A COMPARATIVE STUDY ON INDOOR SOUNDSCAPE IN MUSEUM ENVIRONMENTS

A Master's Thesis

by

CEMRE ORHAN

Department of
Interior Architecture and Environmental Design
İhsan Doğramacı Bilkent University
Ankara
July 2019

To my lovely parents,

Öznur and Fazıl Orhan

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The Graduate School of Economics and Social Sciences

of

İhsan Doğramacı Bilkent University

by

CEMRE ORHAN

In Partial Fulfillment of the Requirements for the Degree of

MASTER OF FINE ARTS

THE DEPARTMENT OF

INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN

İHSAN DOĞRAMACI BILKENT UNIVERSITY

ANKARA

July 2019

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

....

Assist. Prof. Dr. Semiha Yılmazer

Supervisor

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

....

Assist. Prof. Dr. Çağrı İmamoğlu

Examining Committee Member

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

....

Prof. Dr. Arzu Gönenç Sorguç

Examining Committee Member

Approval of the Graduate School of Economics and Social Sciences

....

Prof. Dr. Halime Demirkan

Director

ABSTRACT

A COMPARATIVE STUDY ON INDOOR SOUNDSCAPES IN MUSEUM ENVIRONMENTS

Orhan, Cemre

MFA., Interior Architecture and Environmental Design

Supervisor: Assist. Prof. Dr. Semiha Yılmazer

July, 2019

The aim of this study is to understand how visitors perceive and compare the soundscapes of different museum environments. To reach this goal, physical parameters as acoustic measurements, and perceptual data as questionnaires and interviews were explored in Rahmi M. Koç Museum, and Erimtan Archaeology and Arts Museum. Both museums are located near the main gate of Ankara Castle, which is one of the most historic and cultural part of the city. To find out the acoustical parameters of the case study settings, Equivalent Continuous A-weighted Sound Level (L_{Aeq}) was measured in-situ with Bruel & Kjaer 2230 sound level meter, and Speech Transmission Index (STI) and Reverberation Time (T30) were measured with the Odeon Room Acoustics Software 13.01. For the perceptual data, the questionnaires were analyzed by using SPSS program. Interviews were analyzed with the Grounded Theory (GT) method to explore the visitors' perception towards the indoor soundscapes of museum environments. After analyzing the data of interviews, the conceptual framework was created. This process was completed with the ATLAS.ti Software. Results showed that the soundscapes of the indoor environment cannot be explored only with physical parameters. Results showed that visitors' perception of soundscape changes according to the theme of the museums, and visitors' preference of sound environment changes according to the building types.

Keywords: Auditory Perception, Conceptual Framework, Grounded Theory, Indoor Soundscapes, Museum Environment

ÖZET

MÜZELERDE İŞİTSEL PEYZAJ ÜZERİNE KARŞILAŞTIRMALI BİR ÇALIŞMA

Orhan, Cemre

İç Mimarlık ve Çevre Tasarımı Yüksek Lisans Programı

Tez Yöneticisi: Dr. Öğr. Üyesi Semiha Yılmazer

Temmuz, 2019

Bu çalışmanın amacı, ziyaretçilerin farklı müze ortamlarının işitsel peyzajını nasıl algıladıklarını anlamak ve aynı bağlamdaki mekânların işitsel peyzajlarını karşılaştırmaktır. Bu amaca ulaşmak için Rahmi M. Koç Müzesi'nde ve Erimtan Arkeoloji ve Sanat Müzesi'nde objektif ölçümler ve sübjektif araştırmalar yapılmıştır. Her iki müze de, kentin en tarihi ve kültürel kısmı olan Ankara Kalesi'nin ana kapısının yanında yer almaktadır. Akustik parametreleri bulmak için ses seviyeleri (L_{Aeq}) mekânların içinde ölçülürken, çınlama süresi (T30) ve konuşma iletim indeksi (STI) Odeon Room Acoustics 13.01 yazılımı ile ölçülmüştür. Sübjektif verilerden anketler (n=60) SPSS programı kullanılarak analiz edilirken görüşmeler (n=13) Köklenmiş Teori metoduyla analiz edilmiştir. Görüşmelerin verileri analiz edildikten sonra kavramsal sistem oluşturulmuştur. Bu işlem ATLAS.ti yazılımı ile tamamlanmıştır. Sonuçlar, bir mekânın işitsel peyzajının yalnızca fiziksel parametrelerle değerlendirilemeyeceğini göstermiştir. Mekânlar aynı bağlamda olsa da ziyaretçilerin iç mekân işitsel peyzaj algılarının sergi temalarına göre değiştiği ve ses ortamı tercihlerinin bina çeşidine göre değiştiği görülmüştür.

Anahtar Kelimeler: İç Mekân İşitsel Peyzaj, İşitsel Algı, Köklenmiş Teori, Kavramsal Sistem, Müze Ortamı

ACKNOWLEDGEMENTS

I would like to thank Assist. Prof. Dr. Semiha Yılmazer for her guidance, throughout this study. She has supported me not only in completing this thesis but also in my academic and social life. Thanks to her wisdom I have completed this work.

I would like to thank the examining committee members, Assist. Prof. Dr. Çağrı İmamoğlu and Prof. Dr. Arzu Gönenç Sorguç for their valuable comments and contributions.

I am especially grateful to Volkan Acun for guiding me during the thesis writing process, and to Sıla Çankaya for her supports in statistical analyses.

My dear friend Samah Obeid she has always supported and motivated me in my most difficult times. The best thing that earned me the thesis was her friendship.

I would like to thank Anıl Berk Atalar for making me smile in my most difficult times and taking on every problem with me. Without his support, this thesis would not have been completed successfully.

I would like to express my sincere gratitude to my mother Öznur Orhan, and my father Fazıl Orhan. I have always been proud and honored to be their daughter. My dear siblings Zeynep and Mehmet Emin Orhan, who have always supported me with their love, having you is the biggest chance in my life. Lastly, I would like to thank all my big and beautiful family for being always with me.

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CHAPTER I

INTRODUCTION

Museums are important cultural environments as they emphasize the purpose of collection, education, and recreation of history. Acoustical studies in the museum environments mostly focused on the physical parameters of an acoustic environment (Sala and Gallo, 2007; Carvalho et al. 2013) and prevention ways from the noisy environments in existing literature (Fry, 2002).

It is important to provide proper acoustic conditions in museum environments for a quality museum experience (Fry, 2002). First of all, the geometry of the exhibition halls, materials, and the way these spaces are used, can cause high reverberation easily in museum environments (Carvalho et al., 2013). Respectively, it creates lack of speech intelligibility and echoes which is very annoying for visitors and guided tours (Fry, 2002; Carvalho et al., 2003). Speech intelligibility, reverberation time, and background noise levels were analyzed in the previous studies to clarify the acoustical conditions of the museums (Sala & Gallo, 2007; Carvalho et al. 2013; Acun, Yilmazer, & Orhan 2018; Yilmazer &

Orhan, 2019). A previous study by Carvalho et al. (2013) proved that, compared with old museum, reverberation time is higher in modern museums due to the large room volumes, high ceilings, and highly reflective surfaces.

However, when it comes to the perception of the sound environments, these physical parameters alone are not enough (ISO 2014; Zhang, Zhang, Liu, & Kang, 2016; Kang & Fortkamp, 2017). To understand the perception of sound environment, individuals' subjective responses should also be examined. In this respect, context is the most important aspect of the soundscapes approach, since it has a huge impact on auditory perception, interpretation of auditory perception, responses and outcomes of people towards acoustic environments (ISO, 2014).

In the scope of the soundscapes studies, individuals' perceptions towards the different environments are examined. Brown, Kang, and Gjestland created taxonomy of sound sources in 2011, which showed that the sound sources in outdoor spaces are considered the same with the indoor spaces. However, the soundscapes studies mostly considered outdoor spaces (Aletta & Astofoli, 2018). As Dökmeci and Yilmazer (2014) claimed, due to different geometries, finishing materials, movement, and reverberation of the indoor spaces, there should be more studies conducted in different types of indoor spaces.

Even though the studies on indoor soundscapes have increased in the last decade, there is still limited variety of the indoor areas (Okcu, Ryherd, Zimring, & Samuels, 2011; Mackrill, Cain, & Jennings, 2013; Dökmeci & Kang, 2012;

Bora, 2014; Cankaya & Yilmazer, 2016; Yilmazer & Acun, 2018; Acun & Yilmazer, 2018; Acun & Yilmazer, 2018; Acun et al., 2018; Yilmazer & Orhan, 2019). Although the museum environment was analyzed in terms of soundscapes approach, there is no comparative study which would give much more details about the field in the literature.

The proper acoustic parameters in the museum environments provide visitors with quality and unique museum experience that improve attention, concentration, and complete the mission of education, study, and enjoyment of museums. It is important to understand how effective the soundscapes is on visitors' experience in museums. To accomplish that, this thesis provides readers with the measurements of the physical parameters and evaluation of perceptual data with their comparison and correlation in two different museums; Rahmi M. Koç Museum and Erimtan Archaeology and Arts Museum.

These museums are located in the most cultural part of Ankara. The Rahmi M. Koç Museum, where the building type and theme of the exhibition are historical, is compared with the Erimtan Archaeology and Arts Museum, where the building type is modern but the theme of the exhibition is historical. These two museums were chosen to compare people's perception of soundscapes towards spaces with the same context.

1.1 Aim and Scope

As it was emphasized before, museums' aim of collection, education, and enjoyment can be supported with the proper acoustical environment; thus, visitors could have unique experience. In this respect, studies about the museum acoustics mostly focused on the measurements of physical parameters of acoustical conditions. However, museum environments need to be evaluated with the soundscapes approach by integrating the physical measurements and the perceptual data. When the acoustic analyses of the museum environment are integrated with the individuals' subjective and perceptual responses, the opportunity of understanding the soundscapes of museum environments would occur.

This study aimed to clarify how the visitors' perception of soundscapes changes according to the theme of the exhibitions, and to investigate the effect of perceived sound environment on visitors' preferences towards the built environment. It also adds to the literature as a case study on indoor soundscapes approach and a unique attitude in terms of comparing two spaces having the same context.

In order to accomplish the objectives; the physical parameters of the case study settings were measured. Equivalent Continuous A-weighted Sound Level (L_{Aeq}) was measured as in-situ with Bruel & Kjaer 2230 sound level meter; Speech Transmission Index (STI) and Reverberation Time (T30) were measured with the Odeon Room Acoustics Software 13.01. In the scope of the perceptual data, the interview was evaluated with Grounded Theory (GT) method and analyzed with ATLAS.ti Software; the questionnaire was analyzed by using SPSS program. The comparison of the physical parameters and the perceptual data provided broad information about the visitors' perception of soundscapes towards the museum environments.

1.2 Structure of the Thesis

The thesis consists of six chapters. The first chapter is "Introduction", which gives general information about the soundscapes approach and importance of the study. Then, the aims of the study and structure of the thesis are given respectively.

The second chapter is "Literature Review". It gives background information about the soundscapes, previous indoor soundscapes studies and museum acoustics studies; and methods of soundscapes evaluation which covers details of the evaluation of physical parameters, Grounded Theory method, and evaluation of perceptual data. It also includes background information about the museums, their classifications, architecture, and acoustics.

The third chapter is "Method". The chapter begins by giving information about the design of the study and presents the research questions. Then, it gets more into detail by giving information about the site, participants, and acoustic environments in each museum. The measurement procedure of the physical parameters, perceptual data collection, and Grounded Theory method are given.

The fourth chapter is "Results". It consists of three main sections as physical parameters, perceptual data, and Grounded Theory method. Objective results show the measurement of acoustical parameters of the museums as equivalent continuous a-weighted sound level (L_{Aeq}), reverberation time (T30) and speech transmission index (STI). Subjective results show the evaluation of interviews and questionnaire.

The fifth chapter is “Discussion”. In this chapter, the results of the study are compared with each other and with the previous studies. The results are discussed by considering the differences of physical parameters and perceptual data in two museums.

The sixth chapter is “Conclusion”. The study ends with this chapter. It summarizes the whole study illatively. Recommendations for future studies are also given in this study.

CHAPTER II

LITERATURE REVIEW

2.1 Soundscapes

The term soundscapes was first introduced by a musician R. Murray Schaffer who was very concerned about the relationships between the ear, human beings and acoustic environment (Schafer, 1977). In 1969, he created the World Soundscapes Project (WSP) which aimed to provide a balance between human community and its sonic environment (Westerkamp et al. 2006; Kang et al., 2016). WSP pioneered many important studies such as The Vancouver Soundscapes, The Tuning of the World, and Handbook for Acoustic Ecology.

Schaffer introduced sound typology including three different categories as keynote sounds, signals, and soundmarks (Schaffer, 1977). Keynote sounds refer to omnipresent and prevalent sound and are accepted as background sounds. Signals are known as foreground sounds and include the acoustic warning devices for encoding certain messages or information (Westerkamp et al. 2006). Finally, soundmarks are specific to a certain place and make the acoustic environment unique (Schafer, 1977; Westerkamp et al. 2006; Ozcevik & Can, 2008).

The typology of sounds gives a lot of information about the local environments' soundscapes (Wrightson, 1999). Because of the industrial revolution, unique sounds get masked by louder mechanical sounds (Acun, 2015; Ozcevik & Can, 2008). In 2002, it was proved that more than 30% of EU citizens fell into noise level more than what is specified by World Health Organization (COST, 2013). Since this situation has a negative impact on human health and daily life, an increasing number of complaints remained, a new action called "quiet areas" was emerged with the publication of the EU Directive Relating to the Assessment and Management of Environmental Noise (END). This action aimed to protect special soundscapes that provide "quietness" by initially focusing on reducing the sound level. As it was seen in other regulations, END also clarified that reducing sound levels alone was not enough for life quality and people satisfaction (COST, 2013). It was also seen that not only the sound source, but also the entire sound environment should be considered to achieve their goals.

Soundscapes is an interdisciplinary approach. With the emergence of END, the number of soundscapes studies increased rapidly in Europe and elsewhere separately. This separation caused unorganized and complicated studies. In 2009, COST Action Soundscapes of European Cities and Landscapes was emerged to harmonize soundscapes studies from all over the world. COST

Action brought lots of studies and researchers from different disciplines together and helped them collaborate (COST, 2013). COST Action TD0804 (2009–2013) claimed the aim of the COST Action as;

> “To provide the underpinning science for soundscapes research and make the field go significantly beyond the current state-of-the-art, through coordinated international and interdisciplinary efforts. The Action will promote soundscapes into current legislations, policies and practice, aiming at improving/preserving our sonic environment.”

However, there was still no certainty of definition and evaluation methods of soundscapes. Even though in many studies the surrounding sounds were defined as “perceived soundscapes”, the sound sources found in different sound environments were not categorized (Brown et al., 2011). Thereupon, in 2011; Brown, Kang, and Gjestland created possible taxonomy, which classifies the sound sources in different acoustic environments (Figure 1). The taxonomy shows that the acoustic environment is divided into two main categories as indoor and outdoor. Outdoor acoustic environment has four subcategories as urban, rural, wilderness, and underwater. And the framework supposes that all principles that connect to the outdoor acoustic environment are same for the indoor acoustic environment.

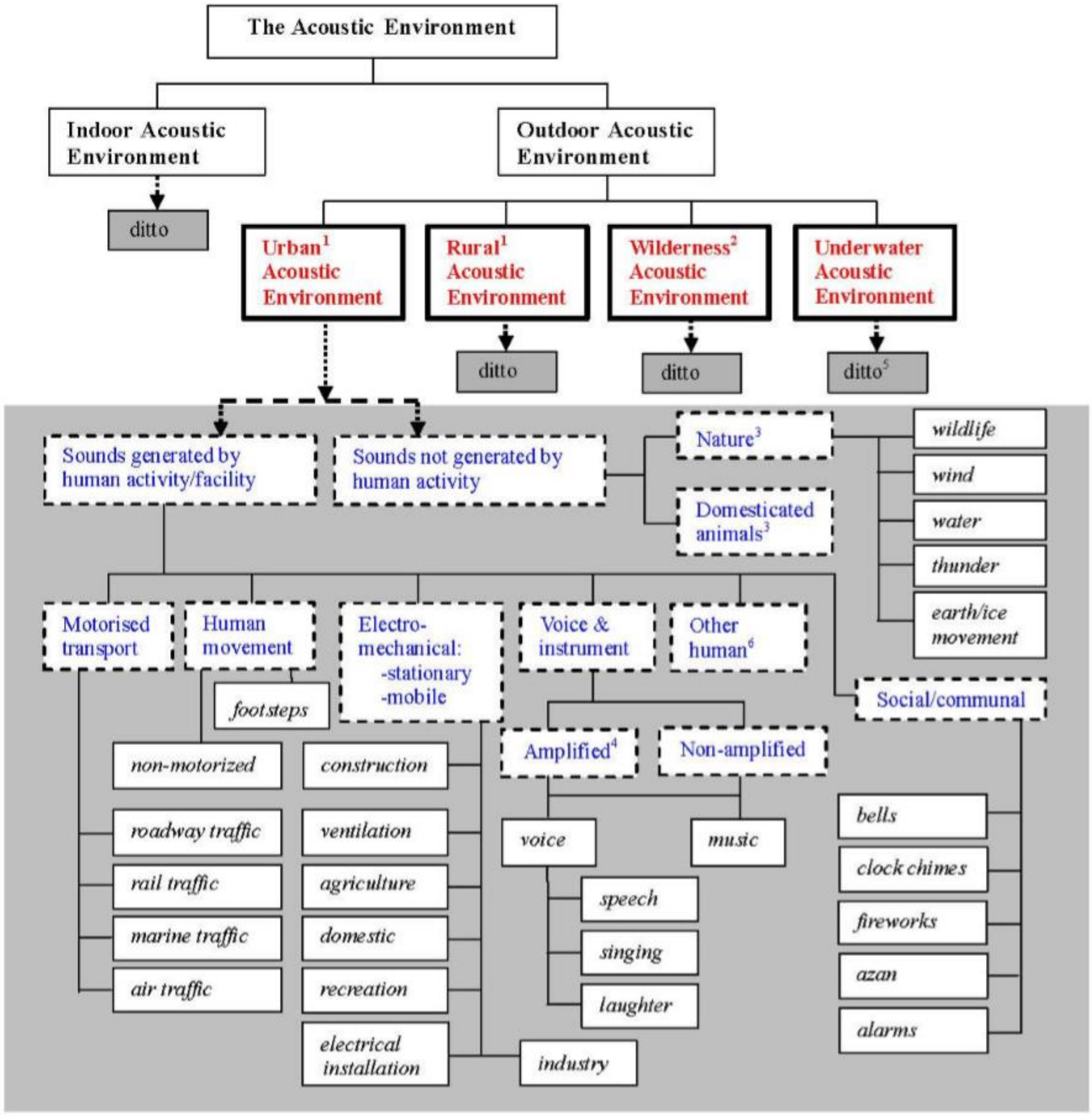


Figure 1. Taxonomy of sound sources according to different places

Researchers explained the term soundscapes as "how the environment is perceived by a listener" for a long time (Porteous and Mastin 1985; Truax 1999; Gage et al. 2004; Yang and Kang 2005; Kang 2006; Schafer, 1988; Westerkamp, 2006). In 2009, studies about developing ISO Standard on the soundscapes studies began and introducing a definition of "soundscapes" was a priority (Kang & Schulte-Fortkamp, 2017). The International Organization for

Standardization provided the definition of soundscapes and a conceptual framework. According to that, soundscapes is “the acoustic environment perceived or experienced and/or understood by a person or people, in context” (ISO 2014). It means that soundscapes exist through human perception. The framework explains the process of perceiving and experiencing the soundscapes with the seven concepts and their connections (Figure 2). These concepts are; context, sound sources, acoustic environment, auditory sensation, interpretation of the auditory sensation, responses and outcomes (ISO, 2014). The framework accepts the context as a main aspect. Sound sources include soundscapes and acoustic environment. The soundscapes is affected by context by the means of auditory sensation, interpretation of the auditory sensation and the response to the acoustic environment (ISO, 2014). Therefore, the soundscapes approach is related to people’s understanding and perception of the acoustic environment and meaning related with it (Traux, 1984; Schule-Fortkamp & Fiebig, 2006; Brown et al., 2011; Yang & Kang 2013; Acun & Yilmazer; 2018)

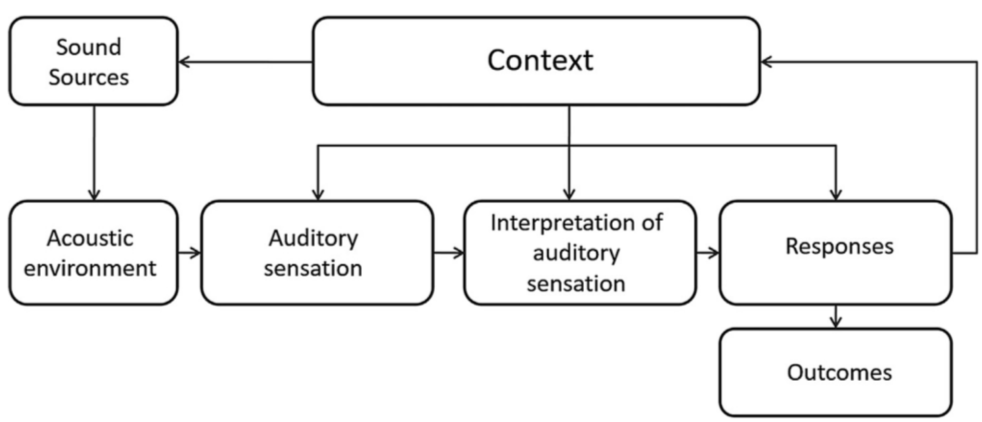


Figure 2. Soundscapes Framework created by ISO12913-1 (ISO, 2014)

2.2.1 Previous Studies on Indoor Soundscapes

Indoor spaces have variety of geometries, materials, acoustical requirements, functions, and activities in it. This diversity generates lots of different acoustic environments. In that sense, in order to better understand the indoor soundscapes, more studies should be conducted in different types of indoor spaces (Okcu et al., 2011; Mackrill et al., 2013; Dökmeci & Yilmazer, 2014; Acun & Yilmazer, 2015; Cankaya & Yilmazer, 2016; Yilmazer & Acun, 2018; Acun & Yilmazer, 2018; Acun & Yilmazer, 2015; Acun & Yilmazer, 2015; Acun & Yilmazer, 2017; Yilmazer & Acun, 2017; Yilmazer & Acun, 2017; Bora & Yilmazer, 2015; Yilmazer & Bora, 2017; Bora & Yilmazer, 2013; Acun et al., 2016; Yilmazer & Orhan, 2019).

Hospitals (Okcu et al., 2011; Mackrill et al., 2013), libraries (Dökmeci & Kang, 2012; Xiao & Aletta, 2016), metro-stations (Bora, 2014), classrooms (Cankaya & Yilmazer, 2016), study areas (Acun & Yilmazer, 2017), care facilities (Aletta et al., 2018), mosque (Yilmazer & Acun, 2018), open-plan offices (Acun & Yilmazer, 2018), and museums (Acun et al., 2018; Yilmazer & Orhan, 2019) are some of the indoor soundscapes research areas that have been studied.

Okcu et al. (2011) held the soundscapes study in two clinical healthcare settings to clarify nurses' wellbeing and work performance, and to see the relation or between the physical parameters and perceptual data. Two 20-bed intensive care units (ICU) with similar patient disease and treatment models were chosen, and called as a neurological ICU (new treatment model) and medical-surgical ICU (old treatment model). Nurses were given a questionnaire which questioned noise annoyance, perceived loudness, and work performance. Even though the measured sound levels were very similar in two different ICU, the perceived sound environment was found more annoying in the medical-surgical ICU. Thus, medical-surgical ICU had negative effect on nurses' work performance, health outcomes, and anxiety. Researchers gave some design advices to create more livable environment for nurses such as reducing impulsive noise sources, use of sound absorptive finishes, and sound control methods for mechanical sound sources like HVAC systems.

Another indoor soundcape study was held in cardiothoracic ward in a UK hospital, by Mackrill et al. (2013). Researchers aimed to clarify people's subjective responses towards the soundscapes and to generate the factors affecting the perception of soundscapes. Acoustic measurements were conducted and perceptual data were collected. Twenty-seven participants including nurses and patients attended the semi-structured interviews. Themes and categories were created according to the Grounded Theory method. The results showed that context is as effective as sound sources on perception of soundscapes. Participants had positive and negative feelings towards the soundscapes of the hospital environment. Some clarified that they developed coping methods like acceptation and habituation once they understood the context of the negative sounds. Researches emphasized the importance of the physical and cognitive factors together to be able to provide positive soundscapes perception on people.

Dökmeci and Kang (2012) studied three different libraries in Sheffield, UK. The aim of the study was comparing the measurement of physical parameters with the perceptual data to see elements affecting soundscapes perception. At the end, the study showed that architectural and functional elements affected the perceptual data. The most annoying sounds were determined as mechanical sound sources like mobile phones, personal music players, and construction noise. On the other hand, sound pressure level and loudness were found significantly related with participants' perceptual evaluations.

Xiao and Aletta (2016) explored acoustic comfort in modern libraries, the quality of perceived sound environment considering the spatial organization to facilitate users' reading and writing activities in the Library of Birmingham. Four groups of participants attended the study and took soundwalks in four different floors. The sound sources were identified, sounds pressure level was measured, and overall quality of perceived sound environment was evaluated. The overall soundscapes quality of each floor was different regardless of the sound pressure level. Results showed that the open plan layout of the library was the determining factor of acoustic comfort. Results also found that the comfort of soundscapes depends mostly on users' soundscapes cognitions and their purpose of using the space rather than the actual measured sound levels.

Bora (2014) studied soundscapes in metro-station. The aim was to clarify the negative and positive forms of the soundscapes in open, semi-open, and enclosed parts of the Akköprü Metro Station with its intermediate surroundings in Ankara. Physical and psychoacoustic parameters were measured in three different parts of the station and compared with the perceptual data. Ninety participants joined the study and they evaluated the parts of the station with 17 adjective pairs in noise annoyance questionnaire while listening the sound records. The enclosed part got the highest rating for annoyance. Participants expressed the open parts as pleasant, calming, natural, and joyful while they expressed the enclose parts as unpleasant, stressful, artificial, and empty.

Cankaya and Yilmazer (2016) studied in classrooms in Bilkent High School; Ankara. Their aim was to create a conceptual framework in high-school environment and clarify the effects of soundscapes on the students' perception. One classroom and one computer laboratory were chosen and 30 students from Bilkent High School attended the study. To clarify the measurements of physical parameters in-situ measurement was conducted. As perceptual data; semi-structured interviews were conducted to see students' perception towards the soundscapes. They used Grounded Theory approach to create the conceptual framework. Results showed that in the classroom and laboratory students preferred to hear music. They perceived the bird singing as the most positive sound source in classroom and laughter in laboratory. The most negative perceived sound source was speech in both spaces. Students had some positive approaches like promoting relaxation, comfort, attention, motivation, concentration, and interaction; and negative approaches like distraction, disturbance, loss of concentration, loss of productivity, and annoyance towards the sound sources. Lastly, authors claimed that physical parameters are not enough to evaluate the soundscapes, as interpretation of the sound is also important. Individual’s perception of soundscapes highly depends on and is shaped by the context of the spaces.

Acun and Yilmazer (2018) explored indoor soundscapes of the four open study areas in Bilkent University Campus. The aim of the study was to investigate the sound environment of the study areas and compare it with the students’ satisfaction, find out the students’ coping methods, and clarify the perceptual dimensions of the indoor soundscapes. They used in-situ sound level measurements as physical parameters and questionnaire as perceptual data. The questionnaire was conducted with 30 students from each study areas in total of 120. It included three parts as; demographic information, five-point Likert scales to evaluate the satisfaction, and semantic differential scale method consists of 14 adjective pairs which were ranked using seven-point scale. After data collection, IBM SPSS Statistics 21 was used to analyze them. Results showed that even the acoustical parameters were measured quite different, soundscapes satisfaction of students was not different as much. The most disturbing and frequently heard sounds were clarified as human-based sound sources in study areas.

Aletta et al., (2018) studied in nursing homes in Flanders, Belgium, with the large-scale survey. Their aim was to provide details of noise sensitivity and sound perception of staff members in their work environment and explore the effects on sound perception of staff role and context. The questionnaire which included categories of noise sensitivity, overall quality of the acoustic environment, soundscapes dimensions, audible safety, sound sources types’ dominance and their corresponding induced annoyance was conducted with 214 participants. Results showed that staff members are slightly to moderately sensitive to noise, however, the perceived sound environment in their work setting is rather positive. There were statistically significant differences in terms of perception between the soundscapes of bedrooms and living rooms. Therefore, bedrooms were perceived as calmer while living rooms were perceived as more eventful. All these results together showed that the context factor has more effects on perception of sound rather than the staff role.

Yilmazer and Acun (2018) studied in the Hacı Bayram Mosque which they called “unique context” because it was the first time that one of the historic religious spaces of Anatolian culture was studied. Their aim was to clarify individuals’ interpretation of the soundscapes of the mosque and its surrounding area, also their auditory sensation with the user-focused approach. To get definitive information about the physical parameters L_{Aeq}, T30, and STI ratings were measured. They used the Grounded Theory method to evaluate the individuals’ perceptual data gathered by semi-structured interviews. Fifteen participants chosen with the purposing sampling method attended the study. According to the semi-structured interview, the conceptual framework was created. Results showed that the sample group had low sound awareness and authors explained that it is related with the function of the building. It was proved that context shaped individuals’ sound preferences and sound expectation, which allowed individuals to interpret the soundscapes that complements the space identity.

Acun and Yilmazer (2018) held the soundscapes study in open-plan offices. The aim of the study was to conduct a Grounded Theory survey and create conceptual framework for open-office environments. Physical parameters were measured both as in-situ and Odeon Room Acoustics Software 13.10 Combined. For collecting perceptual data, 45 participants were involved in semi-structured interviews from each office. Authors emphasized that the measurements of physical parameters alone are not enough to clarify participants' interpretation of soundscapes. Results showed that the sound sources, context of the sound, behavioral tendencies, sound preference, and task type directly affect the interpretation of the soundscapes. Unexpected sound sources and irrelevancy between the sound sources and context caused negative interpretation of soundscapes. It was also clarified that participants created coping methods when they face that problem such as; accepting, habituating, intervening the sound source, and using headphones to isolate themselves from that sound environment. Authors also offered using masking sounds as a design solution for the open-plan office environments.

Indoor soundscapes studies of the museum environment were first started by Acun, Yilmazer and Orhan. Thus, this subject was first introduced into the literature. Details of the studies as follows:

Acun, Yilmazer, and Orhan (2018) explored visitors' subjective perception of the museum soundscapes and how it affects the visitor's experience and to identify the associations between the soundscapes, function and the historic characteristics of the Rahmi Koç Museum, Ankara. Physical parameters were measured with ODEON Room Acoustics Software and perceptual data were collected from 15 participants. Based on the participants' responses to the semi-structured interviews, conceptual framework was created with the Grounded Theory method. The results showed that even the noisiest places can be perceived as normal because of the context of the soundscapes; and individuals need the sound environment to be designed just like the physical environment. This can enhance the visitors' experience to maximum degree in the museums.

Yilmazer and Orhan (2019) investigated the acoustic environment and responses towards it by considering visitors' perception of auditory environment in Erimtan Archaeology and Arts Museum. Physical parameters were measured and perceptual data was collected from six participants. Semi-structured interview was completed and conceptual framework was created with the Grounded Theory method. Results showed that individuals need fully designed environments; and also sound was determined as a very effective design tool to help museums fit the purpose of collection, education, and recreation.

- **Previous Studies on Museum Acoustics**

Studies on museum acoustics generally consider the acoustical parameters rather than the soundscapes of the museums. For instance, Fry (2002) offered ways to prevent noisy environments in the museums whilst Sala and Gallo (2007) and Carvalho et al. (2013) focused on the acoustical parameters of the museums in their study.

Fry (2002) clarified that interactive museums can cause an acoustic chaos. It is important because the sound and acoustic environment have impact on visitors' learning experience. He argued that the problematic sound in the museums is the sound that can be controlled by designers, architects, and exhibit developers. According to him the acoustic chaos is rooted in HVAC systems, motors, vacuum pumps, blowers, fans, poorly implemented speakers, acoustically bright interior surfaces, and floor layout. Throughout the study he gave alternative design solution to each of these. At the end, he emphasized that environments where people can have delightful experiences without irresponsibly noisy can be produced.

Sala and Gallo (2007) conducted a study in the Historical Bardini Museum in Florence. At first they found current situation of indoor air quality, thermal comfort, light, and acoustic of the building and then they checked the comfort parameters and the energy consumption. Their aim was to create significant decrease in energy consumption without changing the historic characteristics of the building. Acoustic measurements concerned only the sound insolation of the façade and reverberation time. For the measurements, they used two channel sound analyzer equipped with the half-inch microphones and preamplifiers. Results showed that both the sound insulation of facade and reverberation time should be improved. They did not give specific results of the measurements. Finally, they offered some design solution such as doubling of the window.

Carvalho et al. (2013) conducted a study which compares acoustical conditions of the old (National Museum of Soares dos Reis) and modern (Contemporary

Art Museum of Serralves) museums. They measured physical parameters as in-situ in the largest showrooms of both of the museums. They measured the reverberation time, equivalent continuous sound pressure level of the background noise as both HVAC off, on, and with visitors, and Rapid Speech Transmission Index. At the end, they compared the results with the ideal values and offered some design solutions. Reverberation time was above the ideal value in both museums but it was higher in the modern museum because of the room volume, high ceilings and the existence of highly reflective surfaces. They suggested the use of sound absorption materials to solve the problems in the buildings.

2.1.2 ISO/TS 12913-2:2018 Acoustics-Soundscapes and Soundscapes Evaluation Methods

Soundscapes occur by human perception towards the acoustic environment (Kang & Schulte-Fortkamp, 2017). After The International Organization for Standardization (ISO) provided, with the ISO/FDIS 12913-1 2014, a definition of soundscapes, the idea that not only the measurements of physical parameters but also the evaluation of perceptual data should be considered in soundscapes studies was occurred. In 2018, The International Organization for Standardization (ISO) provided with the ISO/TS 12913-2 2018 the data collection and reporting requirements for soundscapes studies. According to the standardization, by considering the definition of the soundscapes; people, acoustic environment, and context should be explored with several methods to get full-featured soundscapes study (ISO, 2018). Additionally, it indicated that the process requires the combination of physical parameters; sound levels and/or binaural measurements, and perceptual data; soundwalk and/or questionnaire and/or guided interview to examine the different aspects of soundscapes (ISO, 2018). The standardization briefly explains the aims and gives examples about the methods of questionnaire (Method A), soundwalk (Method B), interview (method C), and binaural measurement.

This thesis is initially focusing on the Grounded Theory method besides other perceptual methods and measurements of physical parameters. Grounded Theory method have been applied to the indoor soundscapes studies before (Mackril et al., 2013; Bora, 2014; Acun, 2015; Cankaya, 2016; Cankaya & Yilmazer, 2016; Acun & Yilmazer, 2018; Acun et al., 2018; Yilmazer & Orhan 2019). All the methods used in the study will be explained in more details.

2.1.2.1 Evaluation of Physical Parameters

- **Equivalent Continuous A-weighted Sound Level (L_{Aeq})**

Equivalent Continuous Sound Level (L_{Aeq}) is defined as the total sound energy within a period and the measurement unit is the logarithmic scale unit of dB ("Acoustic Glossary," 2019). It is measured with sound level meter. Egan (1988) claimed that healthy human ears can detect sound energy from 20 Hz to 20000 Hz frequency ranges, and human speech refers to the range between 125 Hz to 8000 Hz. Even though human ear can detect sound energy from 20 Hz to 20000 Hz, it is more responsive between 500 Hz and 6000 Hz frequency ranges (Acun, 2015). Frequency weighting method is created to reflect the subjective response of humans towards objective sound levels. A- Weighting can reflect human response more precisely than other weightings because it ignores low-frequency sound energy like human ears do (Egan, 1988; Cankaya 2016). These studies generally consider the measurement of the A - weighted sound pressure level (L_{Aeq}) which is abbreviated as dB (A). Additionally, if a frequency weighting is not specified, the A - frequency weighting is understood ("Acoustic Glossary," 2019).

- **Reverberation Time**

Egan (1988) defined the reverberation time as “the time needed for sound to decay 60 dB from the initial sound level”. Wallace Clement Sabine aimed to improve the listening conditions of lecture halls and introduced the term in 1985 (Kendrick, 2009; Acun, 2015). Harris and Shade (1994) claimed that reverberation time depend on the room volume, the sound frequency, and the total sound absorption. Therefore, it was formulated as;

$$T= 0.05 (V/A)$$

In the formula “T” represents reverberation time in seconds, “V” represents room volume (ft^3), and “A” represents total ft^2 of room absorption in Sabin. Based on the relationship between the room volume and reverberation time, Egan generated preferred ranges of reverberation time for different spaces (1998). Figure 3 clarifies that larger spaces have longer reverberation time, whilst smaller spaces have shorter reverberation time.

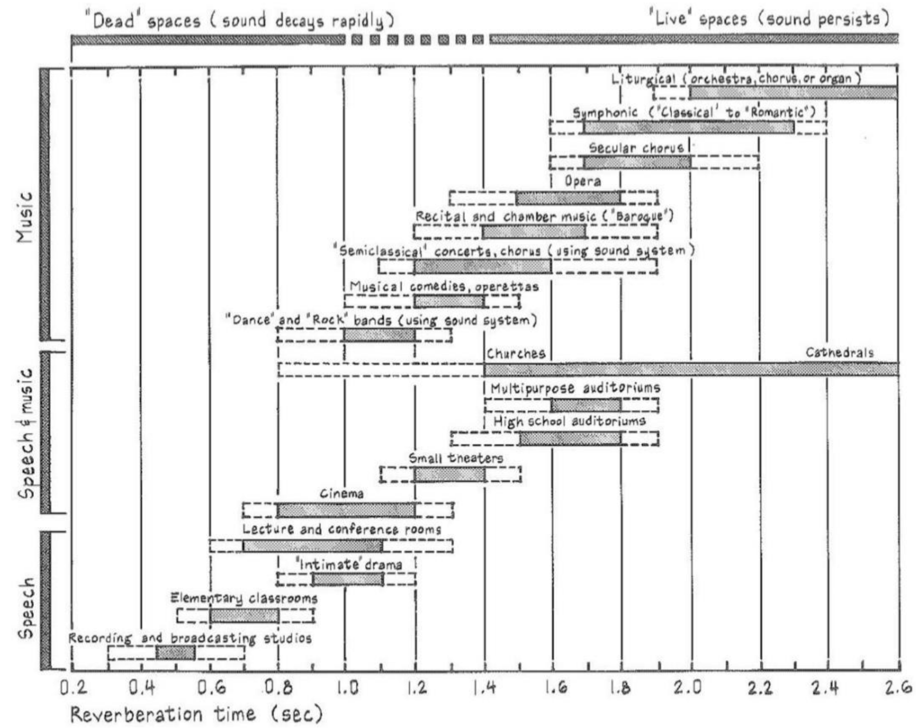


Figure 3. Reverberation time according to the different functional spaces (Egan, 1988)

- **Speech Transmission Index (STI)**

ISO defined the speech intelligibility as “a measure of effectiveness of understanding speech” (2003). Kryster generated Articulation Index (AI) which was used to measure the noise effect on speech intelligibility and his study inspired Houtgast and Steeneken to establish the speech transmission index (STI) (Steeneken, 2001). Egan (1988) clarified that the speech transmission index is the measurement unit of quality of speech intelligibility. STI ratings range between the scale of 0, which refers to bad intelligibility, and 1, which refers to excellent intelligibility (Table 1).

Table 1. Speech Transmission Index (STI) (Adapted from Houtgast and Steeneken, 1971)

Intelligibility Rating	STI
Excellent	> 0.75
Good	0.6 to 0.75
Fair	0.45 to 0.6
Poor	0.3 to 0.45
Bad	< 0.3

2.1.2.2 Grounded Theory Method

Grounded Theory was first introduced by Glaser and Strauss in 1967 (Corbin & Strauss, 1990). Mvaddat (2014) claimed that the aim of Grounded Theory is to analyze the collected data systematically and to form the general frame. Grounded Theory is the most preferred method, within the qualitative methods, when the aim is generating theory out of gathered data (Strauss & Corbin, 1998; Roman et al., 2017; Ruppel & Mey, 2017).

Corbin and Strauss (1990) claimed that, like other qualitative approaches, data of Grounded Theory can be gathered by various sources like interviews, observations, newspapers, videotapes, books and anything related to the study. After the collected data reach theoretical saturation, they all should be transcribed and coded verbally. Coding process has three main steps as; open-coding, axial coding and selective coding (Strauss & Corbin, 1990) (Figure 4). For the open coding step, data are broken down analytically and all the important points are labelled. In that way, researcher can see any detail of the present data. During the axial coding, labels are grouped back together and conceptualized according to their similarities and differences. Thus, the initial categories are occurred. Finally, for the selective coding step, a category which reflects the core of the phenomenon is chosen. Its relation to the other categories is explored, which allows the theory to explain the phenomenon (Strauss & Corbin, 1990). Currently, researchers prefer to use software for analyzing the qualitative data (Ruppel & Mey, 2017). This thesis uses ATLAS.ti Software to analyze the data gathered from interviews for Grounded Theory method.

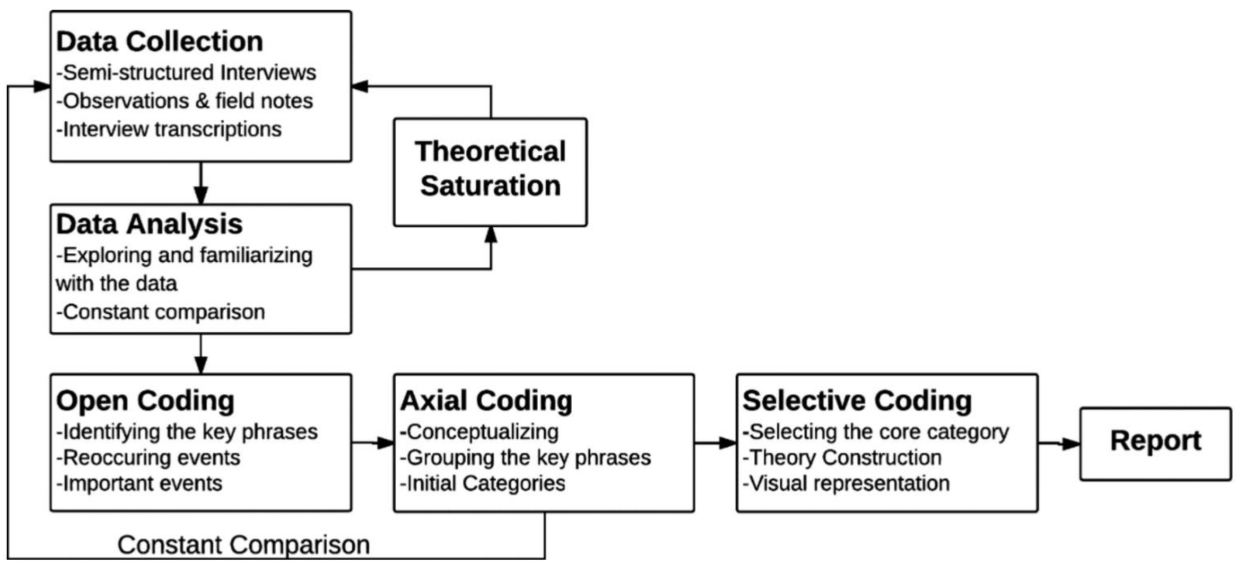


Figure 4. Collection and analysis of the Grounded Theory data (Acun & Yilmazer, 2015)

2.1.2.3 Evaluation of Perceptual Data

The aim of collecting perceptual data is to evaluate soundscapes in the given area from people's subjective responses. The International Organization for Standardization (ISO) provided with the ISO/TS 12913-2 2018 three main perceptual data collection methods as; questionnaire, soundwalk, and interview (2018). They called them as Method A, Method B, and Method C orderly.

Questionnaire, Method A, is one of the most used data collection method in soundscapes studies. Aim of it is to learn how people perceive the acoustic environment. According to ISO/TS 12913-2 2018, it is important to inform participants about how their data will be used and warn them that it is optional to answer any of the questions (ISO, 2018). And all, to reach its aim, questionnaire should include four main parts; sound source identification, perceived affective quality, assessment of the surrounding sound environment, and appropriateness of the surrounding sound environment.

The first part is important to characterize the acoustic environment with the defined sound sources. It is suggested to divide the sound sources into three types as; sounds of technology, sounds of nature, and sounds of human beings (ISO, 2018). ISO/TS 12913-2 2018 explains the second, third and fourth parts with the example of questions in the standard (Figure 5). The results are evaluated with statistical analysis software.

PART 1: TO WHAT EXTEND DO YOU PRESENTLY HEAR THE FOLLOWING THREE TYPES OF SOUNDS?

	Not at all	A little	Moderately	A lot	Dominates completely
Noise (traffic, construction, industry...)					
Sounds from human beings (conversation, laughter, footsteps...)					
Natural sounds (birds, water, wind ...)					

PART 2: TO WHAT EXTEND DO YOU AGREE OR DISAGREE THAT THE PRESENT SURROUNDING SOUND ENVIRONMENT IS...

	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly agree
pleasant					
chaotic					
vibrant					
uneventful					
calm					
annoying					
eventful					
monotonous					

PART 3: OVERALL, HOW WULD YOU DESCRIBE THE PRESENT SURROUNDING SOUND ENVIRONMENT?

Very Good	Good	Neither good, nor bad	Bad	Very bad

PART 4: TO WHAT EXTEND IS THE PRESENT SURROUNDING SOUND ENVIRONMENT APPROPRIATE TO THE PRESENT PLACE?

Very Good	Good	Neither good, nor bad	Bad	Very bad

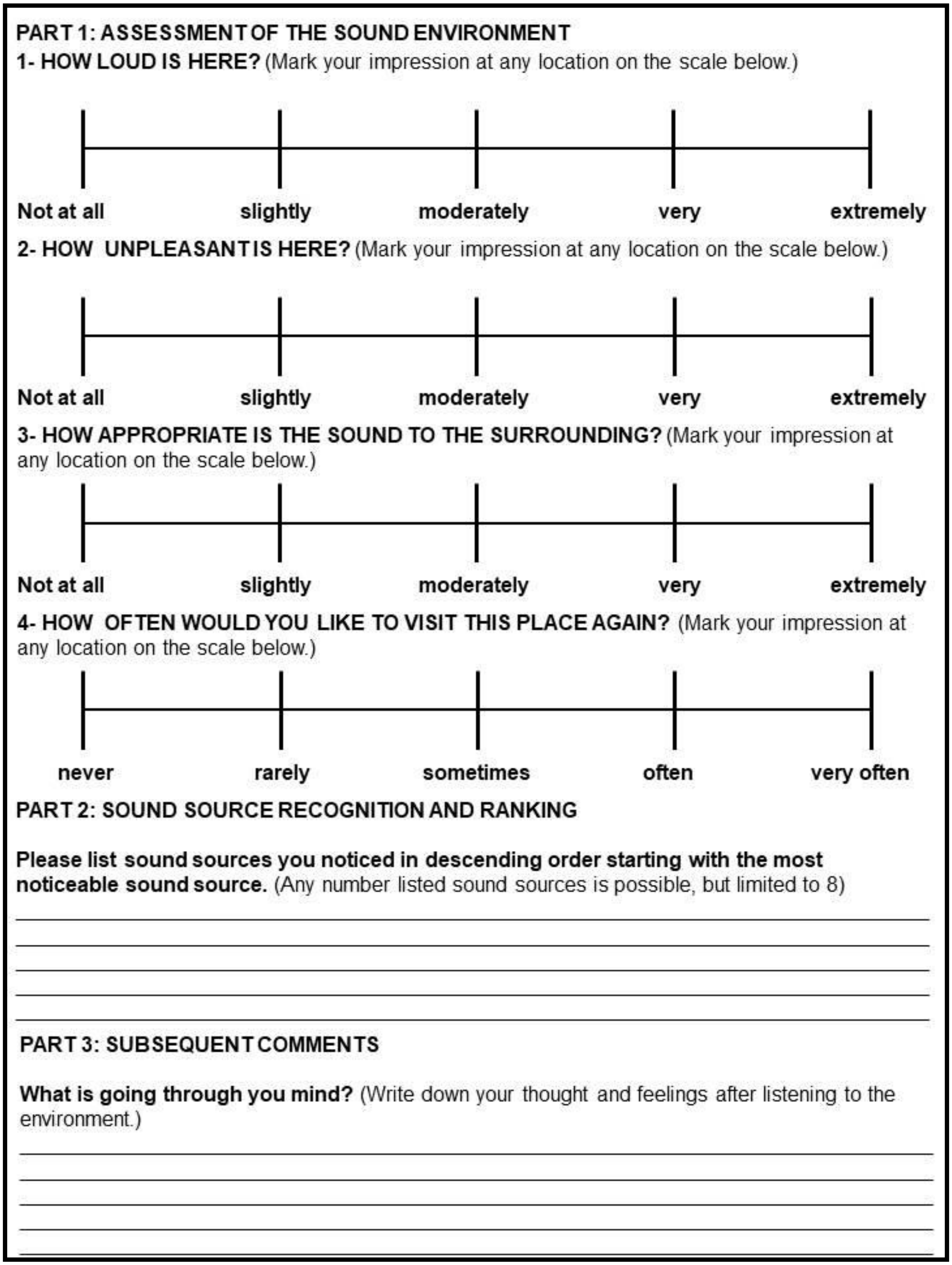
Figure 5. Four main parts suggested for questionnaire method (Adapted from ISO/TS 12913-2 2018)

Soundwalk, Method B, gives information about the existing acoustic environment and proposed environment (ISO, 2018). The term “soundwalk” was first introduced by Schafer (1977) as;

> “The soundwalk is an exploration of the soundscapes of a given area using a score as a guide. The score consists of a map, drawing the listener’s attention to unusual sounds and ambiances to be heard along the way.”

Kang and Zang (2010) clarified that Schafer’s aim was to create awareness on listening attentively. At first, the Soundwalk method consisted of a one-hour walk and then a discussion section, which then left it to the instant debates in the route at pre-determined stops, resulting in more reliable results with instant discussions (Schaffer, 1977; Bruce & Davies, 2014; Davies, 2009; Cankaya 2016). The last standardization of ISO/TS 12913-2 2018 provides very detailed procedure for soundwalk about what the person leading the soundwalk should do, what the person performing the binaural measurements should do, and what participants should do (ISO, 2018). The participants should be given minimum three minutes to listen to the defined environment with all of their senses and should complete the three main parts, which are shown in Figure 6, that ISO/TS 12913-2 2018 provides for soundwalk method (ISO, 2018). These parts of soundwalk method are; assessment of the sound environment, sound source recognition, and subsequent comments.

Indoor acoustic environments are not suitable for this method. Therefore, many urban soundscapes studies used this method (Bruce & Davies, 2014; Kang & Zhang, 2010).



PART 1: ASSESSMENT OF THE SOUND ENVIRONMENT

1- HOW LOUD IS HERE? (Mark your impression at any location on the scale below.)

Not at all | slightly | moderately | very | extremely

2- HOW UNPLEASANT IS HERE? (Mark your impression at any location on the scale below.)

Not at all | slightly | moderately | very | extremely

3- HOW APPROPRIATE IS THE SOUND TO THE SURROUNDING? (Mark your impression at any location on the scale below.)

Not at all | slightly | moderately | very | extremely

4- HOW OFTEN WOULD YOU LIKE TO VISIT THIS PLACE AGAIN? (Mark your impression at any location on the scale below.)

never | rarely | sometimes | often | very often

PART 2: SOUND SOURCE RECOGNITION AND RANKING

Please list sound sources you noticed in descending order starting with the most noticeable sound source. (Any number listed sound sources is possible, but limited to 8)

PART 3: SUBSEQUENT COMMENTS

What is going through you mind? (Write down your thought and feelings after listening to the environment.)

Figure 6. Three main parts suggested for soundwalk method (Adapted from ISO/TS 12913-2 2018)

Interview, Method C, is another mostly used data collection method of the soundscapes studies. Similar to the questionnaire, it aims to explore people's perception towards the acoustic environment. However, it collects the data with open-ended questions and these questions might change according to the way the conversation goes (ISO, 2018). ISO/TS 12913-2 2018 presents an interview guideline related to residential context. The guideline offered a wide range of possible questions to ask and emphasized that it should be adapted to the specific scenario under study (ISO, 2018). Interviews are conducted with participants and results can be evaluated with different methods. This thesis will focus on the Grounded Theory which is one of the most used methods for social sciences and natural sciences (Strauss & Corbin, 1998).

This thesis considers the measurements of Equivalent Continuous A-weighted Sound Level (L_{Aeq}), Reverberation Time (T30), and Speech Transmission Index (STI) in the scope of the physical parameters; questionnaire (Method A) and interview (Method C) in the scope of the perceptual data.

2.2 Museum Environments and Classifications

The term “museum” was used to describe a place of contemplation by Ancient Greece while it was used to describe a place of philosophical discussion by Ancient Roman (Woodhead & Stansfield, 1994, p. 3). Until the seventeenth century the term was not used to explain its current meaning. And by the eighteenth century the term started to mean an institution set up, open to public, to preserve and display collections (Woodhead & Stansfield, 1994, p. 14). The latest and the most known definition of museum was created by the International Council of Museums (ICOM) as:

> “non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment” (ICOM, 2016).”

Museums behave as collection, education, recreation, and exhibition places (Sheng & Chen, 2018). They attract domestic and foreign tourists’ attention excessively and they are the best tools to show the dignity of the country (Henderson, 1998, p. 7). Touring around the halls of a museum is passing through the history of human race because museums are the defender of time by their content (New World Encyclopedia, 2018).

Museums in Turkey have great importance because they are housing Anatolia’s thousands of years of historical and cultural heritage. The first museum in Turkey was founded in 1846 by Tophane-i Âmire Marshall Fethi Ahmet Pasha at Hagia Irene, which was previously used as a military depot in Istanbul (Kültür

Varlıkları ve Müzeler Genel Müdürlüğü, 2014). Since the War of Independence, Atatürk has shown great interest in museums and has provided the establishment of many museums and laid the foundations of Turkish museums. Today there are over 400 museums in Turkey and related development studies are still continuing to raise this number (TUIK, 2017).

Today museum classification varies extremely. They range in size, their purpose, their collections, who run them, and the public they aim to serve (Ambrose & Paine, 2005, p. 7). Because there are too many different types of museums, it is necessary to make a classification. In 1995, ICOM clarified that the definition of the museums cannot be changed according to the administrative unit to which it belongs, its regional feature, functional structure, collection type, or its method of exhibition. But this grouping will play an important role in determining the types of museums. In the previous studies, classifications of museums were determined by considering this declaration of the ICOM.

This thesis focuses on the museum types classified by their collection. In this sense, examples of the museums classified according to their collections are as follows: general museums, archaeology museums, art museums, history museums, ethnography museums, natural history museums, geology museums, science museums, military museums, industrial museums, etc. (Ambrose & Paine, 2005, p. 7; New World Encyclopedia, 2018).

2.2.1 Museum Buildings and Architecture

Earliest museums were not special building type and their purpose was to house precious and luxurious residential objects in the long and narrow galleries (Henderson, 1998, p. 7; Milojkovic & Nicolic 2012). The aim of the galleries was to provide the distant parts of the palaces with a connection. In 1802-1805 the French theorist Jean Nicolas Louis Durand generated the museum model which has many long galleries, four courtyards and a rotunda (Stephens, 1986, p. 16) (Figure 7).

The primary museum scheme was firstly created by Durand's layout. It was continued with other most known plan layout model of Karl Friedrich Schinkel's Altes Museum (Figure 8). Durand's museum building layout made a big contribution to museums' spatial organization. According to that building layout the major rooms were connected to provide the sequence of viewing and there was linear continuity to make visit easy to follow (Milojkovic & Nicolic 2012).

Until the mid-twentieth century Durand's typology for museum design was followed by many architects. Then, as the needs increased, the spatial organizations changed and different resolutions began to be found. Even though the primary museum scheme is preferred in some parts of many museums today, in terms of the linear continuity especially for logical circulation, the dependence on a single model has disappeared and many different types of layouts have begun to be seen (Stephens, 1986, p. 23; Milojkovic & Nicolic 2012).

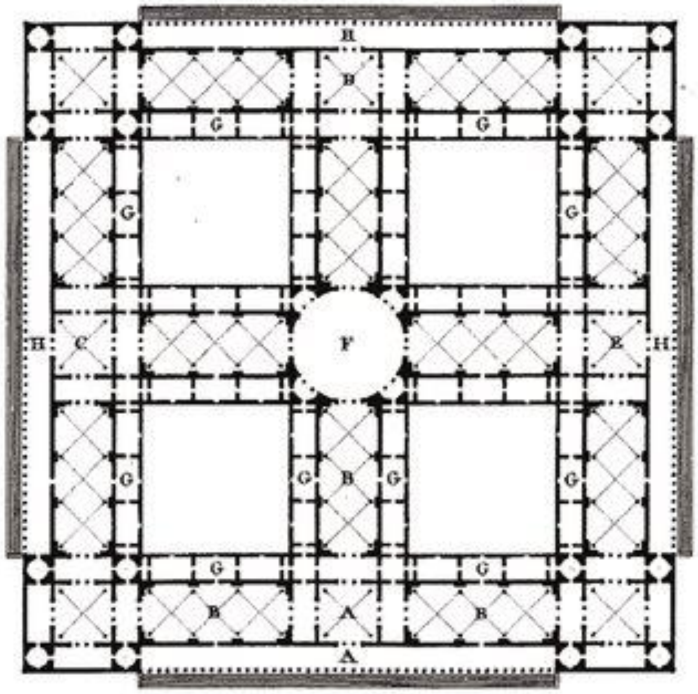


Figure 7. Jean Nicolas Louis Durand’s museum plan layout (Darragh & Snyder, 1993)

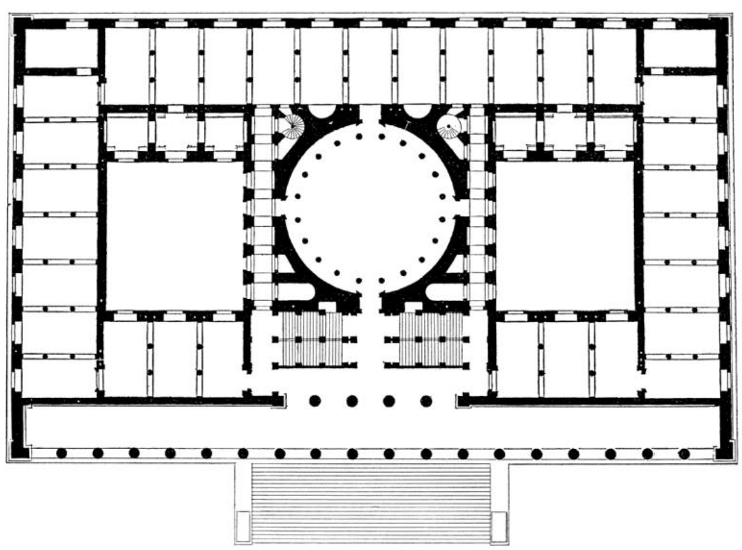


Figure 8. Karl Friedrich Schinkel’s Altes Museum plan layout (Darragh & Snyder, 1993)

Today the museum buildings are examined under two main categories as conversions and purpose-built (Ambrose & Paine, 2005, p. 202; Savaş, 2010). According to the Ambrose and Paine (2005) these categories include;

- An important historic or contemporary building which was used for domestic, public service, industrial, commercial, religious or military purposes.
- Historic, purpose-built museum building.
- Redundant buildings of limited architectural significance.
- Contemporary/new, purpose-built museum buildings.

The museum building should relate to its commission and aim whether it is a converted or purpose-built. Relatively, the space allocation depends on the necessities that museum sets itself (Ambrose & Paine, 2005, p. 202). Museum buildings are now being used as not only for exhibition and preservation purposes but also as social gathering places, education places and marketing places to maximize their appeal to public (Henderson, 1998, p. 11; Rosenblatt, 2001; Cerver, 1997, p. 6; Darragh & Snyder, 1993, p.14).

An American architect Denise Scott Brown said:

> “I think something else is happening in the museums now. In the museums we designed we had to great deal of non-museum space. Today’s museum is part restaurant, part shop, and part education department; it is full of lecture halls, conference rooms, and computer spaces, where visitors can find information away from paintings. Museums want to offer people different ways of knowing art.” (Steele, 1994, p. 9)

This situation generates the public and non-public spaces inside the museums. According to Darragh and Snyder (1993, p. 70), one effective way to define the public spaces is to follow the perspective of a visitor arriving at the museum. Similarly, to define the non-public spaces is to follow the perspective of an arriving work of art. Therefore, Table 2 shows how the spaces in the museums are grouped in the literature (Lord & Lord, 1999, p. 283; Darragh & Snyder, 1993, p. 71; Ambrose & Paine, 2005, p. 203).

Table 2. The categorization of the spaces in the museum environments

Public art-related	**Public non-art-related**	**Non-public art-related**	**Non-public non-art-related**
- Temporary exhibition space - Permanent exhibition space	- Entrance - Admissions - Assembly - Toilets - Study areas - Library - Restaurant - Shop - Auditorium - Orientation	- Storages - Conservation laboratory - Photographic studio - Loading dock, shipping, receiving - Research/study centers	- Offices - Meeting rooms - Lunch rooms - Lockers - Operating spaces - Mechanical equipment rooms

There is no strict rule for creating space allocation in the museums because it changes according to the museum’s need. However, all of the museums have to provide optimal environmental conditions for preserving, protecting, and exhibiting the objects in a most efficient way (Henderson, 1998, p. 9). In this sense, air condition, temperature, humidity, lighting, fire safety, and acoustic conditions are the most considered environmental factors in museum environments (Ambrose & Paine, 2005, p. 164-183; Lord & Lord, 1999, p. 175-217; Darragh & Snyder, 1993, p. 249 - 276).

2.2.2 Museum Acoustics

Museum buildings have a potential to be noisy because of the huge HVAC systems, the variety of activities take place in different functions, and the nature of the museum space (Darragh & Snyder, 1993, p. 249-254). Fry (2002) claims that the noisier the exhibition area is, the louder the visitors are because they raise their voices to be heard.

According to Fry (2002), visitors are the loudest element of museums like any other public spaces. Noise may affect the visitors' comfort by causing disruption of communication between the visitor and exhibition (Rahim *et al.,* 2017). Therefore, standards and national requirements were generated to handle with noise in the museums. According to the regulations in Turkey, the L_{Aeq} level should be maximum 56 dB and the reverberation time should be maximum 1.2 in the museums (Resmi Gazete, 2018).

Besides the importance of the physical parameters, sound is also a very important element for the ambience or atmosphere of the museum such that sound of the fountain or quiet music may help enormously (Ambrose & Paine, 2005, p. 221).

CHAPTER III

METHOD

3.1 Design of the Study

This study examines the visitors’ perception of the soundscapes in the museums. The goal is to provide different case studies on soundscapes approach for literature, and compare the soundscapes of spaces that have the same context. In order to achieve that, Rahmi M. Koç Museum and Erimtan Archaeology and Arts Museum were chosen. Measurements of physical parameters were conducted and perceptual data were acquired. Equivalent Continuous A-Weighted Sound Level (L_{Aeq}), Reverberation Time (T 30), and Speech Transmission Index (STI) were calculated as physical parameters. Perceptual data included questionnaire and semi-structured interview. Interview data were evaluated with Grounded Theory method with the help of ATLAS.ti software and questionnaire data were analyzed with SPSS.

3.1.1 Research Questions

The following research questions were investigated;

How does the visitors' perception of soundscapes change in museum environments?

How does the sound level influence visitors' perception towards the soundscapes?

Does the perceived sound environment affect the visitors' preferences towards the built environment in museums?

3.2 Method

3.2.1 The Site

The case study areas were determined as Rahmi M. Koç Museum and Erimtan Archaeology and Arts Museum. They are both located at an immediate environment of the Ankara Castle (Figure 9). Although the construction date of the Ankara Castle is not known precisely, it is said that its construction dates go back to B.C. 2nd century (T.C. Kültür ve Turizm Bakanlığı, 1987). The castle has become a great defensive center for being built on a steep hillside. The use of the castle both for defense and residential purposes has made it so robust. The area between the southern entrance of Ankara Castle and the plain in front of the Rahmi M. Koç Museum and Erimtan Archaeology and Arts Museum was used as a market place in the 13th and 14th centuries. This market place is called At Pazarı. In the 16th and 17th century because the number of the merchants, craftsmen and tradesmen increased around the Ankara Castle, many inns and Turkish bazaars were built (Terzioğlu, Yertutan, & Boylu, 2009). This situation leads to the creation of the Han district, a place for caravans of merchants to accommodate after travelling along the ancient Silk Road between Chine and Europe. All of these activities caused the generation of various services in the Han district such as: spice dealers, barbers, knife, makers, tanners, cotton dressers, shoe shops, cabinet makers, blacksmiths, etc. (VEKAM, 2008) The Ottoman economy was negatively affected by the Industrial Revolution. The products produced in the Han district lost their competitiveness against the exported goods and commercial activities in the region.

Nowadays, Han district consists of lots of inns, old and traditional houses, museums, galleries, cafes, and local shops. Accordingly, the location of the museums is in the most historical and cultural part of Ankara. And this situation provides people with a unique visual atmosphere and soundscapes.

In order to facilitate to follow, Rahmi M. Koç Museum will be referred as Museum RMK, Erimtan Archaeology and Arts Museum will be referred as Museum EAA at the rest of the study.

Figure 9. Location of the museums (Yellow part represents t of the Erimtan Archaeology and Arts Museum, red part represents the Rahmi M. Koç Museum, and blue part represents the Ankara Castle's southern entrance) (Google Maps, Ankara Kalesi, 2019)

Figure 10. View of museums from the southern entrance of Ankara Castle. Arrow on right shows the Rahmi M. Koç Museum whilst on left shows the Erimtan Archaeology and Arts Museum (Photo taken by the author, 2019)

- **Rahmi M. Koç Museum**

Museum RMK is located opposite to the southern entrance of the Ankara Castle (Figure 10). It has two main sections as Çengelhan and Safranhan. Only the Çengelhan part is examined for this study. Çengelhan was built in 1522-1523 and it was used as caravanserai and storage in the past. The restoration started in 2003 and it was completed in 2005. Therefore, Çengelhan started to serve as Museum RMK. Safranhan was built in 1511 and used respectively as caravanserai, jail, and storage. It was restored between 2012 and 2016, and opened as an extension of the museum. Museum RMK is Ankara's first and Turkey's second industrial museum (Ankara Kalkınma Ajansı, 2016). Therefore, as it was mentioned in the literature review part, this museum belongs to the category of an important historic or contemporary building which was used for domestic, public service; industrial, commercial, religious or military purposes. Çengelhan has a basement, ground floor and the first floor with an inner courtyard and rooms around it. All the rooms are used for different exhibitions. The inner courtyard is surrounded with vaulted cloisters and was covered with glass roof during the restoration in order to protect the exhibited items from different weather conditions, uncontrolled lighting, noise and other external factors (Figure 11). The height of the ground floor is 3.5 m, the first floor is 3.2 m and the courtyard is 10.5 m. There are 20 rooms for permanent exhibitions, two rooms for offices, and one room for gift shop on the ground floor. There are 26 rooms for permanent exhibitions on the first floor. And the courtyard is being used as an exhibition area also. The original stone flooring of the courtyard is covered with wall to wall carpet for acoustical purposes. The mostly used materials on the floors are stone. The ceiling is made out of bricks and the walls are made out of both bricks and local stones. However, in some parts wooden window frames and doors are existed. Its scale, façade, and interior reflect the historic environment around the museum contextually (Figure 11).

It provides people with a chance to go back in time with its unique contents of exhibitions. Historical objects related to the road transportation, rail transportation, maritime, aviation, craftsmanship, scientific instruments, communication instruments, toys, agriculture, and everyday objects are exhibited in the museum (Figure 12).

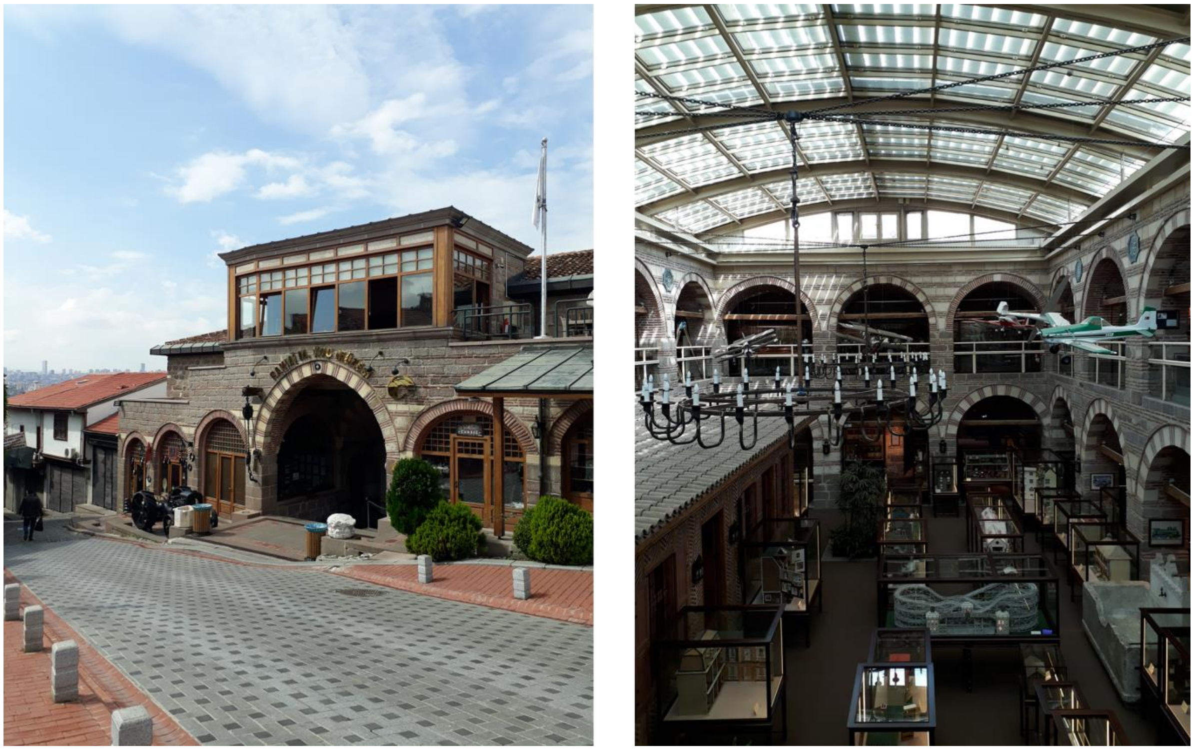


Figure 11. Views from outside and inner courtyard of Rahmi M. Koç Museum

(Photos taken by the author, 2019)

Figure 12. Views of exhibited objects and exhibition areas in Rahmi M. Koç

Museum (Photos taken by the author, 2019)

- **Erimtan Archaeology and Arts Museum**

Museum EAA is located opposite to the southern entrance of Ankara Castle. The museum was opened in 2015. It is comprised of the facades of three old houses around the castle. While the scale and the façade of the building are connected contextually to the historic environment, the interior provides visitors with a contemporary environment and experience (Figure 13). Therefore, as it was mentioned in the literature review part, this museum belongs to the category of contemporary/new, purpose-built museum buildings. It is a three-story building and exhibits more than 2000 objects from Yüksel Erimtan's collection of Anatolian archaeological artifacts like glass artifacts, gems, and coins, etc (History, n.d.) (Figure 14). The main entrance of the museum directs people to the mezzanine floor which has the permanent exhibition of archaeological objects, gift shop, and vestibule. The first floor contains the display of archaeological artefacts and there is also a small cafeteria and library. The ground floor is segregated for the art exhibition and managers' offices. There is always a temporary exhibition throughout the year on the ground floor. The study only takes place in the permanent exhibition areas, which covers the first floor and mezzanine floor, to make the study more reliable. The height of the studied area is 10.6 meters. The main floor covering material is wooden parquet. The local travertine is used on the walls. The material of the ceiling is concrete and there are glass and metal surfaces in interior space.

Figure 13. Views from outside and interior of Erimtan Archaeology and Arts Museum (Photos taken by author, 2019)

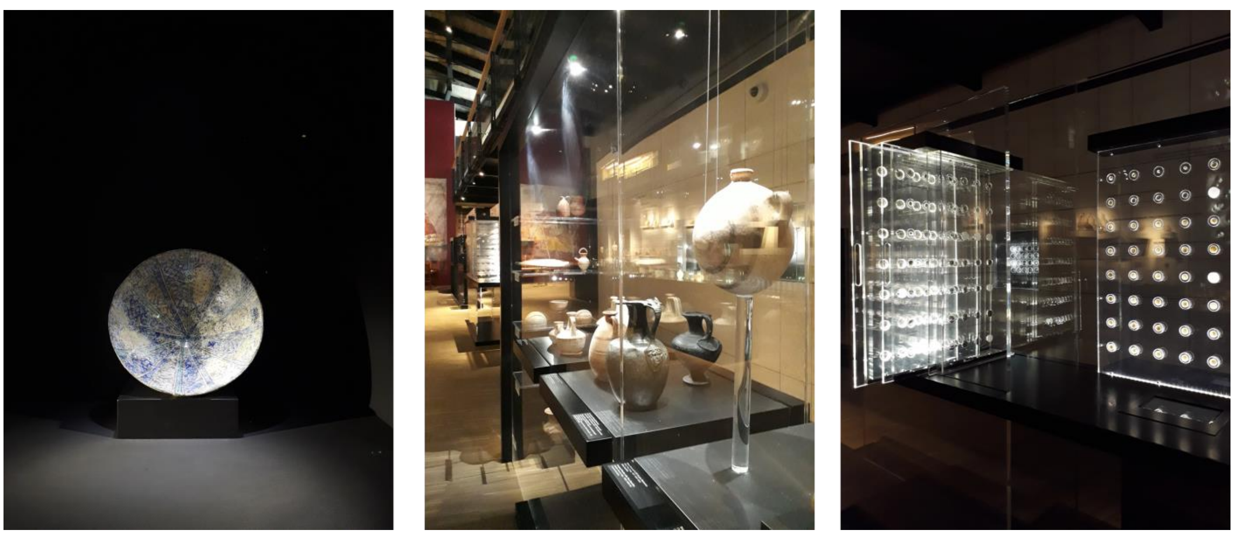


Figure 14. Views of exhibited objects and exhibition areas in Erimtan Archaeology and Arts Museum (Photos taken by author, 2019)

3.2.2 Participants

In each museum, participants were selected among the visitors who have visited all parts of the museum.

- **Rahmi M. Koç Museum**

In total, 30 visitors, 19 to 66 years old, participated in the questionnaire survey voluntarily. Ten men and 20 women (M age = 30; SD age = 13,5 years) were asked about their familiarity with the museum. Only five of them came to the museum before. Therefore, the rest of them were not familiar with the environment.

Seven visitors, 22 to 64 years old, attended the interview voluntarily as well. Two women and 5 men (M age = 46,8; SD age = 16,3 years) were asked 15 main questions and interview was recorded. Only one of them has been there before and the others were not familiar with the museum.

- **Erimtan Archaeology and Arts Museum**

In total, 30 visitors, 18 to 60 years old, voluntarily participated in the questionnaire survey. Fourteen men and 16 women (M age = 28,3; SD age = 10,9 years) were asked their familiarity. Five of them were familiar the museum and 25 of them were there for the first time.

Interviews were conducted with 6 volunteer participants from 24 to 47 years old. One man and 5 women (M age = 35; SD age = 9,4 years) were asked 15 main questions and their voices were recorded. Only one of them was familiar with the museum but the others were not.

3.2.3 Acoustic Environment

- **Rahmi M. Koç Museum**

Museum RMK can be a quite crowded museum because of its broad exhibitions, which appeal to people from all ages, especially to children, and people who have different interests. Accordingly, sound sources in Museum RMK were mostly sounds generated by human activity or facility. These sounds were occurred by human movement, voice and instruments, and other human activities. The sound environment included sounds like; footsteps, speech, laughter, children noise, low level of background music and some mechanical-electronical object related sounds. Additionally, in the vicinity of the entrance door, sounds from outside were heard as the door was open. The sound of the X-ray device was heard when visitors pass by. And the voices from the security guards' radiotelephones were also heard occasionally. The sounds heard in the basement are usually footsteps and conversations. On the ground floor, which includes the courtyard, all the sounds mentioned can be heard. Sound recordings in some exhibition rooms play automatically and continuously. In some exhibition rooms, visitors have to press the buttons to hear the sounds of objects. Thus, visitors are given the chance to control the sounds. Since the courtyard is covered with carpet, footsteps are not heard as much as they are heard in the corridors and exhibition rooms. Although the first floor has a direct connection to the courtyard, there is no sound heard as much as it is on the ground floor. The sounds associated with objects are found in some of the exhibition rooms.

- **Erimtan Archaeology and Arts Museum**

Museum EAA was not expected to be as crowded as the Museum RMK because it mostly attracts people who are interested in history and archeology with its theme, content and exhibited objects. Although there were not many people, sound sources in Museum EAA were sounds generated by human activity or facility, too. The sound environment included human-based sounds like; footsteps, speech, laughter, children noise, and some mechanical-electronical object related sounds. Likewise, since the door of the museum is directly open to the square, sounds from outside are heard. The X-Ray device at the museum entrance made a sound any time a new visitor arrives. And the voices from the security guards' radiotelephones were also heard occasionally in the Museum EAA, too. In addition, there was a low background music. The mezzanine floor is more related to the outside sounds. Since there is no block between the mezzanine floor and the first floor, it is possible to hear the sound that occurs in mezzanine floor from the first floor; likewise it is possible for the exact opposite. The cafeteria on the first floor connects directly to the garden. Although the door of the cafeteria is always closed, people can hear voices from outside while someone goes to the cafeteria. There is only one sound source related with objects on the first floor and it is automatically activated when people pass under. This sound source is suspended from the ceiling and provides Turkish and English information about the objects. The audio recording starts in Turkish and continues in English and takes about 35 seconds. The sound of the elevator is heard when the call button is pressed and when it reaches the floor. Since the floor is covered with wooden parquet in all parts of the museum, it is also possible to hear footsteps of people walking up and down the stairs and walking in the museum.

According to the ISO, sound sources can be divided into three parts as; sounds of technology, sounds of nature, and sounds of human beings (2018). For instance, sounds of technology caused by transportation, cars, buses, planes, industrial objects, signals, construction, and machines. Examples of sounds of nature include singing birds, water, and wind. Examples of sounds of human beings are generally voices, footsteps, children at play and other human based sounds. Table 3 shows the sound sources in both museums.

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 noise	footsteps, speech, laughter, children noise

3.2.4 Measurement of Physical Parameters

The study concerns real acoustic environments of Museum RMK and Museum EAA for the measurement of Equivalent Continuous A-Weighted Sound Level (L_{Aeq}) and concerns visual acoustic environment for the measurements of Reverberation Time (T30) and Speech Transmission Index (STI) values. These parameters were defined as “physical parameters” by ISO/TS 12913-2 (2018).

In-situ acoustic measurements were conducted on Saturday October 27, 2018 before noon from 10:00 a.m. to 12:00 a.m. in Museum EAA and afternoon from 1:00 p.m. to 3:00 p.m. in Museum RMK. The weather was 16 C^{o}, dry, and sunny. There was no extreme noise caused by the weather conditions. Equivalent Continuous A-Weighted Sound Level (L_{Aeq}) was measured with Bruel & Kjaer 2230 sound level meter. Position of the sound level meter was kept more than 1 m from the reflecting surfaces with the height of 150 cm (ISO, 2018). The sound level meter was not placed in each room but rather it was placed in central points of the courtyard where every part of the museums connects in Museum RMK (Figure 15) and central points in Museum EAA (Figure 16). According to the ISO/TS 12913-2:2018, selection of measurement time interval depends on the type of the investigated soundscapes and should be minimum 3 minutes (ISO, 2018). To cover the significant and typical sound sources, time interval was determined as 20 minutes in the two museums.

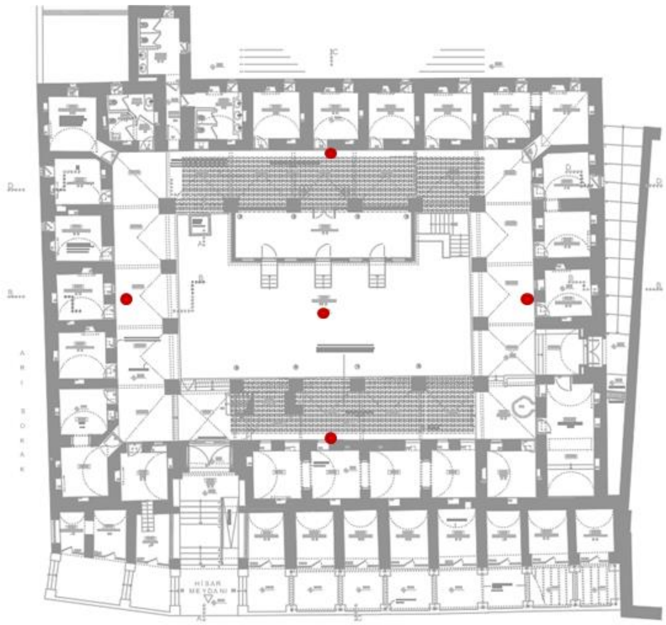


Figure 15. Locations of sound level meter during the in-situ measurement in Museum RMK (G, Mert, personal communication, February 2, 2018)

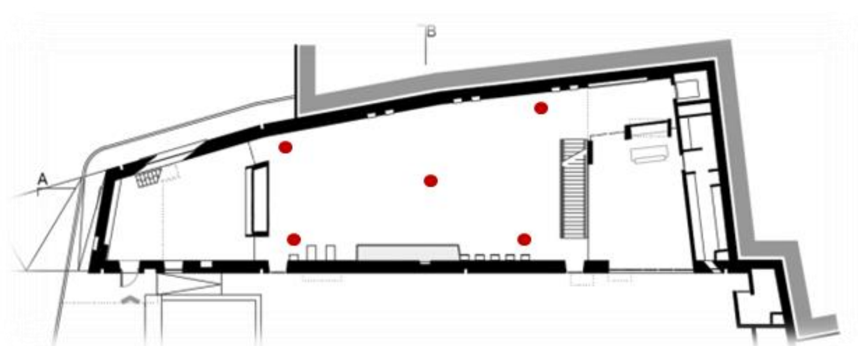


Figure 16. Locations of sound level meter during the in-situ measurement in Museum EAA (O, Yüncü, personal communication, September 5, 2018)

Measurements were conducted during the occupied hours of museums. Total sounds, background sound, and foreground sound were continued during the measurements. The Museum RMK was very crowded that organized tours continuously came to the museum. The essential density was in the toys section. From children to the elderly, everyone concentrated mostly on this section. Therefore, the courtyard of the museum was crowded throughout the measurement. The Museum EAA was not too crowded. Visitors kept to themselves during their visit. Some of the children that came with their families were making noise.

Visual acoustic environment was prepared at SketchUp 18 and imported to Odeon Room Acoustics Software 13.01 Combined, which provided the Reverberation Time (T30) and Speech Transmission Index (STI). 40 receiver and 6 sound sources were placed in key locations of Museum RMK (Figure 17). Twenty-five receivers and 7 sound sources were placed in key locations of Museum EAA (Figure 18). Materials of the museums were selected from the proposed material list of Odeon 13. Sound absorption coefficient of the materials which were not on the list was searched in the literature and the new materials were created for measurement. For instance, the sound absorption coefficient of travertine was found in the article called “Mimar Kemaleddin Salonu Akustik Performans Değerlendirmesi ve Performans İyileştirme Önerileri” by Kurtay, Eryıldız, and Harputlugil (2008).

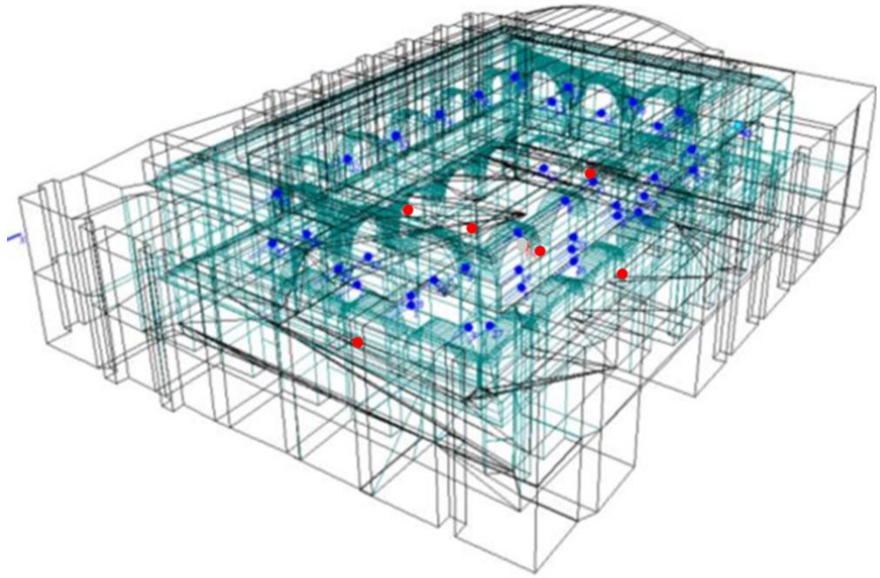


Figure 17. Locations of the sound sources and receivers in Museum RMK (Red points represent the sound sources and blue points represent the receivers in Odeon Software)

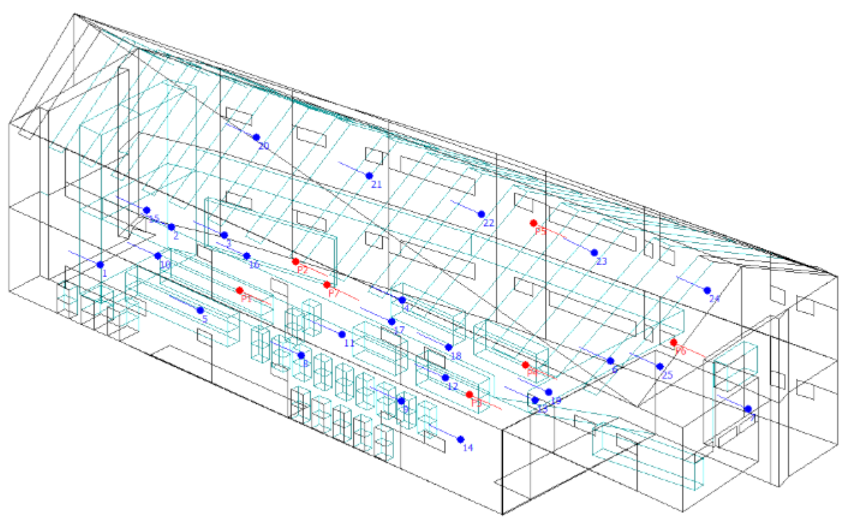


Figure 18. Locations of the sound sources and receivers in Museum EAA (Red points represent the sound sources and blue points represent the receivers in Odeon Software)

3.2.5 Perceptual Data Collection and Grounded Theory Method

ISO/TS 12913-2 defined three examples of perceptual data collection methods as questionnaire (Method A), soundwalk data collection (Method B), and interview (Method C) (2018). This study used Method A and Method C for collecting data in the both of museums. The questionnaire and interview were conducted during the in-situ measurement of Equivalent Continuous A-Weighted Sound Level (L_{Aeq}). Interviews were evaluated with the Grounded Theory Method.

3.2.5.1 Interview Method

Grounded Theory is used as the main means of evaluation of the perceptual data. The interview was prepared following the guideline that ISO/TS 12913-2 provided. That guideline was prepared for residential context based on COST TD0804 STSM. However, 15 interview questions were formulated and rearranged according to the museum environment without disregarding the essentials of ISO/TS 12913-2. The first part of the interview is about built environment, whilst the second part is about auditory environment (See Appendix A).

The aim of the questions was to explore visitors' expectation and perception towards the museums' built and auditory environment. According to the conversation, spontaneous questions were raised. The fifteen main interview questions are as follow:

The first part;

Have you been to this museum before?

Did you have any idea about the theme of the museum?

What do you think is the theme of this museum?

What kind of a museum environment do you imagine when you think about this theme?

Do you think the theme matches to the environment?

What did you think / feel when you first entered the museum?

Should the objects exhibited in this museum be exhibited in a more historic / modern space?

What are your physical expectations from a museum?

Does this museum match your expectations?

The second part;

Which sounds and what kind of sound environment is coming to your mind when it comes to the museum?

What do you expect to hear in the historical / modern museum?

Which sounds did you hear in this museum and how did it make you feel?

What do you think about the sound environment of this museum?

What sounds did you like or bothers you?

Were the sounds you heard in this museum match the museum?

Interviews were conducted with 13 visitors, seven from Museum RMK and six from Museum EAA. People participated in the study voluntarily. Before starting, they were asked whether it would be a problem for them to record audio and whether they visited every part of the museum for more reliable results. The process stopped until the data reached theoretical saturation, which means participants started to give same or similar answers to the questions (Strauss & Corbin, 1998; Dey, 1999). Interviews took between 5 – 17 minutes and completed in one day. Each of them was recorded and transcribed verbally. For recording the audio, smart phone was used. Grounded Theory approach was used to analyze the data. The collected data from each museum were entered to Microsoft Word file and converted into a PDF file. PDF files were imported to ATLAS.ti Software which makes the coding process of the Grounded Theory method more convenient.

The process of Grounded Theory began with the data collection through interviews. Coding process had three parts. The interview data were broken down into key phrases and the related ones were chosen in the open coding. To find the reoccurring statements, interview transcriptions were explored and the key phrases were accredited to them. These key phrases were conceptualized during the axial coding. In the scope of the selective coding, they were grouped to generate core categories and main category, and their relations were explored.

3.2.5.2 Questionnaire Method

The questionnaire started with brief description of the study. Participants were informed that the identity information is not required, the data will be kept confidential and will be used only for scientific purposes and participation is optional before conducting the questionnaire survey. Finally, contact information was given in the description part.

There were open-ended questions part for demographic information including age and gender; and a question that asks visitors if they came to this museum before to evaluate their familiarity to the environment.

The questionnaire had seven main headings which were expectation, preference, auditory environment, physical environment, context, interpretation of sound environment, and response with the total of 33 questions. The questionnaire presented five-point ordinal-category scale which are strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), and strongly agree (5). Visitors were asked to sign boxes based on the agreement level towards the statement written under the headings.

The questionnaire was prepared in Turkish for Turkish visitors (See Appendix B). 30 visitors from the Museum RMK and 30 visitors from the Museum EAA attended to the questionnaire. Participants were selected randomly after they toured the museums. The study was explained in detail and they were asked if they want to join. In order to make the results more reliable, the visitors were asked whether they visited every part of the museum. If they did not visit all parts of the study area, they were not accepted to participate in the questionnaire. The questionnaire was distributed to the people who accepted and they were awaited in a separate place until they completed the questions. Finally, the data were entered into the SPSS program for analysis.

CHAPTER IV

RESULTS

4.1 Physical Parameters

The International Organization for Standardization (ISO) provided with the ISO/TS 12913-2 2018 the physical parameters as sound levels. In the scope of this thesis, to measure the sound levels and acoustic environment Equivalent Continuous A-Weighted Sound Level (L_{Aeq}), Reverberation Time (T30), and Speech Transmission Index (STI) were considered.

4.1.1 Equivalent Continuous A-Weighted Sound Level (L_{Aeq})

Measurements of the Equivalent Continuous A-Weighted Sound Level (L_{Aeq}) were taken in-situ in both museums and were recorded as 95.6 dB in Museum RMK and 94.9 dB in Museum EAA (Table 4). Difference between the measurements was expected because there were more visitors in the Museum RMK compared with Museum EAA.

Table 4. Results of L_{Aeq} measurements in Museum RMK and Museum EAA

MUSEUM	Minimum L_{Aeq}	Mean L_{Aeq}	Maximum L_{Aeq}
Museum RMK	91.7 dB	**95.6 dB**	97.5 dB
Museum EAA	93.1 dB	**94.4 dB**	96.5 dB

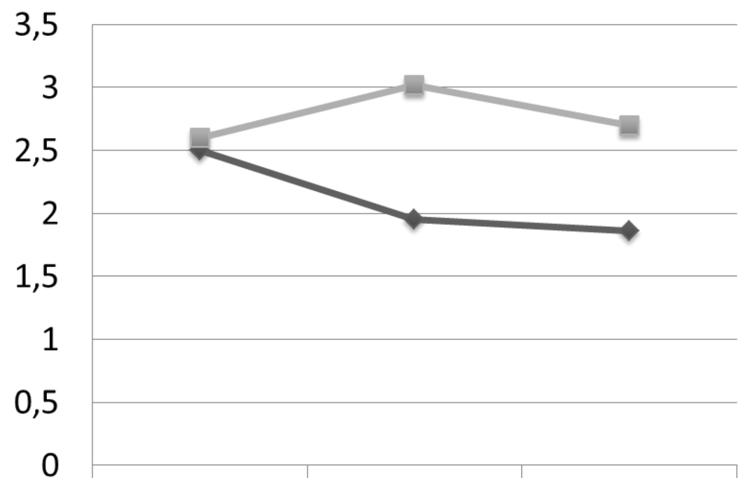
According to the regulations in Turkey, the L_{Aeq} level should be maximum 56 dB in the museums (Resmi Gazete, 2018). The acoustic conditions of both museums are not in accordance with the regulations.

4.1.2 Reverberation Time (T30) and Speech Transmission Index (STI)

Reverberation Time (T30) was measured when the museums are furnished and unoccupied condition with the ODEON Room Acoustics Software 13.01 Combined. The literature and the perceptual data of the study showed that visitors' speech is the most common sound in the museums (Fry, 2002). Accordingly, as the common frequencies of speech; 500 Hz, 1000 Hz, and 2000 Hz are considered only. For the simulation, the background noise is considered to be 50 dB (NC 55).

The ideal reverberation time for the different types of museums should be between 0.8 and 1.4 in frequencies (Carvalho et al.; 2013). According to the regulations in Turkey it should be maximum 1.2 in frequencies (Resmi Gazete, 2018).The reverberation time for the common frequencies of speech were calculated as 2.25 for 500 Hz, 1.95 for 1000 Hz and 1.86 for 2000 Hz in the Museum RMK; and 2.6 for 500 Hz, 3.02 for 1000 Hz and 2.7 for 2000 Hz in the

Museum EAA (Figure 19). It shows that both spaces did not have appropriate conditions for the reverberation time. Even though the Museum RMK's floor is covered with carpet and partially has lower results of reverberation time than the Museum EAA has, it was not enough for the optimal reverberation time.



	500 Hz	1000 Hz	2000 Hz
Museum RMK	2,5	1,95	1,86
Museum EAA	2,6	3,02	2,7

Figure 19. Reverberation Times (T30) in Museum RMK and Museum EAA

As it is seen in Table 5, Odeon 13 showed that the speech transmission index (STI) ratings ranged from 0.43 to 0.77 with average rating of 0.53 in the Museum RMK and 0.41 to 0.52 with the average rating of 0.48 in the Museum EAA. Therefore, Museum RMK and Museum EAA have *fair* intelligibility of speech (Houtgast et al., 2002).

Table 5. Speech Transmission Index (STI) ratings of the museums

MUSEUM	Minimum STI	Mean STI	Maximum STI
Museum RMK	0.43	**0.53**	0.70
Museum EAA	0.41	**0.48**	0.52

According to the Carvalho et al. (2013) the speech transmission index should be between 0.45 and 0.65 in the museums. These results show that both museums have appropriate STI ratings.

4.2 Perceptual Data and Grounded Theory Method

The International Organization for Standardization (ISO) provided with the ISO/TS 12913-2 2018 the perceptual data as questionnaire, soundwalk, and interview. In the scope of this thesis, analysis of questionnaire and interview were considered. The interview data were analyzed with Grounded Theory method and the questionnaire was analyzed with IBM SPSS Statistics 21 software.

4.2.1 Interview Results

Interview data were analyzed with Grounded Theory method and ATLAS.ti software was used to ease the coding process. As it was mentioned, Grounded Theory has three stages; open coding, axial coding, and selective coding. Firstly, the interviews are examined sentence by sentence during the open coding. The data were broken down analytically and all the important points are labelled with key phrases. For instance, comments about the speech and children noise are labelled as ‘Sound Source People’. Then, key phrases were compared to explore their differences and similarities.

During the axial coding, key phrases were conceptualized and core categories and subcategories were generated. The labels of ‘Sound Source People’ were grouped with other sound-related labels as ‘Sound Source Music’, ‘Sound Source Equipment’, and ‘Sound Source Outside’ under the subcategory of ‘Sound Sources’. Other sound-related subcategories as ‘Sound Level’ and physical acoustic measurements created the core category of ‘Auditory Environment’.

In the last phase of the coding process, the selective coding, the main category was identified and the relations between core categories and main category were explored. The patterns that occurred with these relations helped to create the conceptual framework.

Figure 20 shows the coding process of one statement of visitor from Museum EAA. For instance, ‘*There was background music, and sometimes I guess there was sound gave information about the objects and it created a very good environment*’ statement was broken down into pieces by key phrasing the significant points. ‘*There was background music, and sometimes I guess there was sound gave information about the objects’* part labelled as ‘perception of sound environment’. Statements of ‘*background music’* and *‘sound give information about the objects’* were labelled as ‘awareness of sound sources’.

The statement of '*it created a very good environment'* was labelled as 'positive interpretation of soundscapes'. The statement of '*sound give information about the objects and it created a very good environment'* was labelled as 'informative sound source is beneficial'. Lastly, the statement of '*sound gave information about the objects*' was labelled as 'sound source and exhibition are relevant'. Afterwards, these key phrases were conceptualized. As a result of the gradually narrowing conceptualization, subcategories and core categories were created. This process was carried on one by one for each statement in the interviews and finally a conceptual framework was formed (Figure 21).

The study aimed to create different conceptual frameworks for each of the museums. However, after the data analyses, similar patterns and categories were generated for the museums. Therefore, one conceptual framework was created for the study. Core categories are auditory environment, built environment, expectation, perception, context, responses and outcomes. Context is determined as the main category because it has connections with other categories. All of the categories were generated based on the answers of participants from each museum.

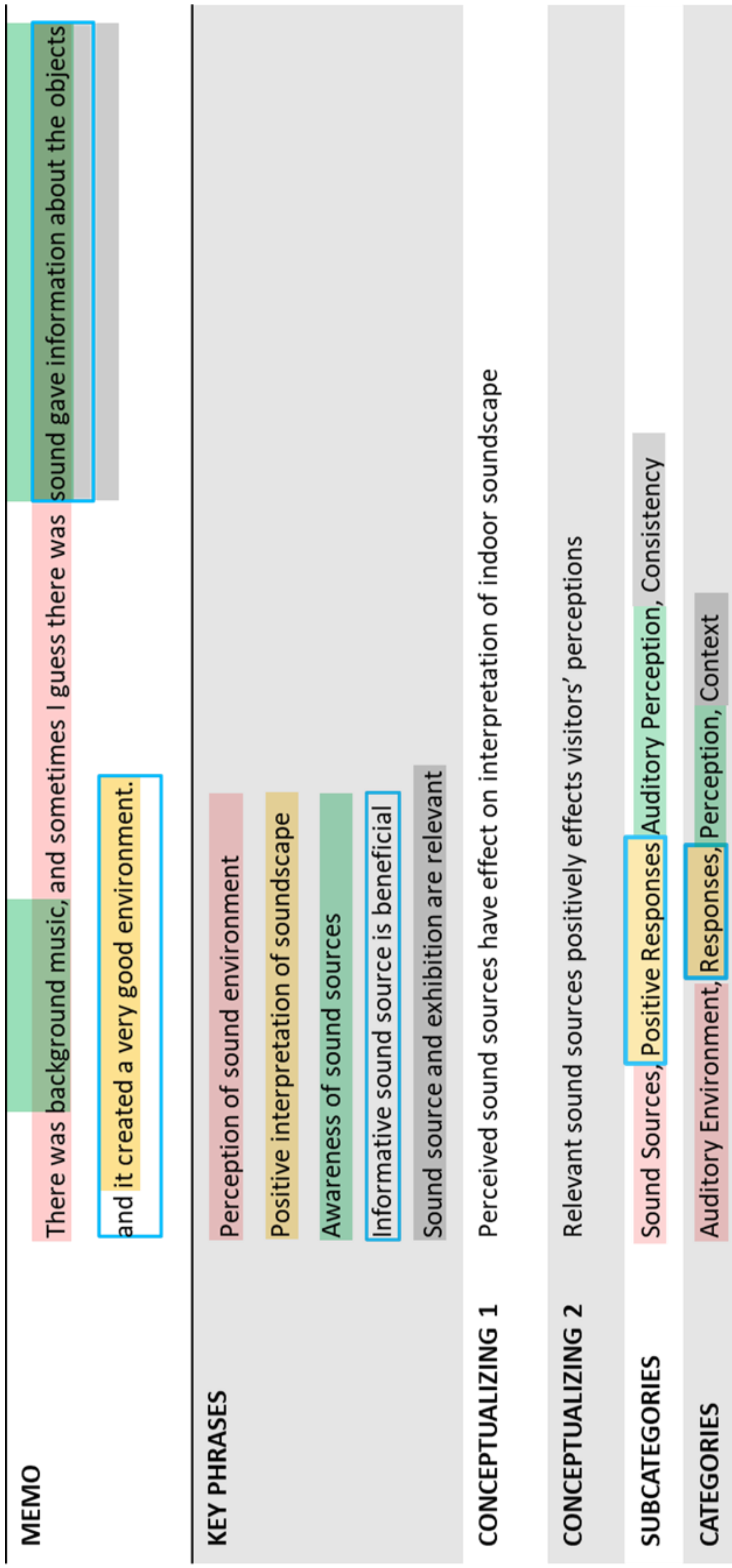


Figure 20. Coding Process

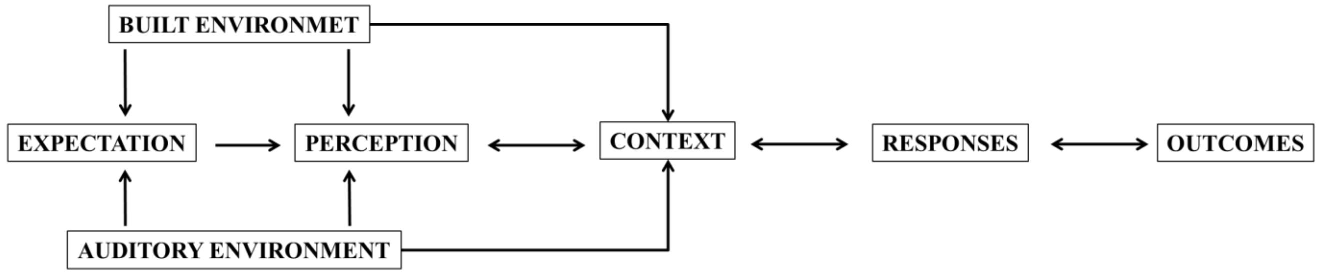


Figure 21. The basic of conceptual framework for high-school environment

The conceptual framework consists of 7 categories and 16 sub-categories (Figure 22). The category of the auditory environment includes L_{Aeq}, T30, and STI values, identification of the sound sources, and sound levels. The category of the built environment includes physical specialties and intuitive specialties. Visitors' expectation and perception towards the built and auditory environment were explored. Visitors decided whether the context is consistent or inconsistent depending on the auditory and built environments. Then, they have positive, neutral or negative responses towards the soundscapes. Finally they come up with the outcomes. Hence, the categories of the conceptual framework were created. Next part gives more detailed explanation of the categories. Some of the examples were also used by Yilmazer and Orhan (2019).

- **Built Environment**

In order to describe the built environment, visitors were asked about what they expect from museum environment in general, what they perceived and if it matched what they expected, what the theme of the museum is, and if the building is matching with the theme. According to their answers, two subcategories as “Physical Specialties” and “Intuitive Specialties” were generated.

These specialties play an important role on visitors’ perception of soundscapes in the museum environment because these specialties identify the context. For this study, physical specialties include lighting, ventilation, space allocation, space definition (historic or modern), layout, and materials; intuitive specialties include terms like spacious, habitant, joyous, cozy, orderly, complicated, and ordinary.

- **Expectation and Perception of Built Environment**

Expectations towards the built environment for the museums were expressed as spacious, broad, and comfortable place to pace around. In the Museum RMK, the environment was mostly defined as complicated, crowded and historical. Even though visitors’ expected museum environment did not match with the perceived environment at the first time, because they could match the museum’s theme with the environment, they were satisfied with the situation.

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*.

In the Museum EAA the environment was defined as spacious and modern. Therefore, the expected environment and the perceived environment were in harmony. However, some visitors could not match the theme of the environment with its environment and indicated their dissatisfaction.

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.*

- **Auditory Environment**

In order to define the auditory environment, visitors were asked what kind of sound comes to their mind in museum environment, what they expect to hear in such a historic/modern building, what they hear, and if the sounds they hear are in accordance with the museum environment.

The L_{Aeq}, T30, and STI values are given at the beginning of the results part, however, it is better to place them in the conceptual framework to compare the perceptual data with physical parameters.

Sound sources are classified under this category as “Sound Source Music”, “Sound Source People”, “Sound Source Equipment”, and “Sound Source Outside”.

Sound levels play an important role to see visitors’ perception of soundscapes because it directly effects their evaluation of general museum atmosphere as annoying or calming etc.

- **Expectation and Perception of Auditory Environment**

Visitors were asked what they expect to hear in museum buildings. All of them clarified that they expect quiet and calm environment.

Most of the visitors from each of the museum expect low sound levels during their visit. They expect to hear soft background music, thematic music, and object-related sounds which gives information or attracts attention to the exhibited objects.

RMK: *For example, there's 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 a 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 with Anatolia culture.*

Some of them do not expect a totally quiet environment because it might be irritating in some cases while some of them want to be in a quiet environment to be able to focus better. So, quite environments create both positive and negative consequences as;

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 what I am viewing at that moment. So I think it's better to be quiet.*

Visitors made positive and negative comments on the sound sources. The positivity and negativity are directly related with the environment and the context of the sound sources.

The most wanted sound sources were identified as background music and object-related sounds. On the other hand, the most unwanted sound sources were defined as human-based sound sources like loudly speaking, children noise, and outdoor sound sources.

- **Context**

In the literature, context is defined as “the interrelationships between person and activity and place, in space and time” (ISO, 2003; ISO, 2014; Kang & Fortkamp, 2017; ISO, 2018). As it was demonstrated in previous studies, this study also proved that the context forms visitors’ responses towards the soundscapes and has huge effect on the subcategories of responses as positive, neutral, and negative (Yilmazer & Bora, 2017; Acun et. al., 2018; Yilmazer & Acun, 2018; Yilmazer & Orhan, 2019). Accordingly, context is not only related with the auditory environment but also with the built environment (Yilmazer & Bora, 2017; Cankaya & Yilmazer, 2016; Yilmazer & Acun, 2018; Acun & Yilmazer, 2018; Acun et al., 2018; Yilmazer & Orhan, 2019). When people match the context of the sound with the physical environment, they give positive responses towards the soundscapes. And if not, they give negative responses towards the soundscapes.

RMK: *There is 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, except for the sense of taste. When you are there the sound is making you feel like in a real street.*

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

The study also showed that even the most disturbing sounds can be acceptable if the sound is consistent with the context. For example, participants were asked if the sounds they hear are in accordance with the museum soundscapes. Visitor from museum RMK answered;

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

Same question is answered by a visitor in museum EAA like;

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

Both of the museums have different parts and different themes. The context of the museums covers both the physical and auditory elements in the spaces. Therefore, if the context is consistent with the environment visitors have positive responses towards the soundscapes.

- **Responses and Outcomes**

Visitors' responses were grouped as positive, neutral, and negative. Positive responses were related with informative, didactic, thematic sound sources which provided them with comfort, concentration, satisfaction, and attract their attention during their visit. Negative responses were related with noise and 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. Sound of exhibited objects was really great and informative.*

EAA: *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.*

Outcomes were classified as long-term outcomes and emotional outcomes in this study. According to the visitors' answers, the long-term outcome is defined as interruption of activity. On the other hand, emotional outcomes were 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 here. I left because I was no longer interested in what I read in this noise. I could not understand what I read.*

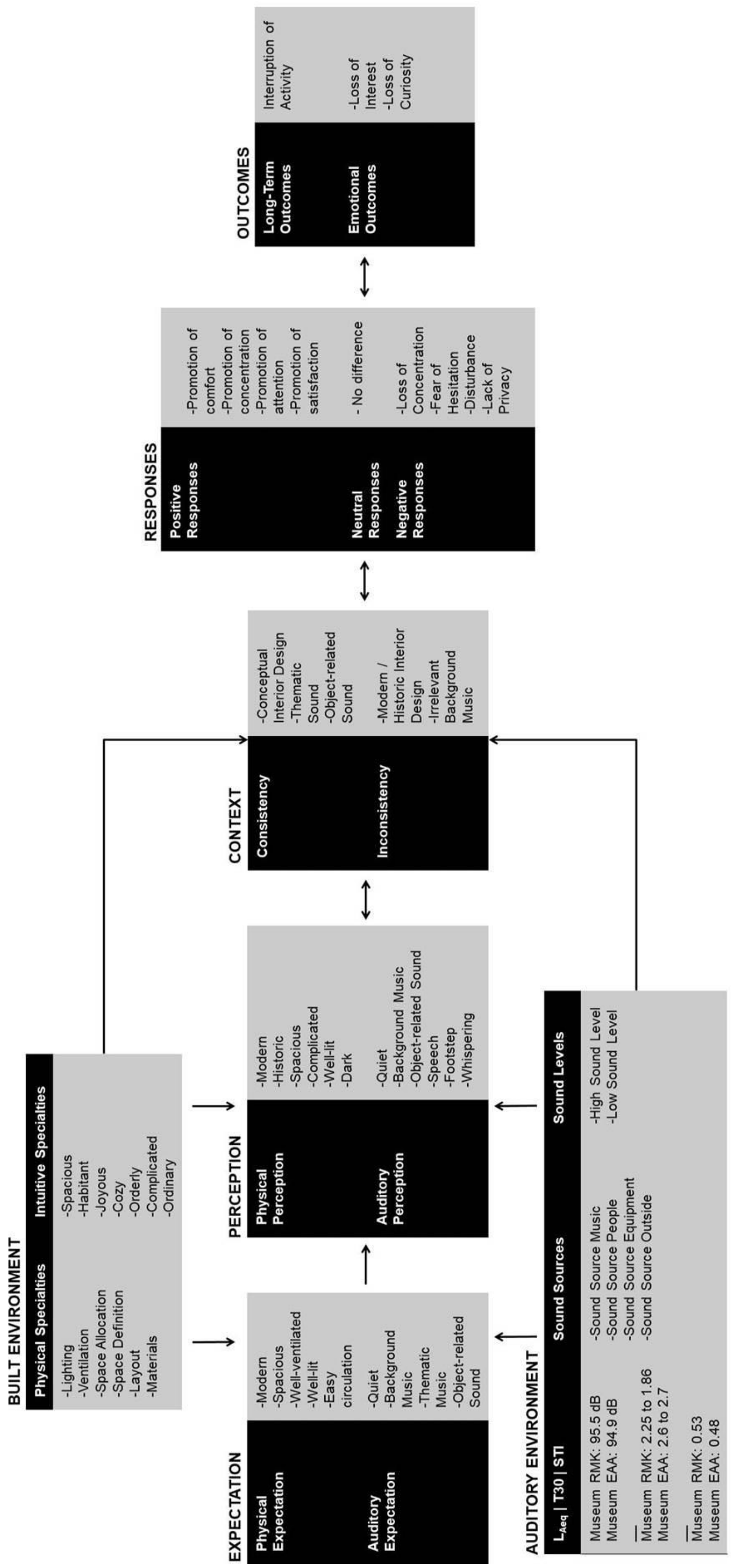


Figure 22. The detailed conceptual framework for the museum environment

4.2.2 Questionnaire Results

The questionnaire were conducted with visitors from Museum RMK (n=30) and Museum EAA (n=30) and evaluated with IBM SPSS Statistics 21 software. Reliability analysis, frequency tables, Independent Samples t-test and Spearman's Rho correlation coefficient were conducted.

First of all, demographic results of the participants were explored (Table 6). The questionnaires were distributed to visitors randomly, that is why participants' age varied. Participants were aged between 18 and 66 years, although there was intensity in range of age in 20 – 29 years. Visitors were asked if they had previously visited the museum to explore the familiarity to museums. Results showed that 16.7% of visitors were familiar while 83.3% of visitors were unfamiliar with the museums.

Table 6. A table showing the visitors' socio-demographic characteristics

Demographic results		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

For the reliability testing, Cronbach' alpha was computed to ensure consistency of the questionnaire. The reliability of the questionnaire was checked and the value was found as 0.7 which demonstrates that the questionnaire is reliable (Hair et al., 2010).

In order to make it easier to read the evaluation of questionnaire, the five-point-scale was recoded into a three-point-scale. Strongly disagree (1) and disagree (2) were recoded as disagree (-1), neither agree nor disagree (3) was recoded as neutral (0), and agree (4) and strongly agree (5) were recoded as agree (+1).

4.2.2.1 Independent Samples T-Test

The independent samples t-test was run at 95% significance level to explore whether there are differences in evaluation of the questions between Museum RMK and Museum EAA. According to Argyrous (2014), independent samples t-test can be explained with the value of *p-score.* When the value of *p* is smaller than alpha ($\alpha = 0.05$) then it means that there is a significant difference between both museums.

As it was mentioned in methodology, the questionnaire has seven main factors, which are called expectation, preference, auditory environment, physical environment, context, interpretation of sound environment, and response. Results showed that there is a significant difference in the evaluation of preference and physical environment factors. Preference of historical building type, preference of building type according to the exhibition's theme, lighting conditions, and wayfinding in the museum were investigated at 95% significance level (2-tailed) (Table 6). According to the independent samples t-test results there is no significant difference in visitors' evaluation towards expectation, auditory environment, context, interpretation of sound environment, and response factors. To clarify the differences, frequency distribution of preference and physical environment were explored (see Appendix C).

Table 7. Significant difference in the evaluation of preference and physical environment factors

ITEMS	**p**	**t**	**df**
preference of historical building type (q 2.1)	**0.012**	2.598	58
preference of modern building type regarding the theme of the exhibition (q 2.4)	**0.005**	-2.938	58
lighting conditions (q 4.5)	**0.009**	-2.715	58
wayfinding (q 4.1)	**0.003**	3.084	58

In Museum RMK, results showed that 25 visitors evaluated the preference of historical building type as agree, 3 visitors evaluated as disagree, and 2 visitors evaluated as neutral. In Museum EAA, results showed that 16 visitors evaluated the preference of historical building type as agree, 10 visitors evaluated as disagree, and 4 visitors evaluated as neutral. In Museum RMK where the building type is historical, visitors preferred museums to be in historic building more comparing to the visitors in Museum EAA where the building type is modern.

In Museum RMK, results showed that 2 visitors evaluated the preference of building type as modern regarding the theme of exhibition as agree, 2 visitors evaluated as neutral, and 26 visitors evaluated as disagree. In Museum EAA, results showed that 7 visitors evaluated the preference of building type as modern regarding the theme of exhibition as agree, 8 visitors evaluated as neutral, and 15 visitors evaluated as disagree. In Museum RMK where the building type and theme of exhibition is historical, visitors disagreed that the museum should be in modern building comparing to the visitors in Museum EAA where the building type is modern but the theme of exhibition is historical.

In Museum RMK, results showed that 19 visitors evaluated the lighting quality as high, 6 visitors evaluated as neutral, and 5 visitors evaluated as low. In Museum EAA, results showed that 28 visitors evaluated the lighting quality as high, 1 visitor evaluated as neutral, and 1 visitor evaluated as low. In Museum RMK, results showed that 19 visitors evaluated the wayfinding as easy, 2 visitors evaluated as neutral and 9 visitors evaluated as difficult. In Museum EAA, results showed that 28 visitors evaluated the wayfinding as easy, 1 visitor evaluated as neutral, and 1 visitor evaluated as difficult. These results showed that when the lighting quality is high visitors perceived the wayfinding easier.

4.2.2.2 Spearman's Rho Correlation Coefficient

In order 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). According to Argyrous (2014) Spearman's rho (rs) is used to evaluate the correlation between ordinal variables and to analyze the dependency between each question. Spearman's rho value ranges between -1 and +1 values. If the value is higher than 0.3 it indicates a significant correlation between the tested variables. The negative or positive sign helps us to interpret the direction of the correlation (Argyrous, 2014).

In the Museum RMK, visitors' expectations of physical and auditory environment showed significance correlations. The expectation of physical environment was found as having positive significant correlation with ceiling height, sincere atmosphere, spacious exhibition areas, lighting quality, air quality, temperature and humidity, daylight, and historical building type. In the Museum EAA, visitors' expectation of physical environment was found as having positive significant correlation with ceiling height and spacious exhibition areas only (Table 8).

Table 8. Items that have significant correlations with visitors' expectations of physical environment

ITEMS	**MUSEUM RMK**			**MUSEUM EAA**		
	rs	**p**	**n**	***rs***	**p**	**n**
Ceiling height (q 4.2)	**0.586**	0.001	30	**0.520**	0.003	30
Sincere atmosphere (q 4.3)	**0.498**	0.005	30	0.153	0.419	30
Spacious exhibition area (q 4.4)	**0.461**	0.010	30	**0.577**	0.001	30
Lighting quality (q 4.5)	**0.652**	0.000	30	0.126	0.506	30
Air quality (q 4.6)	**0.388**	0.034	30	0.052	0.785	30
Temperature and humidity (q 4.7)	**0.381**	0.038	30	-0.015	0.939	30
Daylight (q 4.8)	**0.571**	0.003	30	0.113	0.554	30
Historical building type (q 2.1)	**0.601**	0.000	30	-0.317	0.870	30

In the Museum RMK, the expectation of auditory environment was found as having positive significant correlation with sounds heard within the museum, and as having negative significant correlation with disturbing sound source. In the Museum EAA, the expectation of auditory environment was found as having negative significant correlation with disturbing sound (Table 9).

Table 9. Items that have significant correlations with visitors' expectations of auditory environment

ITEMS	MUSEUM RMK			MUSEUM EAA		
	rs	**p**	**n**	***rs***	**p**	**n**
Sounds heard within the museum (q 5.3)	**0.659**	0.000	30	-0,032	0,868	30
Disturbing sound sources (q 6.4)	**-0.466**	0.009	30	**-0.542**	0.174	30

In Museum RMK, disturbing sound environment was found as having positive significant correlation with the sound, difficulties of hearing object-related sounds, difficulties of connecting to exhibition, and desire of leaving the exhibition and having negative significant correlation with the museum atmosphere. In Museum EAA, it was also clarified that disturbing sound environment was found as having positive significant correlation with the sound level, difficulties of hearing object-related sounds, difficulties of connecting to exhibition, and desire of leaving the exhibition. It showed negative significant correlation with the museum atmosphere and visitors' attachment to the environment (Table 9).

Table 10. Items that have significant correlation with disturbing sound environment

ITEMS	MUSEUM RMK			MUSEUM EAA		
	rs	**p**	**n**	***rs***	**p**	**n**
Sound level (q 3.1)	**0.611**	0.005	30	**0.432**	0.017	30
Difficulties of hearing object-related sounds (q 3.3)	**0.555**	0.001	30	**0.701**	0.000	30
Difficulties of connecting to exhibition (q 6.5)	**0.362**	0.049	30	**0.401**	0.028	30
Desire of leaving the exhibition (q 7.4)	**0.621**	0.000	30	**-0.500**	0.005	30
Museum atmosphere (q 7.1)	**-0.384**	0.036	30	**-0.370**	0.044	30
Visitors' attachment to the environment (q 7.2)	-0.149	0.431	30	**0.432**	0.017	30

The ceiling height was found as having a negative significant correlation with perception of disturbing sound sources in both museums. Visitors' perception towards the sincere museum atmosphere was found as having a positive significant correlation with the content of the sound sources and with the visitors' attachment to the environment in both museums.

In Museum RMK, visitors' preference of historical building type was found as having a positive significant correlation with content of the sound sources. The same was not found as having a significant correlation in Museum EAA at 95% or 99% significance level (Table 11).

Table 11. Items that have significant correlations in both museums

ITEMS	MUSEUM RMK			MUSEUM EAA		
	rs	p	n	*rs*	p	n
The ceiling height (q 4.2) / disturbing sound sources (q 6.4)	**-0.403**	0.027	30	**-0.441**	0.015	30
Visitors' perception towards the sincere museum atmosphere (q 4.3) / content of the sound sources (q 5.1)	**0.513**	0.004	30	**0.371**	0.043	30
Visitors' perception towards the sincere museum atmosphere (q 4.3) / visitors' attachment to the environment (q 7.2)	**0.365**	0.047	30	**0.467**	0.009	30
Visitors' preference of historical building type (q 2.1) / content of the sound sources (q. 5.1)	**0.364**	0.048	30	-0.064	0.738	30

CHAPTER V

DISCUSSION

5.1 Comparison of Methods towards the Built Environment

The independent samples t-test showed that there are differences in the evaluation of the questions between Museum RMK and Museum EAA, especially in the questions related with the preferences and built environment. Preference of building type, preference of building type according to the exhibition's theme, lighting quality, and wayfinding were found different at 95% significance level (2-tailed). Therefore, the frequency distribution was explored for detailed explanation.

Results showed that, the preference of the building type is mostly historical in both museums. However, visitors at the Museum RMK preferred historical building type much more. Although the vast majority of visitors in Museum EAA seem to prefer the historical building type, since they experienced a modern building there, their perception affected their preferences. Relatively, the preference of building type as modern regarding the theme of exhibition is agreed much more in Museum EAA than it was in Museum RMK. These results showed that historical exhibitions in historical buildings are more appealing to people's preferences and expectations comparing with the historical exhibitions in modern buildings. For instance, during the interviews, when visitors were asked if the museum is matching with their expectations. One visitor from Museum RMK said:

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*.

One visitor from Museum EAA said:

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.*

The interview results showed that visitors expect the museums to be well-lit and uncomplicated environments. Similarly, the ease of way finding and lighting quality in the Museum EAA is quite higher compared with the Museum RMK according to the statistical results. It means that the better the lighting is, the easier the visitors’ way finding is in museums. Lighting quality help visitors to perceive the environment easily and have better museum experience. It also shows that modern buildings provide visitors with more proper environments for the museum experiences. Even though the Museum RMK has the glass ceiling on the courtyard, which provides direct sunlight to the interior, it was not enough for easy wayfinding comparing with the Museum EAA.

During the interviews, visitors expressed their expectation of built environment as spacious, calming, bright, and airy spaces. Relatively, the statistical results showed that there is positive significant correlation between the expectation of physical environment and ceiling height, sincere atmosphere, spacious exhibition areas, lighting quality, air quality, temperature and humidity, and daylight in Museum RMK. The same was found in Museum EAA between the expectation of physical environment and ceiling height and spacious exhibition areas. It is clearly seen that the perceived physical environment was matching with visitors expectations in the museums.

5.2 Comparison of Methods towards the Auditory Environment

The regulations in Turkey claim that the L_{Aeq} level should be maximum 56 dB in the museums (Resmi Gazete, 2018). However, the L_{Aeq} level was measured as 95.6 dB in Museum RMK and 94.4 dB in Museum EAA. Therefore, because of the difference between required and measured L_{Aeq} levels, it was expected to receive visitors' feedbacks towards the perceived sound environment negatively. However, in both museums visitors did not take a negative approach towards the sound environment. Carvalho et al. (2013) claimed that the Reverberation Time (T30) should be 0.8 to 1.4 and the regulations in Turkey showed that the reverberation time should maximum be 1.2 in museums (Resmi Gazete, 2018).

However, the results showed that the reverberation time for the common frequencies of speech are calculated as 2.25 for 500 Hz, 1.95 for 1000 Hz and 1.86 for 2000 Hz in the Museum RMK; and 2.6 for 500 Hz, 3.02 for 1000 Hz and 2.7 for 2000 Hz in the Museum EAA (Figure 19). This situation can be explained with the lack of the absorbing materials. Even though the floor was covered with wall-to-wall carpet in Museum RMK, it was not enough to absorb the sound properly. Carvalho et al. (2013) explained the required speech transmission index as between 0.45 and 0.65 in the museums. STI ratings in the Museum RMK was ranged from 0.43 to 0.77 with average rating of 0.53 and was ranged from 0.41 to 0.52 with the average rating of 0.48 in the Museum EAA. According to Houtgast et al. (2002), both museums have *fair* intelligibility of speech and appropriate STI rating for the standard of museums. It shows that speeches are neither difficult nor easy to understand and express in these museums, and there were no compliments related to it through interviews. As in the previous soundscapes studies, this study also showed that the perception of visitors cannot be evaluated by only measuring the physical parameters of the acoustic environment (ISO, 2014; Acun, 2015; Cankaya, 2016; Cankaya & Yilmazer, 2016; Zhang et al., 2016; Kang & Schulte-Fortkamp, 2017; Aletta et al., 2018; ISO, 2018; Acun & Yilmazer, 2018; Acun et al., 2018; Yilmazer & Orhan 2019). Other factors that affect their perception should be considered in detail.

Egan (1998) clarified that the higher the volume is, the longer the reverberation time is. As Carvalho et al. (2013) and Dökmeci and Kang (2016) clarified, high ceilings cause echo within the space and discomfort to people. However, the statistical results showed that the ceiling height was having a negative significant correlation with perception of disturbing sound environment in both museums. Even though the reverberation time is longer in the spaces with higher ceilings, because visitors perceive the built and auditory environment in a holistic way, they did not get disturbed. Also, because the physical environment is matching with the expectation of a spacious museum environment, they did not perceive the disturbing sound where the ceilings are high.

To reveal what effects the visitors' expectation and perception towards the soundscapes within a specific context, interviews were conducted with the visitors in the scope of the Grounded Theory. During the interviews visitors had a general idea that high level of sound would be disturbing in museums. Even though the correlation of sound level and visitors' disturbance level results showed positive significant correlation in both museums, it is important to consider their perception towards the sound environment and physical environment together.

Mechanical sounds such as HVAC systems, motors, fans, poorly implemented speakers, lighting, floor layout, and glazing areas were evaluated as negatively in the museums in the literature (Fry, 2002; Carvalho et al., 2013). Truax (1984) claimed that the lack of negative sound is not enough to generate positive environments. Visitors' expectation of soundscapes of the museum environments was to be quiet and calm. Low level background music and object-related sounds were expected and preferred most in both of the museums. Visitors stated that human-based sound sources like loudly speaking or children noise and outdoor sound sources are the ones they do not want to hear in the museums in general. Nevertheless, like Fry (2002) claimed in his article, most of the visitors stated that they do not want library like stillness in museum environments. Relatively, low level speech was stated as expected sound sources in the museums and had positive effect on visitors' experience. Visitors claimed that speech helped them to move more freely within the museum and make sure they are not stressed to make noise and disturb other visitors just like in the libraries. Acun (2015) found that keyboard sound created positive feeling on the employees' sound perception in open-plan offices. Cankaya (2016) also found that computer fan sound and keyboard-mouse sound were wanted sounds because they were evoking a feeling that all of the students are working, at that moment, in a classroom environment. As seen in these studies, visitors in both museums stated that it was good for them to hear others' speeches that would contribute to their own museum experience.

Visitors indicated, during the interview, that they are disturbed if the sound they hear is not relevant with the context. At the same time, they claimed that even the sound level is high; if the sound source is relevant with the context they are not bothered, as it is in the children noise example. The reason why the children noise was accepted in the Museum RMK is that the context was matching with the sound. In fact, it was said that toys section was very convenient for children to express their excitement, astonishment, and feelings loudly in Museum RMK. However, because the Museum EAA exhibits objects related with archaeology and art, visitors needed more concentration. Therefore, the children noise was accepted as a part of the visit in the Museum RMK while it was reported as annoying in the Museum EAA.

Statistical results showed a positive significant correlation between the content of the sound sources and visitors’ perception towards the museum’s atmosphere for both museums. Similarly, sound sources related with the theme of the exhibition were found as having a positive significant correlation with the visitors’ attachment to the environment in both museums. Therefore, it is seen that sound sources are related to themes contributes positively to the visitors' experiences and to the perception of a sincere museum atmosphere. One visitor in Museum RMK said that it would be better to hear the anthem of Fenerbahçe in the team’s room. Other one from Museum EAA claimed that she wanted to hear Anatolian music in the part of artefacts from Anatolia is exhibited. Both said they would have had a more realistic experience if these sounds were heard.

During the interviews, visitors gave positive responses to the sound sources related with objects because of their informative and attractive contents. The uncontrolled and high level of irrelevant sound sources caused negative responses because these caused the interruption of activity, loss of concentration, curiosity, and interest.

In Museum RMK, visitors’ preference about the type of museum building was found as having a positive significant correlation with sound sources. Therefore, visitors in Museum RMK were satisfied with the relation between what they heard, theme of the exhibition, and the historic characteristics of the building.

However, in Museum EAA, the statistical results and interview results showed that visitors could not match the modern building type with the theme of the exhibition and accordingly with the sound sources. It showed that visitors need to perceive the auditory and built environment in a holistic way.

CHAPTER VI

CONCLUSION

Soundscapes studies generally focused on urban and rural areas rather than indoor spaces. Indoor soundscapes studies were mostly considered within the last decade. Museums are important contributions to indoor soundscapes studies in terms of their purpose of collection, education, and recreation. The increasing interest in museums has made this study more valuable.

Previous studies on museums' acoustic environment clarified the standards of physical parameters of spaces. Perception of visitors was disregarded in the scope of acoustical museum studies. This thesis gathered two approaches as measurements of physical parameters and perceptual data together to fill this gap. The aim of the study is to compare the visitors' perception of soundscapes in different museums. Two museums were involved in the study; Rahmi M. Koç Museum and Erimtan Archaeology and Arts Museum. The reason that these museums were chosen is; one of them is a historical building exhibits historical objects and the other one is a modern building exhibits historical objects. In that sense, how the building type and theme of the exhibition effect the visitors' perception of soundscapes was investigated.

At first, for the measurements of physical parameters, in-situ acoustic measurements were conducted in Museum RMK and Museum EAA. Equivalent Continuous A-Weighted Sound Level (L_{Aeq}) was recorded as 95.5 dB in Museum RMK and 94.9 dB in Museum EAA. Therefore, it was seen that acoustic conditions of both museums are not in accordance with the regulations. Reverberation Time (T30) and Speech Transmission Index (STI) were also measured to reveal the acoustic conditions of museums by using Odeon Room Acoustics Software 13.01 Combined. Results of reverberation time (T30) measurements showed that both of the museums did not have proper reverberation time. Speech transmission index (STI) ratings were identified differently in two museums and both have fair intelligibility of speech. Secondly, to get the perceptual data, semi-structure interview was conducted with 13 visitors and questionnaire was conducted with 60 visitors. Grounded Theory method was used to evaluate the interviews and statistical software program SPSS was used to evaluate the results of questionnaire. To create an integrative soundscapes approach on museums, gathered data were evaluated and compared with each other.

The results of the measurements of physical parameters showed that soundscapes cannot be evaluated only considering the acoustical parameters. Even though the acoustical conditions of the spaces are not appropriate with the standard, perception of soundscapes environment can be positive within the right context. In this study, it is seen that visitors' perception of soundscapes changes according to the theme of the museums and it is directly related with the preference of building type as historical or modern. As Bruce and Davies (2014) claimed, context, as the meaning attributed to sound, is more important than the level of sound. Therefore, as it was found in this study also, peoples' perception mostly depends on the context of which sound is heard rather than the physical parameters of acoustic environment.

- **Limitations of the Study**

This study has a few limitations. First of all, the number of participating interview and questionnaire was relatively small and the age of sample size was highly heterogeneous. Although these limitations are common in many studies, as the sample size increases, more significant statistical values can be found. Secondly, the number of sound sources available in the museums was not equal, which affected visitors' perception of the sound environment and the results differently.

- **Recommendations for Further Research**

This study will contribute another perspective to the literature and provide new case study examples of soundscapes approaches. Museums address broad visitor mass from different age, nationality, culture, and background. Therefore, the perception of visitors can be very different. In order to see that, this study can be conducted in other types of museums, such as general museums, history museums, ethnography museums, natural history museums, geology museums, science museums, military museums, etc. regarding the different demographic features of participants. Additionally, further researchers can use the method of this thesis to evaluate different types of indoor environments. They can also use this thesis as design recommendation in museum environments in the means of considering the expectations of visitors towards the auditory and built environment.

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APPENDICES

APPENDIX A

1. Daha önce bu müzeye geldiniz mi?

   Have you been to this museum before?

2. Müzenin temasıyla ilgini bir fikriniz var mıydı?

   Did you have any idea about the theme of the museum?

3. Sizce bu müzenin teması nedir?

   What do you think is the theme of this museum?

4. Bu temayı düşündüğünüzde nasıl bir müze ortamı hayal ediyorsunuz?

   What kind of a museum environment do you imagine when you think about this theme?

5. Sizce bu tema ile mekân eşleşiyor mu?

   Do you think the theme matches to the environment?

6. Müzeye ilk girdiğinizde ne düşündünüz / hissettiniz?

   What did you think / feel when you first entered the museum?

7. Bu müzede sergilenen objeler daha tarihi/modern bir mekanda mı sergilenmeli?

   Should the objects exhibited in this museum be exhibited in a more historic / modern space?

8. Bir müzeden fiziksel olarak beklentileriniz nedir?

   What are your physical expectations from a museum?

9. Bu müze beklentilerinizle eşleşiyor mu?

   Does this museum match your expectations?

The second part;

10. Müze denilince aklınıza hangi sesler ve nasıl bir ses ortamı geliyor?

    Which sounds and what kind of sound environment is coming to your mind when it comes to the museum?

11. Tarihi/modern müzede ne duymayı beklersiniz?

    What do you expect to hear in the historical / modern museum?

12. Bu müzede hangi sesleri duydunuz?

    Which sounds did you hear in this museum and how did it make you feel?

13. Sizce bu müzenin ses ortamı nasıl?

    What do you think about the sound environment of this museum?

14. Hoşunuza giden ya da sizi rahatsız eden sesler nelerdi?

    What sounds did you like or bothers you?

15. Bu müzede duyduklarınız müze ile bağdaşıyor mu?

    Were the sounds you heard in this museum match the museum?

Figure A.1. Interview questions both in Turkish and English

APPENDIX B

Müzelerde Ses Ortamı Algısı Araştırması

Bu anket çalışması, Bilkent Üniversitesi İç Mimarlık ve Çevre Tasarımı Bölümü'nde hazırlanan, algılanan ses ortamı araştırması kapsamında yapılmaktadır. Ankette kimliğiniz sorulmamaktadır. Tüm katılımcılardan elde edilen veriler kesinlikle gizli tutulup, sadece bilimsel amaçla kullanılacaktır. Katılım tamamen isteğe bağlıdır.

Araştırmayla ilgili bilgi almak için: cemre.orhan@bilkent.edu.tr

Yaş:	
Cinsiyet:	
Bu müzeye daha önce geldiniz mi?	

1. BEKLENTİ	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
1.1. Buraya gelirken aklımda mekânla ilgili bir fikrim vardı.					
1.2. Bu mekan aynı fonksiyondaki diğer mekanlarla (müze) benzerlik gösteriyor.					
1.3. Buraya gelirken mekânda duyacağım sesler konusunda bir beklentim vardı.					
1.4. Bu mekân beklentilerimle örtüşüyor.					
2. TERCİH	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
2.1. Müzelerin tarihi binalarda olmasını tercih ederim.					
2.2. Müzelerin modern binalarda olmasını tercih ederim.					
2.3. Bu temaya sahip bir müzenin, tarihi binada olmasını tercih ederim.					
2.4. Bu temaya sahip bir müzenin, modern binada olmasını tercih ederim.					
3. SES ORTAMI	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
3.1. Bu mekandaki ses seviyelerini yüksek buldum.					
3.2. Bu mekandaki ses ortamını rahatsız edici buldum.					
3.3. Bazı sergi alanlarında, sergilenen objelerle alakalı sesleri duymakta zorlandım.					
3.4. Müzede arka plan sesi olmasını isterdim.					
3.5. Ses kaynakları, ses ortamındaki temalarla doğrudan alakalıydı.					

4. FİZİKSEL ORTAM	1 Kesinlikle Katılmıyorum	2 Katılmıyorum	3 Kararsızım	4 Katılıyorum	5 Kesinlikle Katılıyorum
4.1. Müzede yönümü bulmakta zorlandım.					
4.2. Müze içerisindeki geniş/yüksek tavanlı mekânlar daha çok hoşuma gitti.					
4.3. Müzenin ziyaretçilere sıcak/samimi bir ortam sağladıklarını düşünüyorum					
4.4. Müzedeki sergi alanları genel olarak ferahtı.					
4.5. Müzedeki sergi alanlarının genel olarak iyi aydınlatıldığını düşünüyorum.					
4.6. Müzedeki hava kalitesinin iyi olduğunu düşünüyorum.					
4.7. Müzedeki hava sıcaklığı/nem miktarının iyi olduğunu düşünüyorum.					
4.8. Müzedeki güneş ışığı miktarının iyi olduğunu düşünüyorum.					
5. İÇERİK	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
5.1. Sergi alanlarında duyduğum seslerin genel olarak bu müzeye uygun olduğunu düşünüyorum					
5.2. Müze binasının tarihi dokusunun, sergilenen objelere uygun olduğunu düşünüyorum.					
5.3. Duyduğum seslerin, içinde bulunduğum ortama uygun olması benim için önemlidir.					
6. SES ORTAMINI YORUMLAMA	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
6.1. Sergilenen objelerle bağlantılı sesler duymak pozitif bir etki yarattı.					
6.2. Sergilenen objelerle bağlantılı sesler duymak merak hissi uyandırdı.					
6.3. Müzede duyduğum seslerin sakin bir ortam hissi uyandırdı.					
6.4. Sergi alanlarını gezerken rahatsız edici seslerle karşılaştım.					
6.5. Sergi alanlarında karşılaştığım rahatsız edici sesler, sergilenen objelerle bağ kurmamı zorlaştırdı.					
7. YANIT	**1 Kesinlikle Katılmıyorum**	**2 Katılmıyorum**	**3 Kararsızım**	**4 Katılıyorum**	**5 Kesinlikle Katılıyorum**
7.1. Ses ortamının, müzenin atmosferine olumlu bir katkısı olduğunu düşünüyorum.					
7.2. Ses ortamı, müzede sergilenen dönemin içindeymişim gibi hissetmeme yardımcı oldu.					
7.3. Ses ortamı, sergiye konsantre olmamı zorlaştırdı.					
7.4. Ses ortamından rahatsız olduğum zaman, bulunduğum sergi alanını terk etme ihtiyacı hissettim.					

Research on Sound Environment Perception in Museums

This survey is conducted within the scope of perceived sound environment research prepared by Bilkent University Interior Architecture and Environmental Design Department. The survey does not ask for your identity. Data obtained from all participants will be kept strictly confidential and used for scientific purposes only. Participation is entirely voluntary.

For more information: cemre.orhan@bilkent.edu.tr

Age:	
Gender:	
Have you been to this museum before?	

1. EXPECTATION	**1 Strongly Disagree**	**2 Disagree**	**3 Neither agree nor disagree**	**4 Agree**	**5 Strongly Agree**
1.1. I had an idea about the place before I came.					
1.2. This place is similar to other places of the same function (museum).					
1.3. When I came here, I had expectations about the sounds I would hear in the place.					
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 historical buildings.					
2.2. I prefer museums to be in modern buildings.					
2.3. I would prefer a museum with this theme to be in the historical building.					
2.4. I would prefer a museum with this theme to 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. I found the sound levels high in this place.					
3.2. The sound environment in this place uncomfortable.					
3.3. In some exhibition areas, it was difficult to hear sounds related to the objects on display.					
3.4. I wish there was background sound in the museum.					
3.5. Sound sources were directly related to the theme.					

4. PHYSICAL ENVIRONMENT	1 **Strongly Disagree**	2 **Disagree**	3 **Neither agree nor disagree**	4 **Agree**	5 **Strongly Agree**
4.1. I had trouble finding my way in the museum.					
4.2. I liked the large / high ceilings in the museum.					
4.3. I think the museum provides a warm / sincere atmosphere for visitors.					
4.4. The exhibition areas were generally spacious.					
4.5. The museum is generally well lit.					
4.6. The air quality is good.					
4.7. The air temperature / humidity is good.					
8.4. The amount of sunlight is good.					
5. CONTEXT	1 **Strongly Disagree**	2 **Disagree**	3 **Neither agree nor disagree**	4 **Agree**	5 **Strongly Agree**
5.1. The sounds in the exhibition areas are generally suitable for this museum.					
5.2. The historical texture of the museum building is suitable for the exhibited objects.					
5.3. It is important for me that the sounds I hear are suitable for environment I am in.					
6. INTERPRETATION OF SOUND ENVIRONMENT	1 **Strongly Disagree**	2 **Disagree**	3 **Neither agree nor disagree**	4 **Agree**	5 **Strongly Agree**
6.1. Hearing voices associated with the exhibited objects had a positive effect.					
6.2. Hearing the sounds associated with the exhibited objects aroused the curiosity.					
6.3. The sounds I heard in the museum aroused the feeling of a quiet environment.					
6.4. I encountered disturbing noises while visiting the exhibition areas.					
6.5. The disturbing sounds I encountered in the exhibition areas made it harder 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 effect on the atmosphere of the museum.					
7.2. The sound environment helped me to feel like I was in the period exhibited in the museum.					
7.3. The sound environment made it hard for me to concentrate on the exhibition.					
7.4. When I was disturbed by the sound environment, I left the exhibition space.					

Figure B.1. Sound Environment Perception questionnaire both in Turkish and English

APPENDIX C

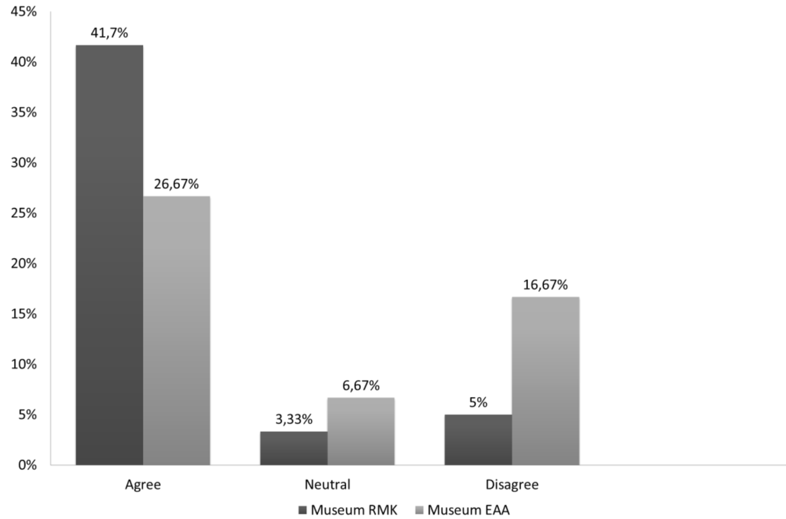

Figure C.1. A clustered bar chart showing the frequency distribution of preference of historical building type

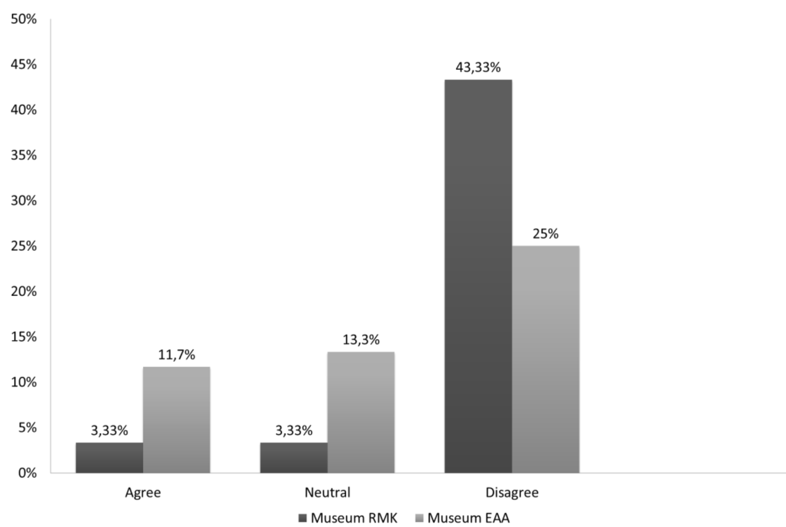

Figure C.2. A clustered bar chart showing the frequency distribution of preference of building type as modern regarding the theme of exhibition

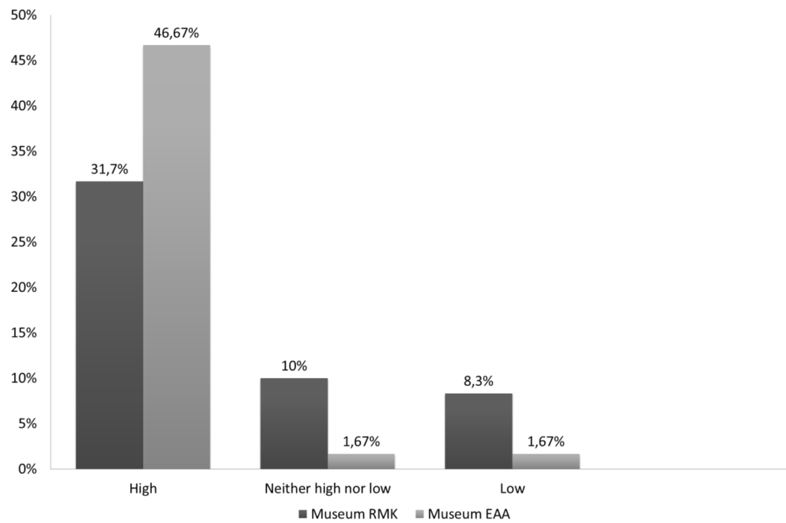

Figure C.3. A clustered bar chart showing the frequency distribution of lighting quality

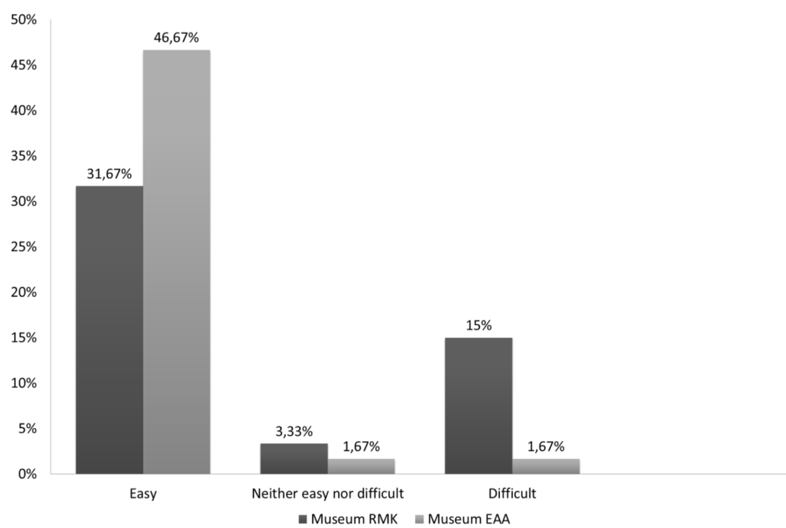

Figure C23.4. A clustered bar chart showing the frequency distribution of difficulty of wayfinding