mobile or static. Humans are considered as both the source and the receiver of sound. Temporary sound source factors include the time of day, season and procedure[4].

The soundscape studies aim to establish how the auditory landscape is perceived and generate soundscape data suitable for the spaces by generating varied data for desired or undesirable soundscape design. Nowadays, soundscape studies focus on creating artificial or unique themes, identifying symbolic sounds specific to urban spaces, the documentation of symbolic sounds and the classification of sounds [5,6,7]. Many methods are used to determine, register and archive the quantitative and qualitative data of the soundscape in the outdoor environment. Binaural audio recordings, qualitative and quantitative sound tests, soundwalks, laboratory research, behavioral observations and simulative sound investigations supported by virtual technologies are the various methodologies of soundscape [7,8,9]. Many investigations are handled on the perceptual terms about the sonic environment to specify the environmental perception [10,11,12]. These terms are defined by their emotional and sensory connotations [12,13].

Istanbul's land walls and surroundings have a significant role in the city's historical, sensory, and cultural memories from the past to the present. The land walls were built 7.5 kilometers long in the reign of II. Theodosius. The purpose of constructing walls was to protect the territorial integrity of the city, determining the borders and administration [14, 15]. The walls lost their defensive function and became a part of civilian life with the establishment of the Ottoman State. Over time, gardens, farming areas, new neighborhoods and ports were established in Ottoman times. This transformation, which was realized with the construction of 10th street in the 1980s, accelerated the transformation in the surrounding area. This transformation has mostly resulted in the separation of open green spaces from their positive perception and cultural context. Unplanned and uncontrolled spatial transformations took place in place of the destroyed open green spaces [16]. In recent years, the highway and construction activities developed in this region have transformed the functions of outdoor green spaces by affecting the soundscape. This region, which has become an undefined urban rift [17], which contains many functions out of context within the land walls and its surroundings, has been transformed by many large-scale projects in the last decade. The increasing presence of highways has caused the destruction of natural and cultural landscapes in the region, and the transformation of the soundscape.
Although people have historical knowledge of the area, few studies have been done on its sensory heritage. From past to present, urban gardens, cemeteries and historical neighborhoods play an essential role in sensory memories of the city. This area was chosen for two main reasons. The first reason is that the sensory studies developed on the region are insufficient, and the second reason is that the region is transforming rapidly. The main reason for research is contributing to livability and sensory awareness of research fields. This study focuses on existing sonic data. Based on existing sound references, perceptions of public green spaces in this region were examined.
The paper focused on the region between Yedikule and Topkapı. The used methodologies are binaural sound recordings, classifying them, questionnaires and analysing. This study has been discussed through binaural records and tests by contributing to the auditory comfort and livability of the region.

2 Methodologies

In this paper, a field study was conducted in the Land wall region of Istanbul. The methodology consists of three main steps. The first step is to record sound from field areas public green spaces. The second step is to do a questionnaire with 37 participants. The third step is classifying and analysing test outputs.

2.1 Voice Records

In the scope of the survey, the Zoom H6 voice recorder was used for binaural recordings, and 13 different cases were recorded. Every single record has been five minutes long and recorded from one point of selected locations. At the same time, weather conditions are considered in the recording process.
The Brüel Kjaer type 2236 -sound pressure level (SPL) meter simultaneously measured the average SPL dB. Out of the 13 recordings, eight were selected according to their quality and variety of sound sources. The audio recordings were converted into two minute recordings with the Adobe Audition program.

2.2 Questionnaire

Eight recordings were listened to by 37 subjects with special headphones. During the listening test, three conditions were applied: silence conditions for the environment, each subject should not have hearing loss and every person should be over 18. A sound source, definitive sound, voice level, disturbing voice level and sound perception are asked in questions. Sound source and definitive sound were asked with the same metrics to subjects (Table 1). The list that occurred depends on Schafer's theory[2](Table 1). Sound volume and disturbing level asked to subject with metrics from 1 to 5. Subjects' perceptual conditions are specified with thirty different psychoacoustic metrics [10,13]. According to their perception, every person listens to eight different records and replies to metrics from 1 to 5. Overall, subjects' response to definition, sound level, disturbing level and perception tests for every record. The whole process takes 40 minutes for every subject.

Table 1: Definitive and Sound Source List (The list created according to the Schafer [2] criteria)

Nature Sound	Human Sound	Technological Sound
Dog Sound	Child Sound	Klaxon Sound
Cat Sound	Azan Sound	Train-Subway Sound
Bird Sound	Speech Sound	Ticket Sound
Leaf Sound	Other Human Sound	Bus Sound
Water Sound		Motorcycle Sound
Wind Sound		Construction Sound
		Music Sound
		Swing Sound
		Plane Sound
		Traffic Sound
		Other

2.3 Analysing

As a result of the survey, the spatial acoustic comfort survey data obtained were classified and seperated in the Excel program. The separated data were analysed with average numbers comparatively by Excel. The result of the analysis was evaluated with the positive, negative and spatial aspects of the perception of the soundscape in and around the Istanbul Land Walls.

2.4 Case study site

The line between Yedikule to Topkapı is focused on the scope of research. Overall, Land walls (Figure 1; a) include 12 gates and 7.5 km. In this study, the research work on the environment of six historical gates which are Topkapı, Mevlanakapı, Silivrikapı, Belgradkapı, Yedikule, and Mermerkapı. Yellow lines show the border of the site study (Figure 1; b). In the detailed study, the site study focuses on selected 13 different points, which are red and orange (Figure c-d).

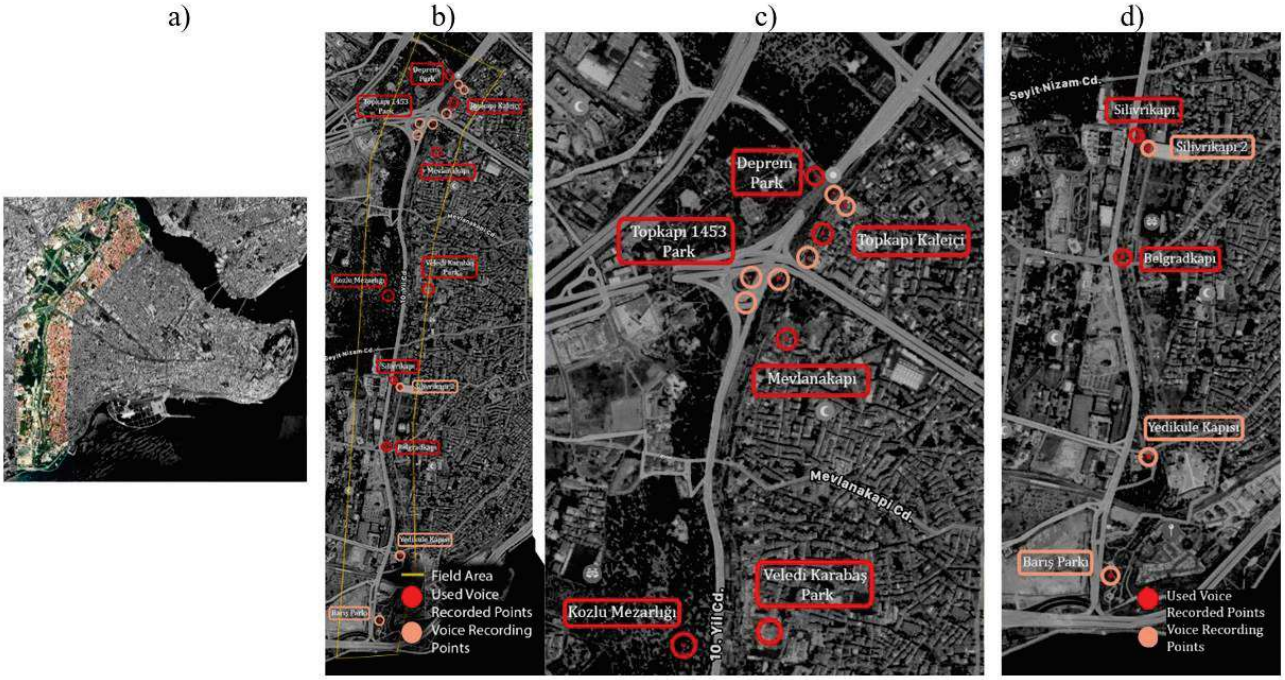


Figure 1: a) The location of Land walls in Historical Peninsula **b)** Field Area General Map **c)** Area's Map between Vatan Street to Silivrikapı **d)** Field map's Silivrikapı to Altın Kapı

The criteria for site selection were based on these two components. Firstly, the function variety happens in these environments, such as existing urban gardens, cemeteries, public parks and roads. The second reason is the accessibility of that environment.

The scope of the research site area includes 7 neighborhoods and 31 urban gardens. These areas' owners are mostly municipalities, governments and foundations; for this reason, there is not any limitation about use by pedestrians and citizens. Voice recordings were made in 13 different places and these places belong to the municipality and government. When choosing these regions, it was preferred that they be areas where pedestrian access could be provided continuously along the line of the Land Walls and have public functions. (Figure 2). After the obtained sound data, the spaces were separated. The functions of the areas decided to focus on are monumental, urban park, and railroad (Table 2).

Table 2: Functions of Recording Area's

Location	Function
Eski Kozlu Cemetery	Cemetery, Roads, Urban Park
Silivrikapı	Bus Station, Urban Garden, Pedestrian way, University, Roads
Belgradkapı	Urban Garden, Traffic Lights, Roads
Mevlanakapı Park	Urban Park, Cultural Centre
Topkapı Park	Urban Park, Café, Library
Deprem Park	İnterchange way of transportations, Railroad, Urban Park
1453 Park	Museum, Urban Park
Karabaş Park	Neighbourhood Park, Cafe

3 Findings

The obtained data shows that five of the eight regions are parks and three are used as public spaces. In the light of the data, the sound sources, descriptive sounds, sound levels, sound comfort level and people's perceptions of these sounds were calculated with the determined adjective pairs. In addition, function, perception and sound comfort data were evaluated by examining 30 adjective pairs. Twenty of the thirty-seven participants were female; seventeen participants were male. Twelve of them are between the ages of 18-25, twenty-four of them are between the ages of 26-35 and two of them are between the ages of 36-45. The average age of participants is 27.

3.1 Subjective Data

The obtained data illustrates the existing vehicle, traffic, and klaxon sounds, mostly considered in the category of technological sounds in the recordings. In all venues and recordings, these sounds were evaluated in "annoying" and "extremely annoying". Speech and child sound are selected as existing and descriptive categories in many places (Table 3). These sound level of annoyance varies according to the category, location and sound recordings. Although sound recording places have three different functions, the vehicle sounds and discomfort levels do not differ significantly and influence the subjects in a negative way.

Table 3: Eski Kozlu Cemetery, Silivrikapı, Belgradkapı, Mevlanakapı Park, Topkapı Park, Deprem Park 1453 Park and Karabaş Park's definitive and existing voices average outputs depends on Questionnaire

Location	Data of Questionnaire
Eski Kozlu Cemetery	Human sound, traffic and klaxon sound selected as existing sound. Klaxon sound selected as extremely annoying.
Silivrikapı	Traffic and human sound selected as existing sounds. Traffic and klaxon sound preffered as definable sound of that environment at the some time these vocices found extremely annoying.
Belgradkapı	Speech, Traffic, Klaxon, bus, motorcycle sounds are existing sounds. Klaxon and traffic sounds are the defining sounds of that environment. Traffik and Klaxon sound prefered extremelly annoying and annoying with 95 percent.
Mevlanakapı Park	Speech sound, child sound, bird sound and wind sound selected as existing sound. Human sounds are the definable sounds of that place. Human sound and bird sounds selected as pleasant.
Topkapı Park	Wind sound, human sound and machine sounds are the existing sounds of place. The definitive sound is wind sound. Wind sound and human sounds are preffered as pleasant and unsure sounds.
Deprem Park	The definable sound is traffic and motorcyle sound. Motorcycle, subway, bird, speech, construction and music sounds are the existing sound of place. Traffic, klaxon, train, motorcycle and construction sound selected as annoying and extremely annoying.
1453 Park	Mostly animal sound, wild, child are existed sound and selected as pleasant.
Karabaş Park	Bird, wind, speech, child, traffic and klaxon sound are existed sound. Child and traffic sound are definable sound of Park. All selected sound mostly preferred as pleasant or highly pleasant except traffic and klaxon sound.

Surveys on the study area's sound levels and disturbance levels revealed that Silivrikapı and Belgradkapı regions are significantly different from other regions. It has been concluded that Karabaş Park is louder than other parks in the park region, but the disturbance level of this noise level varies more than in other regions.

Table 4: Average Sound Levels of Locations according to subjects' perception

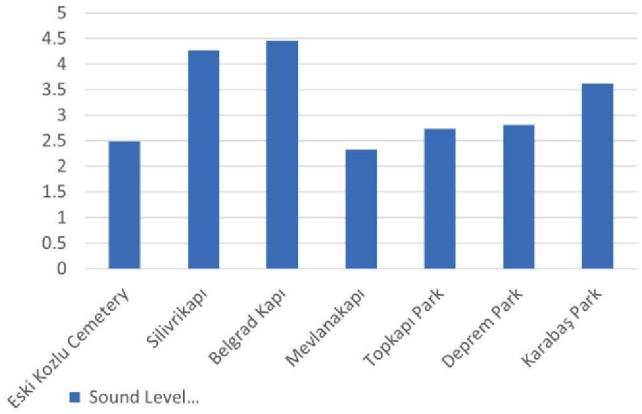


Table 5: Recorded Points dB according to SPL meter data

Location	Eski Kozlu Cemetery	Silivrikapı	Belgradkapı	Mevlanakapı Park	Topkapı Park	Deprem Park	1453 Park	Karabaş Park
Decibel	52	73	73	59	61	58	56.8	69

When selecting perception metrics, academic outputs checked and selected used with 30 metrics [7,10,12]. While metrics were classified and evaluated, they were evaluated into two basic classes. It is classified into two assessment pairs: positive-negative and neutral evaluation pairs. Neutral metrics include common-strange, heavy-light, sharp-dull, far-nearby, lively-calming, not sharp-sharp, unclear-distinct, rough-smooth metrics. The results were gained from the average of the data. Overall, common metrics are chosen in every location at neutral metrics (Table 6). Karabaş Park, Belgradkapı and Silivrikapı regions are selected by lively and sharp.

Table 6: The result of the Questionnaire Neutral metric test from Recorded Points

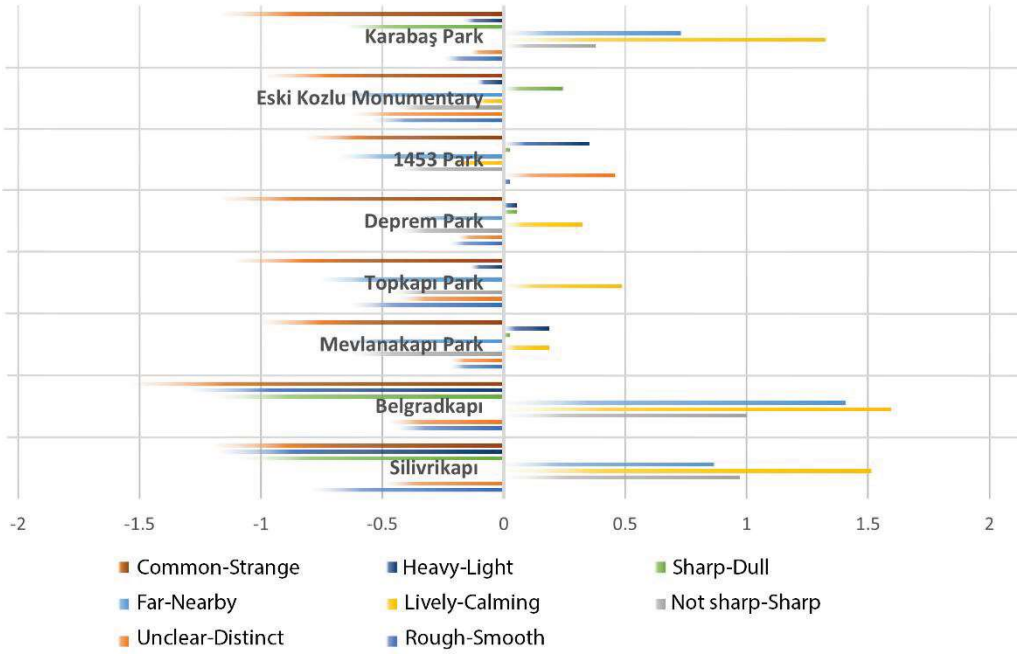
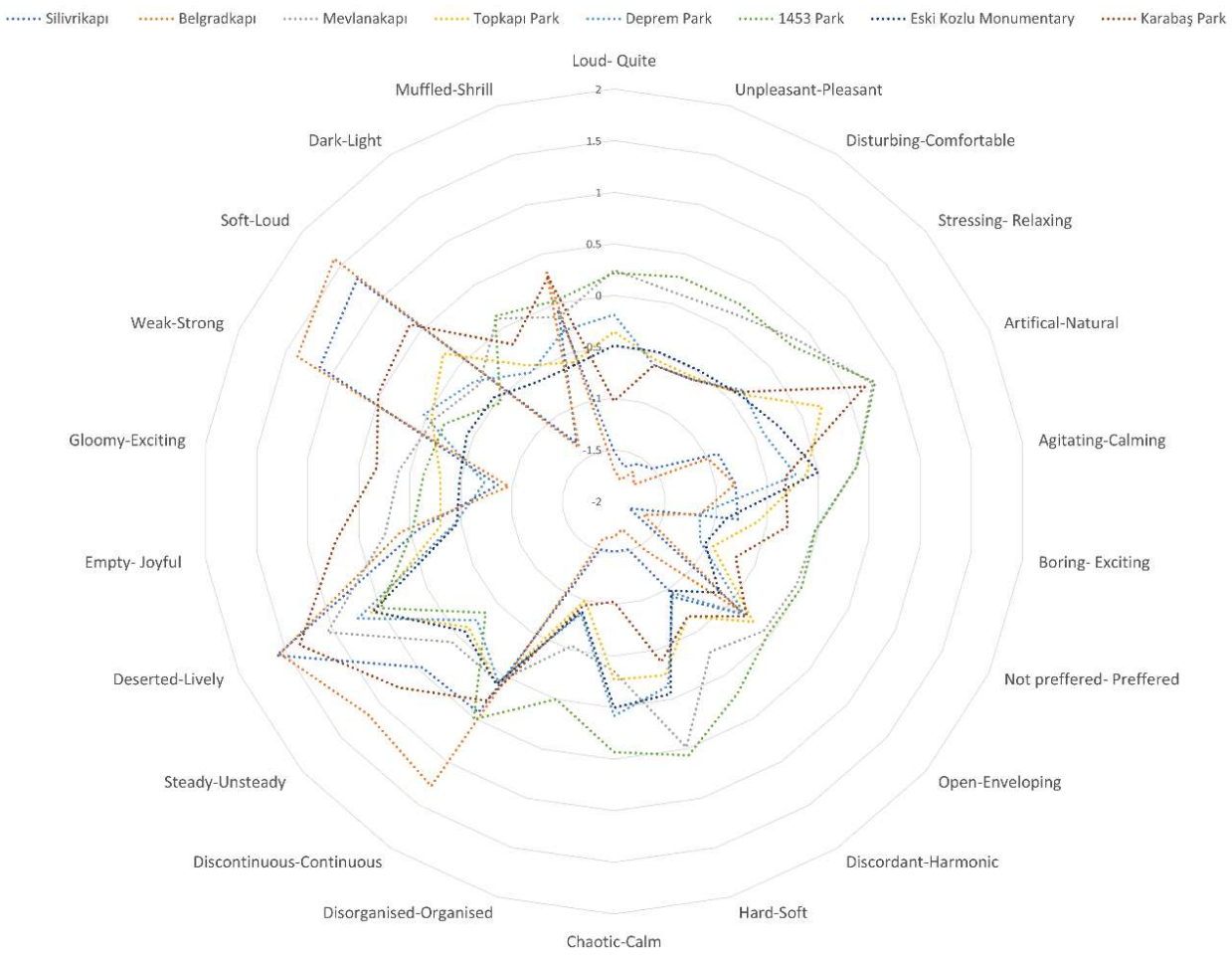


Table 7: The result of the Questionnaire Subjective metric test Depends on Recorded Points



Across eight regions, a total of 22 metrics were contrasted positively and negatively (Table 7). Lively and continuous metrics show the result on the positive side. Boring, not preferred, disorganized and open metrics are mostly chosen as negative metrics.

In a positive majority, Karabaş park, 1453 park and Mevlanakapı park were selected. The data was arranged similarly across the table. On the other hand, regional similarities could not be found in neutral metrics. Belgradkapı and Silivrikapı regions mostly preferred negative metrics. Also, almost all metrics were followed by each other with similar data. This similarity continued to confirm neutrality in the qualifying metrics. The data was arranged in similarly across the table.

On the other hand, regional similarities could not be found in neutral metrics. Belgradkapı and Silivrikapı regions mostly preferred negative metrics. Also, almost all metrics were followed by each other with similar data. This similarity continued to confirm neutrality in the qualifying metrics.

Table 8: Objective Data of Field Area

Location	Decibel	Weather	Date
Eski Kozlu Cemetery	52	+13 Celsius, %70 Humidity 7.4 km/h wind, Sunny	28.11.2021
Silivrikapı	73	+12 Celsius, %75 Humidity 7.1 km/h wind, Cloudy	24.11.2021
Belgradkapı	73	+12 Celsius, %75 Humidity 7.1 km/h wind, Cloudy	24.11.2021
Mevlanakapı Park	59	+13 Celsius, %70 Humidity 7.4 km/h wind, Sunny	28.11.2021
Topkapı Park	61	+13 Celsius, %70 Humidity 7.4 km/h wind, Sunny	28.11.2021
Deprem Park	58	+13 Celsius, %70 7.4 km/h wind, Sunny	28.11.2021
1453 Park	56.8	+13 Celsius, %70 7.4 km/h wind, Sunny	28.11.2021
Karabaş Park	69	+13 Celsius, %70 7.4 km/h wind, Sunny	28.11.2021

During the study, the weather conditions of the places are sunny or cloudy; the humidity is between %70 -%75 and the wind speed is between 7.1-7.4 km/h. At the same time, the decibel range of binaural sounds is in the range of 52-73 decibels (Table 8).

4 Conclusions-Discussion

The study examined the area between the districts of Yedikule and Topkapı. The study focuses on the urban gardens, parks and cemeteries. The main purpose of this study is the fill the literature gap by considering that no studies developed specifically for this region have focused on the sense of sound and the existing data is changing rapidly. The findings show that the spatial transformation experienced in recent years has also affected the soundscape. In this research, three main methodologies, which are binaural recordings, questionnaires and analysis used. In this study, the perceptions of the people about the public green spaces in this region were examined based on the following results:

- It is concluded that there is a serious relationship between the acoustic comfort of the regions and the function usage purpose of the places.
- It is deduced that the acoustic comfort and perception data of the parks built by the municipality in the last 30 years are better than the historical gardens and the surroundings of the gates.
- The historical urban gardens' acoustic comforts are worse than urban parks because of the highway distance and traffic density.
- In negative parameters, all places in the questionnaire are obtained lively and continuous metrics.
- In negative parameters, most places are chosen as boring, not preferred, disorganised and with open metrics.
- Overall, common metrics are chosen in every location.
- Karabaş Park, Belgradkapı and Silivrikapı regions are ticked by, lively and sharp.

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