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Harmony of context and the built environment: Soundscapes in museum environments via GT

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ABSTRACT

This paper presents an approach to analyze visitors' expectations and perceptions of museums' built and auditory environments. It aims to explore visitors' perception of acoustic and built environments in museums, generate a systematic categorization, and create a conceptual framework using the Grounded Theory (GT) approach. We measured the Equivalent Continuous A-weighted Sound Level (L_{Aeq}) and, following the ISO/TS 12913-2/3, conducted semi-structured interviews and questionnaire surveys were conducted to discover the sound environments and capture the subjective responses of visitors in two museums: the Rahmi M. Koç Museum (RMK) and the Erimtan Archaeology and Arts Museum (EAA) (both located in the most historical part of Ankara, Turkey). Although the selected museums offer two different experiences based on themes, exhibitions, and interior designs, we examined whether the museums' soundscapes, connected contextually to the historical environment, could be perceived different from one another. Results show that Museum RMK, which has historical exhibitions and an historical building type, is more appealing to people's preferences and expectations than Museum EAA, which has historical exhibitions and a modern building type. The findings of the study reveal that peoples' perceptions are mostly dependent on the context in which sound is heard, rather than on sound levels in museums. In some areas, where sound was used as a design element, visitors had a better museum experience because they were able to interact with the exhibited objects on exhibit and feel as if they were living in a specific period.

1. Introduction

The International Organization for Standardization (ISO) released three standards to guide soundscape studies. The ISO 12913-1:2014 published the definition of soundscape and the conceptual framework [1] as "the acoustic environment perceived or experienced and/or understood by a person or people, in context" [1]. The conceptual framework identifies the continuum of perception and the experience of soundscapes with seven concepts and their relations (Fig. 1). On this basis, the soundscape approach is relevant to individuals' perceptions and notions of the acoustic environment and the meaning attached to it [2–6].

In 2018, the ISO/TS 12913-2 published a standard for *Data Collecting and Reporting Requirements* for soundscape studies. This standard suggests combining the physical parameters and the perceptual data and indicates that people, the acoustic environment, and context should be explored through several methods to achieve a fully featured soundscape study, one that could be implemented in planning and design phases [7]. The standard provides three methods, Method A, Method B, and Method C; they refer to the questionnaire, soundwalk, and interview respectively. Recently, ISO/TS 12913-3 published a third standard for *Data Analysis* that extensively specifies the processes one would use to analyze the data gathered through Method A, Method B, and Method C [8].

Although for decades the majority of soundscape studies focused on urban soundscapes, many attempts have been made more recently to explore indoor soundscapes. Healthcare facilities [9–12], educational environments [13,14], residential environments [15], public transport spaces [16], libraries [17,18], offices [6], religious spaces [19], and museums [20–24] are some of the indoor spaces studied in the scope of soundscape approach.

Among public spaces, museums are essential cultural environments as they educate people, as well as collect and exhibit historical artifacts. In that sense, providing a proper museum

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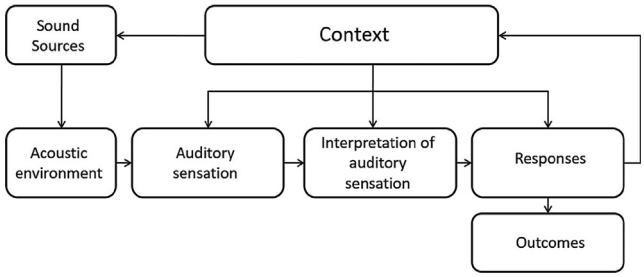


Fig. 1. The conceptual framework of soundscapes includes concepts such as context, sound sources, acoustic environment, auditory sensation, interpretation of the auditory sensation, responses, and outcomes. Context is obtained as the main category and the soundscape is affected by it through auditory sensation, interpretation of the auditory sensation, and the response to the acoustic environment [1].

environment enhances visitor experience. Most museum studies focus on the physical parameters of museums (such as lighting, air quality, thermal comfort, etc.); the importance of creating a convenient acoustic environment within museums is underestimated [25]. Many museum acoustics studies focus only on the measurements of physical parameters [26,27]. However, to be able to discover individuals' perceptual approaches toward museums' soundscapes, it is important to understand the effects of museums' built and auditory environments on individuals' perceptions. This concept should be explored in detail because the classification of museums varies in regards to their size, purpose, collections, administrators, and the public they aim to serve [28]. The acoustic environment of the museums is altered according to the architectural elements, shapes, volumes, materials, themes, and functions. In their investigation into museum studies, Darragh and Snyder [29] prove that this diversity in the acoustic environment indicates that museums also have the potential to be noisy.

Previous soundscapes studies have revealed that the context of soundscapes is connected to and affected by the built and auditory environments of places [6,13,16,19,21]. Based on these connections, this study aims to identify whether there is a relation between visitors' perceptions of soundscapes and the built and auditory environments of the museums. For that reason, this study focuses on visitors' preferences and perceptions of the buildings' types, themes of the exhibitions, and sound environments.

Because this study is exploratory, the research questions were generated as follows: How do built and acoustic environments affect visitors' perceptions of the soundscapes? How does sound level influence visitors' perceptions of the soundscapes? Does the perceived sound environment affect visitors' preferences of the built environment in museums?

In that manner, we measured the physical parameters and evaluated the perceptual data in two museums: the Rahmi M. Koç Museum (RMK) and the Erimtan Archaeology and Arts Museum (EAA). The Equivalent Continuous A-weighted Sound Level (L_{Aeq}) was measured in-situ and semi-structured interviews and questionnaires were conducted synchronously. As suggested by ISO/TS 12913-3 [8], the perceptual data were analyzed with statistical measurements and the Grounded Theory (GT) method in order to generate a conceptual framework for both museums.

2. Method

2.1. Site

Han Street has always been the most historical region of Ankara. The studied museums are in this region and located opposite the Ankara Castle (Fig. 2). The exterior appearances of the museums are contextually compatible with this historical environment. However, the museums offer two different experiences because of their themes, exhibitions, and interior designs.

The Museums are close in proximity and connected by the square in front of them, which was used as a market place in the 13th and 14th centuries (Fig. 2). Since the 16th century, this area (which has been part of many trade routes, including the Silk Road), has been known as Han Street. These trade routes, and the travelers who used them, inspired construction of many inns, caravanserais, and Turkish bazaars. Of the many historical services on Han Street, such as spice dealers, barbers, cutlery, tanners, cotton dressers, shoe shops, cabinet makers, blacksmiths, etc., some continue to work today. Moreover, many structures that were inns, traditional residential areas, museums, galleries, restaurants, and local shops are now used for different purposes. Because the museums are located in this area, visitors are welcomed with unique scenery and soundscapes.

Museum RMK consists of two main sections, Çengelhan and Safranhan. This study was conducted in Çengelhan, which was built in the 16th century and used as caravanserai and storage area. It was restored and converted into a museum in 2005 as the second industrial museum in Turkey.

The building has a typical Ottoman Inn plan layout that consists of a basement, ground floor, and first floor, as well as an inner courtyard with several rooms around it. These rooms are used for exhibitions with different themes. The courtyard is surrounded with vaulted cloisters and the ceiling is covered with a glass roof to protect the exhibitions from the weather, uncontrolled light, noise, and other external elements (Fig. 3). On the ground floor, 20 rooms are used for permanent exhibitions, two of them for offices, and one as a gift shop. On the first floor, 26 rooms are used for permanent exhibitions. The courtyard is also an exhibition area.

The scale, facade, and interior of the museum contextually represent the historic environment around the building (Fig. 3). Historical objects related to road transportation, rail transportation, maritime, aviation, craftsmanship, scientific instruments, communication instruments, toys, agriculture, and everyday objects are exhibited in the museum (Fig. 4).

The more contemporary Museum EAA was built and opened in 2015. Its exterior consists of three facades of traditional Ankara houses, and it sits opposite the castle. The museum's scale and facade contextually represent the historic environment around it, while its interior has a contemporary ambiance (Fig. 5).

The building has a ground floor, first floor, and mezzanine floor. The main entrance of the museum leads visitors directly to the mezzanine floor where the vestibule, gift shop, and permanent exhibitions are located. On the first floor, there is another permanent exhibition area, a cafeteria, and a library. The ground floor consists of staff offices and temporary exhibition areas. For more reliable results, only the permanent exhibition areas, which cover the first floor and mezzanine floor, were included in this study. There are Anatolian archaeological artifacts (glass artifacts, gems, and coins, etc.) on exhibit in the permanent exhibition areas (Fig. 6).

The museums vary in some aspects. The plan layouts, heights of the studied areas, and materials of museums are presented in Table 1.

2.2. Participants

Visitors participated voluntarily in the study. Of the visitors, 16.7% were familiar with the museums and 83.3% visitors were unfamiliar. A total of 60 visitors from Museum RMK (n = 30) and Museum EAA (n = 30), 24 male and 36 female (M age = 29.17; SD age = 12.3 years, age range 18–66), took the questionnaire sur-

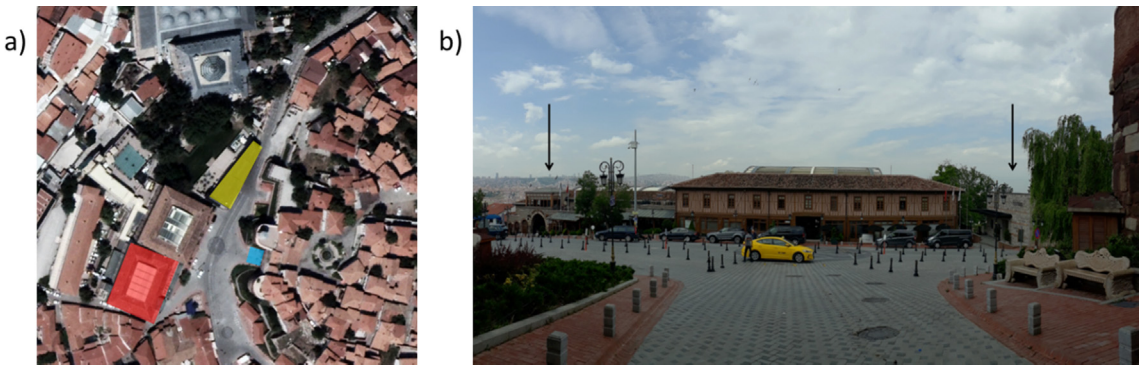


Fig. 2. a) Location of the museums (The Erimtan Archaeology and Arts Museum is shown in yellow, the Rahmi M. Koç Museum in red, and the Ankara Castle's southern entrance in blue) b) View of museums from the southern entrance of Ankara Castle. An arrow on the left shows the Rahmi M. Koç Museum and the arrow on right shows the Erimtan Archaeology and Arts Museum. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 3. Views from the outside and inner courtyard of Rahmi M. Koç Museum.

Fig. 4. Views of exhibited objects and exhibition areas in Rahmi M. Koç Museum.

Fig. 5. Views from the outside and interior of the Erimtan Archaeology and Arts Museum.

Fig. 6. Views of exhibited objects and exhibition areas in the Erimtan Archaeology and Arts Museum.

Table 1
Spatial features of museums.

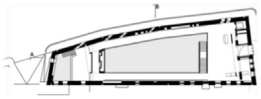
	PLAN	Heights	Material			
RMK		3.5 m (first floor) 10.5 m (courtyard)	**Floor** - Stone - Carpet	**Wall** - Stone	**Ceiling** - Glass - Stone - Brick	**Doors, windows, other surfaces** - Wood - Glass
EAA		10.6 m	- Wooden parquet	- Travertine	- Concrete	- Metal - Wooden - Glass

Table 2
A table showing the visitors' socio-demographic characteristics.

Demographics		Frequency (N)	Percentage (%)
Gender	Male	24	40.0
	Female	36	60.0
Age range	18–19	12	20.0
	20–29	29	48.3
	30–39	6	10.0
	40–49	6	10.0
	50–59	5	8.3
	60–69	2	3.3
Familiarity	Familiar	10	16.7
	Unfamiliar	50	83.3

vey (Table 2). Among these participants, a total of 13 visitors, 6 male and 7 female (M age = 41.5; SD age = 14.6 years, age range 22–64) volunteered to participate in the interview as well.

2.3. Acoustic environment

There are various exhibitions in the Museum RMK, and they appeal to different age groups and to people with different interests; therefore, we expected this museum to be crowded and noisy. Because the theme, content, and exhibited objects in the Museum EAA typically appeal to people interested in archeology, it was less likely that the museum would be as crowded and noisy as Museum RMK. ISO/TS 12913–2 suggests classifying the sound sources under the categories of 'sounds of technology', 'sounds of nature', and 'sounds of human beings' to report the acoustic environment [7]. Table 3 shows the sound sources in the museums during the study.

2.4. Physical parameters

In-situ measurements of L_{Aeq} were made during business hours with a Bruel & Kjaer 2230 sound level meter. It was placed at a height of 150 cm and kept a minimum of one meter away from reflected surfaces (Fig. 7) [7]. To be able to catch all significant sound sources, we used a time interval of 20 min in both museums. The study took place on a weekend so that there would be high occupancy rates in the museums. The average sound levels (L_{Aeq}) were measured as 95.6 dB (L_{Amax}: 97.5, L_{Amin}: 91.7) in Museum RMK and 94.4 dB (L_{Amax}: 96.5, L_{Amin}: 93.1) in Museum EAA. Because the foreground noises were masked by extremely high background noises, there was a lack of variation [23].

Table 3
Sound sources in museum RMK and museum EAA.

Sound sources	Museum RMK	Museum EAA
Sounds of technology	- background music - object-related sounds (Mustafa Kemal Atatürk's voice, train whistle in rail transportation section, hammer smith, coppersmith, and carriage sounds in craftsman street, engine sound in machine section) - X-ray device - security guards' radiotelephones	- background music - object-related sounds (one informative sound source suspended from the ceiling) - X-ray device - security guards' radiotelephones - elevator
Sounds of Nature	–	–
Sounds of Human Beings	- Footsteps, speech, laughter, children's noise	- Footsteps, speech, laughter, children's noise

2.5. Data collection

This study uses quantitative and qualitative research methods to understand visitors' perceptions of the soundscapes of museums. We conducted the questionnaire survey to collect quantitative data; semi-structured interviews were used to collect qualitative data for the GT analysis. The questionnaire survey and semi-structured interviews [7,20,23,24] were conducted while the in-situ measurements of L_{Aeq} were carried out.

The questionnaire survey has seven parts of five-point Likert scales (strongly disagree = 1, to strongly agree = 5) to assess the visitors' subjective responses. The seven parts were comprised of *expectation, preference, auditory environment, physical environment, context, interpretation of the sound environment,* and *response* [1] with a total of 33 questions. The questionnaire used in the present study is shown in Table 9 in the Appendix A. The collected data were entered into the IBM SPSS Statistics 21 software for statistical analysis. To compare and correlate the data, the Mann-Whitney U Test and Spearman's rho were performed.

The purpose of the semi-structured interviews was to identify visitors' expectations and perceptions of museums' built and auditory environments. The semi-structured interview was generated with 15 main questions that were divided into two main parts: the built environment and the auditory environment (Table 4). We also asked spontaneous questions based on the conversation. After the purpose and process were explained to participants, we started the audio-recording. Each of the interviews took between 5 and 17 min. In the scope of the GT approach, the data collection process stopped when the data reach theoretical saturation. The audio files were transcribed verbatim and translated from Turkish to English. The GT approach has three coding steps, open coding, axial coding, and selective coding. The coding process was completed using the ATLAS.ti Software. To identify the related and unrelated items, the data were broken down into key phrases. The interview transcriptions were analyzed to find the reoccurring statements and key phrases were accredited to them. After the key phrases were conceptualized, they were grouped back to generate the core categories and the main category, and their relations were explored. Lastly, the systematic categorization of museum soundscapes was generated.

3. Results

3.1. The questionnaire survey

We examined the reliability of the questionnaire using the Cronbach's Alpha score. The value was found to be 0.787, which demonstrates that the questionnaire is reliable. To evaluate the differences between two museums in terms of the seven parts of the questionnaire, the Mann-Whitney U Test was used. The test revealed that there is a significant difference between the museums, based on statements *"I prefer museums to be in historic buildings (Q 2.1)*" and *"I prefer that a museum with this theme should be in a modern building (Q 2.4)*" (Table 5).

The majority of visitors (n = 25) in Museum RMK, which has a historical building type, agreed with the statement "*I prefer museums to be in historic buildings (Q 2.1)*", while visitors (n = 16) in Museum EAA, which has a modern building type, agreed less overall. Similarly, more visitors (n = 26) in Museum RMK, where the building type and theme of the exhibition are historical, disagreed with the statement "*I prefer that a museum with this theme should be in a modern building (Q 2.4)*" than visitors (n = 15) in Museum EAA,

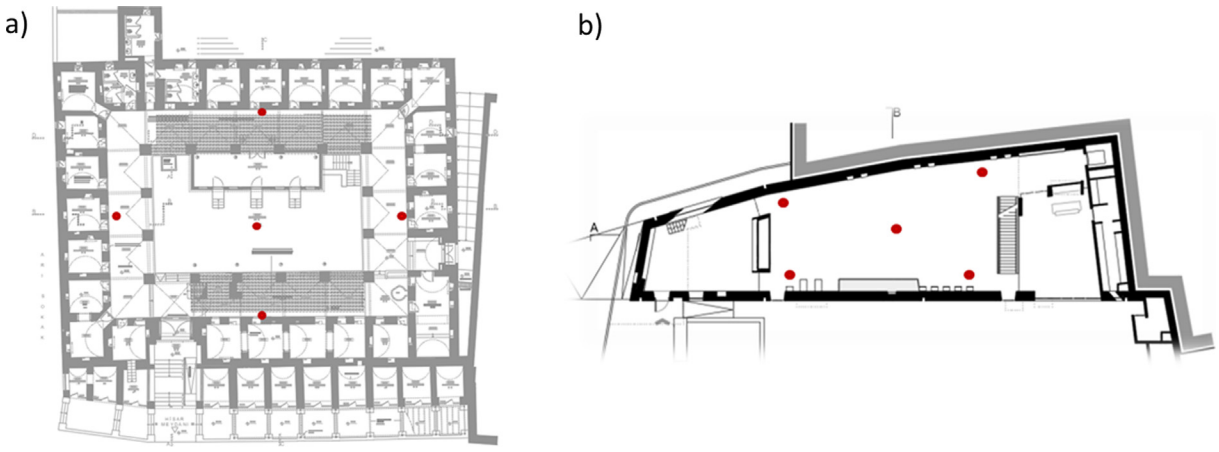


Fig. 7. a) Locations of the sound level meter during the in-situ measurement in Museum RMK b) Locations of the sound level meter during the in-situ measurement in Museum EAA.

Table 4
The fifteen main questions, prepared at the beginning of the semi-structured interviews.

First Part (Built Environment)
1. Have you been to this museum before?
2. Did you have any idea about the theme of the museum?
3. What do you think the theme of this museum is? [20,23]
4. When you think about this theme, what kind of museum environment do you think about it?
5. Do you think the theme matches the environment? [23,24]
6. What did you think/feel when you first entered the museum? [20]
7. Should objects exhibited in this museum be exhibited in a more historic/modern building? [23,24]
8. What do you expect museums to have in the built environment?
9. Does this museum match your expectations?
Second Part (Auditory Environment)
10. What kind of sounds comes into your mind when thinking about a museum? [20]
11. What do you expect to hear in the historical/modern museum? [24]
12. Which sounds did you hear in this museum and how did it make you feel? [7]
13. What do you think about the sound environment of this museum? [23,24]
14. What is pleasant/unpleasant about the sounds in this museum? [7]
15. Were the sounds in this museum in harmony with the environment? [24]

where the building type is modern but the theme of the exhibition is historical.

To explore the correlation between the seven factors of the questionnaire, Spearman's rho (rs) is used at 95% and 99% significance levels (2-tailed). The *expectations* and the *physical environment* aspects show significant correlations in both museums. While the *"This place matches my expectations (Q 1.4)" statement* has a significant positive correlation with *"I think the museum provides visitors with a warm/friendly environment (Q 4.3)"* (rs = 0.489; p = 0.005), *"The exhibition spaces in the museum were spacious (Q 4.4)"* (rs = 0.461; p = 0.01), and *"I prefer museums to be in historic buildings (Q 2.1)"* (rs = 0.601; p = 0.000) statements in Museum RMK, it has a significant positive correlation only with the *"The exhibition spaces in the museum were spacious (Q 4.4)"* (rs = 0.461; p = 0.01) statement in Museum EAA.

In the Museum RMK, the *"I had an expectation about the sounds I was going to hear in this museum (Q 1.3)"* statement has a significant positive correlation with the *"It's important to me that the sounds I hear are appropriate to the environment I'm in (Q 5.3)"* statement. It has significant negative correlations with the statement *"I encountered disturbing sounds while visiting the exhibition areas (Q 6.4)"* statement in both museums (Table 6).

Results show that the "*The sound environment in this museum was disturbing (Q 3.2)*" statement has significant positive correla-

Table 5
Statements that have significant differences between the museums according to the Mann-Whitney *U* Test.

Statements	*Median (RMK)*	Median (EAA)	n	*U*	z	p	r
I prefer museums to be in historic buildings (Q 2.1)	35.13	25.87	30	311.000	−2.511	0.012	0.32
I prefer that a museum with this theme should be in a modern building (Q 2.4)	25.03	35.97	30	286,000	−2.955	0.003	0.38

Table 6
Statements that have significant correlations with *"I had an expectation about the sounds I was going to hear in this museum (Q 1.3)"* statement.

Statements	Museum RMK			Museum EAA		
	rs	p	n	rs	p	n
It's important to me that the sounds I hear are appropriate to the environment I'm in (Q 5.3)	**0.659**	0.000	30	−0.032	0.868	30
I encountered disturbing sounds while visiting the exhibition areas (Q 6.4)	−**0.466**	0.009	30	−**0.542**	0.174	30

Table 7
Statements that have a significant correlation with *"The sound environment in this museum was disturbing (Q 3.2)"* statement.

Statements	Museum RMK			Museum EAA		
	rs	p	n	*rs*	p	n
The sound level in this museum was high (Q 3.1)	**0.611**	0.005	30	**0.432**	0.017	30
In some exhibition areas, it was difficult to hear sound related to objects (Q 3.3)	**0.555**	0.001	30	**0.701**	0.000	30
Disturbing sounds in the exhibition areas made it difficult for me to connect with the objects on display (Q 6.5)	**0.362**	0.049	30	**0.401**	0.028	30
The sound environment has a positive contribution to the museum ambiance (Q 7.1)	−**0.384**	0.036	30	−**0.370**	0.044	30
When I was uncomfortable with the sound environment, I felt the need to leave the exhibition space where I was (Q 7.4)	**0.621**	0.000	30	−**0.500**	0.005	30

tions with the statements "*The sound level in this museum was high (Q 3.1)*", *"In some exhibition areas, it was difficult to hear sound related to objects (Q 3.3)*", *"Disturbing sounds in the exhibition areas made it difficult for me to connect with the objects on display (Q 6.5)*", and *"When I was uncomfortable with the sound environment, I felt the need to leave the exhibition space where I was (Q 7.4)*", and has a significant negative correlation with "*The sound environment has a positive contribution to the museum ambiance (Q 7.1)*" statement in Museum RMK. It has significant positive correlations with the *"The sound level in this museum was high (Q 3.1)"*, *"In some exhibition areas, it was difficult to hear sound related to objects (Q 3.3)"*, *"Disturbing sounds in the exhibition areas made it difficult for me to connect with the objects on display (Q 6.5)*" statements, and has significant negative correlations with the "*The sound environment has a positive contribution to the museum ambiance (Q 7.1)*" *and "When I was uncomfortable with the sound environment, I felt the need to leave the exhibition space where I was (Q 7.4)*" statements (Table 7).

Additionally, the *"The sound environment has a positive contribution to the museum ambiance (Q 7.1)*" statement has significant positive correlations with "*The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)*" and *"The sound environment helped me feel like I was in the era on display at the museum (Q 7.2)*" statements in each museum. Lastly, the *"I prefer museums to be in historic buildings (Q 2.1)*" statement has a significant positive correlation with the "*The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)*" statement in Museum RMK (Table 8).

3.2. Grounded Theory analysis

A conceptual framework is defined as a network of linked categories that together provide an extensive understanding of a phenomenon [30]. There was a need for a relevant conceptualization for the museums' soundscapes. Therefore, a holistic and systematic approach was developed to reveal the interpretation of the museums' soundscapes in this study.

Interview data were analyzed with the GT method and the ATLAS.ti software was used to ease the coding process. After the interviews were examined sentence by sentence, the key phrases, sub-categories, core categories, and the main category were identified. For instance, comments about the speech and children's noise were labeled 'Sound Source People'. The labels of 'Sound Source People' were grouped with other sound-related labels such as 'Sound Source Music', 'Sound Source Equipment', and 'Sound Source Outside' under the subcategory of 'Sound Sources'. Other sound-related subcategories such as 'Sound Level' and 'Physical Parameters', created the core category of 'Auditory Environment'. After each core category was identified, we explored the main category and its relations with the core categories. The categories were placed in graphical order, depending on the relations between them [23,24]. The links and patterns within these relations helped to create the conceptual framework, which identifies the visitors' perceptions of soundscapes in museums (Fig. 8).

The interpretations of the soundscapes of the museums were determined based on the categories generated out of the gathered data. The analysis shows that the built and auditory environment

Table 8
Statements that have significant correlations in each museum.

Statements	Museum RMK			Museum EAA		
	rs	p	n	*rs*	p	n
The sound environment has a positive contribution to the museum ambiance (Q 7.1) / The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)	**0.513**	0.004	30	**0.371**	0.043	30
The sound environment has a positive contribution to the museum ambiance (Q 7.1)/ The sound environment helped me feel like I was in the era on display at the museum (Q 7.2)	**0.365**	0.047	30	**0.467**	0.009	30
I prefer museums to be in historic buildings (Q 2.1) / The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)	**0.554**	0.002	30	−0.064	0.738	30

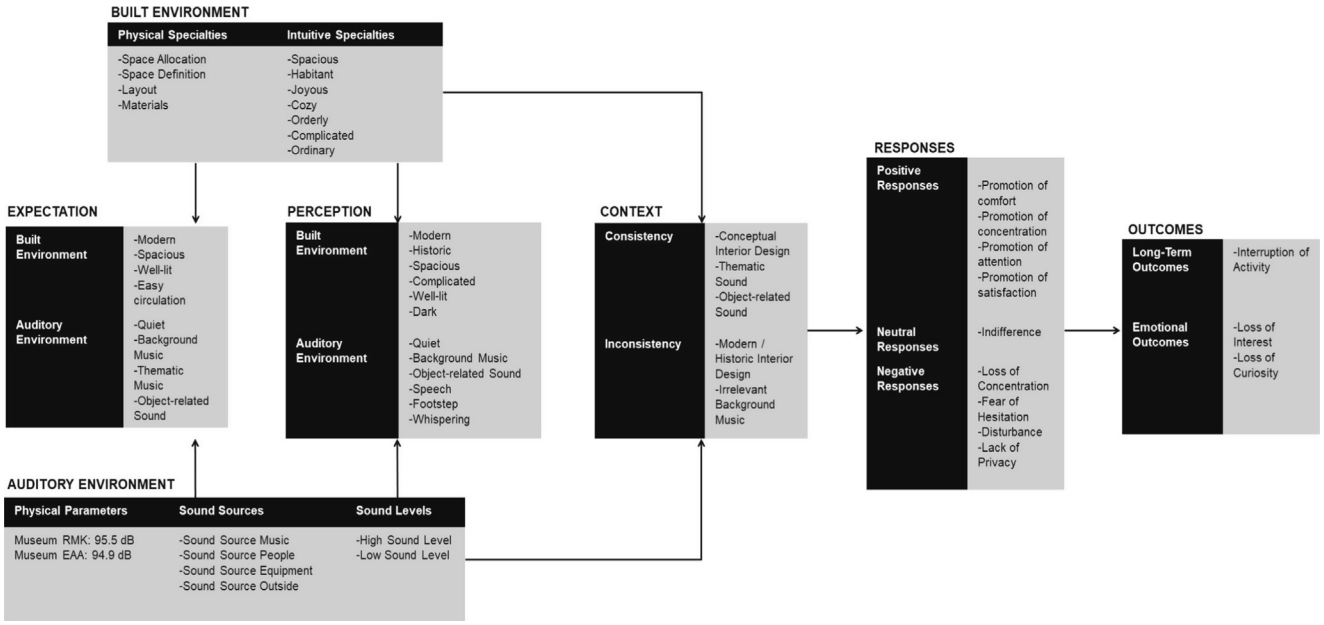


Fig. 8. Conceptual Framework for the Soundscapes of the Museum RMK and Museum EAA.

categories directly affect visitors' expectations and perceptions within the museums. These categories are followed by a more complicated category, the context of the soundscape. Context is the main category of this framework, and is defined as "the interrelationships between person and activity and place, in space and time" [1]. It has been clarified that people, activity, and place are determinant factors of the context of soundscapes [32]. This framework also indicates that the categories of built and auditory environments directly influence the context. The category of context affects visitors' responses toward soundscapes as either positive, neutral, or negative; those responses led visitors to come up with different outcomes. Even though we expected to generate two different conceptual frameworks for each museum, there were no differences in the responses toward the perception of built and auditory environments. During the data analysis, the similarities of key phrases and subcategories in different museums became clearer. Therefore, one common conceptual framework was created. Each category will be explained in detail in the following sections.

3.2.1. Built environment

Two subcategories, 'Physical Specialties' and 'Intuitive Specialties', were generated under the category 'Built Environment'. These specialties play an important role in visitors' perceptions and expectations in the museums because they identify the context. For this study, physical specialties include space allocation, space definition (historical or modern), layout, and materials; intuitive specialties include terms like spacious, habitant, joyous, cozy, orderly, complicated, and ordinary.

3.2.2. Auditory environment

There was a direct relationship between the 'Perception' and 'Expectation' and the 'Auditory Environment' categories. This category was divided into subcategories as 'Physical Parameters' and 'Sound Source'. Sound has a definitive effect on visitors' perceptions because it directly affects how one evaluates the general museum. Sound sources were divided into 'Sound Source Music', 'Sound Source People', 'Sound Source Equipment', and 'Sound Source Outside'.

3.2.3. Expectation and perception of the built environment

A person interact with a place based on their previous experiences, which shape their expectations. As Bruce and Davies [31] suggest, the effect of expectation should be considered in the soundscape studies. In our case, visitors claimed that their prior experiences affected their expectations of built and auditory environments. Relatively, one can see that built and auditory environments affect visitors' perceptions. Visitors expected the museums to be modern, spacious, broad, and comfortable but they described Museum RMK as complicated, crowded, and historical. However, even though their expectation of the built environment did not match with their perceptions, because visitors could relate to the museums' themes through the built environment, they were still satisfied.

RMK: Even though I think of a modern building when the museum is mentioned since the objects exhibited here are historical, it is also compatible with this historic building.

The Museum EAA is depicted as spacious and modern. Accordingly, the expectation was similar to the perception of this built environment. Nonetheless, some of the visitors found that the museums' theme did not match its built environment.

EAA: It would be better if the historical objects here were displayed in a historical building. It was more like I could have been living at that time.

3.2.4. Expectation and perception of auditory environment

Visitors to both museums expected the museums to have a quiet and calm auditory environment. Most of them explained that they expected to hear low sound levels of background music, thematic music, and object-related informative sounds during the visit.

RMK: . . .For example, there is the Fenerbahçe section. Once I entered there, I expected to hear the anthem of Fenerbahçe or fans cheer played continuously, so as not to disturb people.

EAA: In the museum, I expect to hear music that can reflect the old history. For example, if the works of Anatolia are exhibited, I would like to hear the music composed in and related to Anatolia culture.

The quiet environments evoked both positive and negative reactions. Some visitors did not expect the museums to be discomfortingly quiet, while others expected a quiet environment in order to better focus on the objects and exhibits.

RMK: *Museums should not be completely silent. I feel uncomfortable if it is completely silent. So, for example, I should be able to comment on what I see there when I visit the museum with someone. I need to make comments. There must be an arrangement that would provide me with this environment. If it is a very quiet environment, I feel uncomfortable thinking that I am making a lot of noise while commenting. So it shouldn't be too quiet.*

EAA: I expect museums to be quiet. I cannot focus on what I am viewing at that moment. So I think it's better to be quiet.

The sound sources were also perceived as both positive and negative. This is directly related to the environment and the context of the sound sources. The sound sources that were perceived most positively were the background music and the object-related sounds; the most negatively perceived sound sources were human-based (loud speaking, noise from children, and outdoor sound sources).

3.2.5. Context

Context is defined as "the interrelationships between person and activity and place, in space and time" [1]. It has been clarified that people, activity, and place are determinant factors of the context of soundscapes [32]. In this study, these elements are directly linked to the category of context. Because each of the visitors' statements is related to the context, it was chosen as the main category of this framework. As clarified in previous studies, this study also proves that context shapes visitors' responses toward soundscapes, and influences their responses (whether positive, neutral, or negative) [6,16,21,24]. Accordingly, context is connected to the built and auditory environment [6,13,16,19,21,24]. Visitors responded positively or negatively to the soundscapes depending on the consistency between the context, the built environment, and the auditory environment.

RMK: There is an Ankara Street section on the lower floor. There are sounds of craftsman who makes saddle and blacksmith's sound while forging. There is also an old carriage and you can hear the sound of whinny and horseshoe. It is like I am walking in the old streets of Ankara. This was the most impressive part addresses to four senses. When you are there the sound is making you feel like in a real street.

EAA: I heard people were talking loudly sometimes. But because they were talking about the exhibition, I did not get disturbed.

This study also shows that even the most unwanted sounds can be perceived positively if there is harmony within the context. This can be explained by the perception of the children's noise in the two different museums.

RMK: *There is intense children's noise but it is not disturbing for me because this is the toys section. But if I hear the same sound in the modern art museum I would be irritated. Children's curiosity, gestures, and conversations are very appealing to space here.*

EAA: I am uncomfortable with the noise of these children. I cannot focus on what I am reading while they are making noise and this museum is not a place for children who make noise.

3.2.6. Responses and outcomes

Responses, based on the interpretations of the built and auditory features of the museums generated the outcomes. Visitors' responses were grouped as positive, neutral, and negative. They gave positive responses to the informative, didactic, and thematic sound sources that provided them with comfort, concentration, satisfaction, and attracted their attention during their visit. Negative responses were due to unwanted sounds that caused loss of concentration, fear of hesitation, disturbance, and lack of privacy.

RMK: I heard Mustafa Kemal Atatürk's voice in the section of Atatürk, and engine sounds in the machines' sections. The sound of the exhibited objects was great and informative.

EAA: The sound recording was very distracting. Because it has a sensor, it automatically restarts when someone goes near it. I could not concentrate on reading other things while it is on.

Outcomes are divided into 'Long-term Outcomes' and 'Emotional Outcomes' in this study. Long-term outcomes are defined as interruptions in activity, and emotional outcomes are determined as loss of interest and loss of curiosity.

EAA: I was disturbed because of the crying child and I had to stop reading the information about the exhibited objects over there. I left because I was no longer interested in what I read in this noise. I could not understand what I read.

4. Discussion

In this study, qualitative and quantitative methods were used to generate a conceptual framework. Categories have many similarities with previously generated conceptual frameworks [6,19,20,33] and the ISO 12913-1 [1]. Context was found to be the dominant element to influence visitors' responses toward the built and auditory environments directly.

4.1. The museum context and the built environment

We found context was the core category of the framework because it linked with other categories in many relations. Interview results showed that visitors expect the auditory environment of a museum to be calm, with low-level background music. Statistical results also reveal that the statements, *"The sound level in this museum was high (Q 3.1)*" and *"Disturbing sounds in the exhibition areas made it difficult for me to connect with the objects on display (Q 6.5)*" have a significant positive correlation (Table 7). Mechanical sounds (HVAC systems, motors, fans, and poorly implemented speakers) were evaluated negatively in the museums [25,27]. Yang and Kang [22] claim that acoustic comfort increases when loudness decreases. However, the lack of a negative sound or low-level sound is not enough to generate positive environments [2]. Visitors indicated that they were disturbed when they heard *irrelevant* sounds. Even if the sound level was high, if there was consistency between the sound source and the built environment they were not disturbed (as they would have been in the example of children noise). The reason why children's noise was acceptable in the Museum RMK is that the context of sound matched with the built environment. The 'toys' section was an appropriate place for children to express their excitement, astonishment, and feelings loudly in Museum RMK. However, because the exhibited objects are mostly archaeological in Museum EAA, the museum experience requires more concentration. Therefore, while children's noise was accepted as part of the visitor experience in the Museum RMK, it was reported as annoying in the Museum EAA.

Statistical results show a significant positive correlation between the *"The sound environment has a positive contribution to the museum ambiance (Q 7.1)*", "*The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)*", and *"The sound environment*

helped me feel like I was in the era on display at the museum (Q 7.2)" statements in both museums (Table 8). Therefore, when there was consistency between the sound sources and exhibition themes, it contributed positively to the visitors' museum experiences. This is evident in the 'Ankara Street' section of Museum RMK, where visitors felt like as though they were in a real street of that period. Relatively, in the Museum RMK, the "*I prefer museums to be in historic buildings (Q 2.1)*" statement was found as having a significant positive correlation with "*The sounds I heard in the exhibition spaces were appropriate for this museum (Q 5.1)*" *statement*. Therefore, one could say that visitors in Museum RMK were satisfied with the relationship between what they heard, the theme of the exhibitions, and the historical characteristics of the building.

As proposed by Fry [25], the evidence we found shows that visitors do not want a library-like stillness in the museums environments'. Relatively, visitors expected a low level of speech; this expectation had a positive effect on their experiences and interactions with the exhibitions. Visitors claimed that others' speech helped them to move more freely. In this way, they were not worried about making noise or disturbing others (like they might have in libraries). For instance, Acun and Yilmazer [6] found that keyboard sounds created positive feelings for the employees' (based on their sound perception) sound perception in open-plan offices; Cankaya and Yilmazer [13] found that the sound of a computer fan or a keyboard-mouse were welcome sounds in the classrooms as they evoke a feeling that all of the students are working. Similarly, visitors in both museums stated that it was good for them to hear others' speeches, and that would contribute to their own museum experiences.

Visitors perceived the sound sources, as consistent with the objects, positively because they provide informative and attractive content. The uncontrolled and high level of irrelevant sound sources were perceived negatively; these caused an interruption in activity, and a loss of concentration, curiosity, and interest. Therefore, it has been found that there should be harmony between the context of sound and the built environment within the museums in order to provide visitors with a unique museum experience.

4.2. Outcomes for designers

In this section, we explore the importance of the design of space, form, shape, exhibited objects, and soundscape in museums for visitors. Because the museums are places for exhibitions, visitors explained that, regardless of the physical characteristics of the museum buildings, they expected that the museum building designs would have historical features. They do not only need to see the historical features, but also to feel as if they were in the period of the exhibited objects. Therefore, they expect to experience a museum designed in consideration of all these details, in the built and auditory elements.

This study shows that visitors in both museums preferred historical building types. However, visitors of Museum RMK agree on this idea more than visitors of Museum EAA. Even though the vast majority of visitors in Museum EAA preferred the historical building type, because they had experienced a modern building, their preferences were affected by their perceptions. Relatively, considering the theme of the exhibition, visitors of Museum EAA preferred the modern building type more than the visitors of Museum RMK. Furthermore, results show that historical exhibitions in historical buildings are more appealing to people's preferences and expectations than historical exhibitions in modern buildings.

RMK: Even though I think of a modern building when the museum is mentioned since the objects exhibited here are historical, it is also compatible with this historic building.

EAA: It would be better if the historical objects here were displayed in a historical building. It was more like I could have been living at that time.

As a result of the analyses, it was observed that visitors need fully designed built and auditory environments in museums. It was found that the soundscape design is as important as the design of space, form, and shape in the museums for visitors to better engage in the environment. When the built and auditory environments are in harmony, visitors experience the museum properly. In this sense, considering the subjective interpretations of the visitors, one can imagine that using soundscape as a design element during the design phase of museums would enhance the museum experience.

5. Conclusion

This study shows that the museums' building types, either modern or historical, as well as the themes of its exhibitions, directly affect visitors' soundscape perceptions. Context, as the meaning attributed to sound, is found to be more important than the level of sound. Therefore, visitors' perceptions mostly depend on the context in which sound is heard, rather than sound level. When the visitors were content with the relationship between what they heard, the theme of the exhibitions, and the historical characteristics of the building, they gave positive responses. In this respect, visitors' built environment preferences were influenced by the sound environment.

One of the most important conclusions is that visitors are interested in museums having, and perhaps even need them to have, designed sound environments. In some areas, where sound was used as a design element, visitors' museum experiences were much more positive because they could interact with the exhibited objects and feel as if they were living in a specific period. This study is limited to two museums that are contextually connected to their historical environment. The results may vary for other kinds of museums, because they might differ in many aspects. Future studies would need to include many different cases to yield more detailed results.

CRediT authorship contribution statement

Cemre Orhan: Software, Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Visualization, Project administration. **Semiha Yilmazer:** Conceptualization, Methodology, Resources, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Table 9
The 33 questions prepared for the questionnaire survey.

1. Expectation	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
1.1 I had an idea about this place before I came.					
1.2 This place is similar to the other museums.					
1.3 I had an expectation about the sounds I was going to hear in this museum.					
1.4 This place matches my expectations.					
2. Preference	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
2.1 I prefer museums to be in historic buildings.					
2.2 I prefer museums to be in modern buildings.					
2.3 I prefer that a museum with this theme should be in a historic building.					
2.4 I prefer that a museum with this theme should be in a modern building.					
3. Sound environment	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
3.1 The sound level in this museum was high.					
3.2 The sound environment in this museum was disturbing.					
3.3 In some exhibition areas, it was difficult to hear sound related to objects.					
3.4 I wish there was a background sound in the museum.					
3.5 The sound sources were directly related to the themes in the exhibition.					
4. Physical environment	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
4.1 I had a hard time finding my way at the museum.					
4.2 I like the high-ceiling spaces in the museum better.					
4.3 I think the museum provides visitors with a warm/friendly environment.					
4.4 The exhibition spaces in the museum were spacious.					
4.5 I think the exhibition spaces in the museum are well lit.					
4.6 I think the air quality at the museum is good.					
4.7 I think the amount of air temperature/humidity in the museum is good.					
4.8 I think the amount of sunlight in the museum is good.					
5. Context	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
5.1 The sounds I heard in the exhibition spaces were matching with this museum.					
5.2 The historical structure of the museum building was compatible with the exhibits.					
5.3 It's important to me that the sounds I hear are appropriate to the environment I'm in.					
6. Interpretation of sound environment	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
6.1 Hearing sounds connected to the objects on display had a positive effect.					
6.2 Hearing sounds connected to the objects on display aroused a sense of curiosity.					
6.3 The sounds I heard in the museum evoked a sense of a calm environment.					
6.4 I encountered disturbing sounds while visiting the exhibition areas.					
6.5 Disturbing sounds in the exhibition areas made it difficult for me to connect with the objects on display.					
7. Response	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
7.1 The sound environment has a positive contribution to the museum ambiance.					
7.2 The sound environment helped me feel like I was in the era on display at the museum.					
7.3 The sound environment made it difficult for me to concentrate on the exhibition.					
7.4 When I was uncomfortable with the sound environment, I felt the need to leave the exhibition space where I was.					

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