EVALUATING THE RELATIONSHIP BETWEEN INDOOR SOUNDSCAPE PERCEPTION AND OVERALL SPATIAL EXPERIENCE THROUGH ACOUSTICAL POST-OCCUPANCY EVALUATION

AYAD ABURAWIS

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EVALUATING THE RELATIONSHIP BETWEEN INDOOR SOUNDSCAPE PERCEPTION AND OVERALL SPATIAL EXPERIENCE THROUGH ACOUSTICAL POST-OCCUPANCY EVALUATION

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ABSTRACT

EVALUATING THE RELATIONSHIP BETWEEN INDOOR SOUNDSCAPE PERCEPTION AND OVERALL SPATIAL EXPERIENCE THROUGH ACOUSTICALPOST-OCCUPANCY EVALUATION

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Soundscape and space experience have a very close relationship. These two concepts have often been investigated separately. However, the important factors that affect each other are found in the literature. From this point of view, the variation and diversity of identifying those factors was because of the deference in semantic and languages of the researchers. Unifying the factors of soundscape perception and space experience in a logic way is an urgent demand nowadays. In addition, identifying the relationship between soundscape perception and spatial experience within the evaluation of their factors is crucial. The previous studies attempted to identify most of the important factors, but revealed that there is no study concerned with evaluating the relationship between the two concepts in order to improve the different phases of building process. Therefore, it is essential to evaluate this relationship and adapting a proper tool to achieve the purpose of this study.

This study attempt to produce an integrated framework for soundscape perception and spatial experience within a systematic review of recent progress, and adapting post-occupancy evaluation methodology. First, factors under soundscape perception and space experience are reviewed in detail and merged to form conceptual classification models. Six soundscape perception factors are formed, whereas five space experience factors are presented. Second, factors under the merged conceptual models are integrated by considering occupants' experience of space regarding their variance in perception of soundscapes through acoustical post-occupancy evaluation (POE). An

adapted study design is proposed under indicative, investigative and diagnostic stages of POE by presenting the methods, data types and factorial correlations for each stage. In the case study, 38 offices in Cankaya University were observed and 7 points of measurements were taken to obtain an indication about the space characteristics and sound sources. In addition, a semi-structured interviews were conducted to 20 offices in order to reveal more details of soundscape and space factors. The comprehensive questionnaire was applied to 300 users of office spaces in six Universities in Turkey. The data were analysed by using Statistical Package for Social Science (SPSS) and the results are thoroughly discussed. The study resulted and concluded that there is a significant relationship between soundscape perception and space experience and explained the effect of related factors on this relationship. The recommendations involved these results towards feed the future projects in the building industry.

Keywords: soundscape perception, spatial experience, indoor soundscaping, post-occupancy evaluation

ÖZ

AKUSTİK KULLANIM SONRASI DEĞERLENDİRME KAPSAMINDA, İÇ MEKAN AKUSTİK PEYZAJ ALGISI VE İÇ MEKAN DENEYİMİNİN İLİŞKİSİNİN DEĞERLENDİRİLMESİ

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Temmuz 2019

İşitsel peyzaj ve mekan deneyimi kavramlarının birbiri ile çok yakın bir ilişkisi vardır. Bu iki kavram sıklıkla ayrı ayrı incelenmiştir, oysa birbirlerini etkileyen önemli ortak faktörler barındırmaktadır. Bu iki kavramın çalışılması için kullanılan faktörlerin tanımlanması, çeşitliliği ve farklılıkları, araştırmacıların anlamsal ve linguistik sıkıntılar yaşamasına sebep olmaktadır. Bu nedenle, işitsel peyzaj algısı ve mekan deneyimi kavramlarının alt faktörlerini tanımlamak ve mantıklı bir şekilde birleştirmek günümüzde acil bir ihtiyaçtır. Ek olarak, işitsel peyzaj algısı ile mekan deneyimi arasındaki ilişkinin belirlenmesi, bu iki kavramın alt faktörlerinin değerlendirilmesi açısından da önemlidir. Önceki çalışmalar, etkin faktörlerin çoğunu belirlemeye çalışmış, ancak mimari tasarım ve yapım sürecinin farklı aşamalarını iyileştirmek için iki kavram arasındaki ilişkinin değerlendirilmesiyle ilgili literatürde açık olduğu belirlenmiştir. Bu nedenle, bu ilişkiyi değerlendirmek ve bu çalışmanın amacına ulaşmak için uygun bir araştırma uyarlamak ihtiyacı doğmuştur.

Bu çalışma, son gelişmelerin sistematik olarak gözden geçirilmesi ve değerlendirme metodolojisinin uyarlanması dahilinde işitsel peyzaj algısı ve mekan deneyimi için entegre bir çerçeve üretme girişimidir. İlk olarak, işitsel peyzaj algısı ve mekan deneyimi altındaki faktörler detaylı bir şekilde gözden geçirilmiş ve

kavramsal sınıflandırma modelleri oluşturmak için birleştirilmiştir. Altı işitsel peyzaj algı faktörü oluşturulmuş, buna karşın beş mekan deneyimi faktörü sunulmuştur. İkincisi, birleştirilmiş kavramsal modeller altındaki faktörler, akustik kullanım sonrası değerlendirme (POE) yoluyla, kullanıcıların işitsel peyzaj algılarındaki farklılıklara ilişkin mekan deneyimleri dikkate alınarak bütünleştirilmiştir. Uyarlanmış çalışma tasarımı, her bir aşama için yöntemleri, veri türlerini ve faktör korelasyonlarını sunarak, POE çerçevesinde, oruşturma ve teşhis aşamaları altında önerilmiştir. Bu çalışmada ilk olarak, Çankaya Üniversitesi'nde bulunan 38 ofis gözlemlenmiş ve mekan özellikleri ve ses kaynakları hakkında bir gösterge elde etmek için 7 ölçüm noktası belirlenerek ölçümler yapılmıştır. Ayrıca, işitsel peyzaj ve mekan faktörlerinin daha fazla detayını ortaya çıkarmak için 20 ofis kullanıcısı ile yapılandırılmış görüşmeler yapılmıştır. Son aşamada, Türkiye'deki altı üniversitede bulunan toplam 300 ofis kullanıcısına ulaşılmış ve çalışma kapsamında geliştirilen anketler uygulanmıştır. Veriler, Sosyal Bilimler İçin İstatistik Paketi (SPSS) kullanılarak analiz edilmiş ve sonuçlar detaylı olarak tartışılmıştır. Araştırma sonucunda işitsel peyzaj algısı ile mekan deneyimi arasında anlamlı bir ilişki olduğu sonucuna varılmış ve ilişkili faktörlerin, bu ilişki üzerindeki etkisi detaylı olarak açıklamıştır. Ayrıca bu çaşılma kapsamında varılan sonuçların, mimari proje ve yapım aşamalarının geliştirilmesi yönünde kullanılmasına yönelik önerilerverilmiştir.

Anahtar Kelimeler: işitsel peyzaj algısı, mekan deneyimi, iç mekan işitsel peyzajı, kullanım sonrası değerlendirme

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CHAPTER I

INTRODUCTION

1.1 Overview

Soundscape is a newly emerging research field first presented in the 1970s by Murray Schafer. He claimed that the term soundscape, in other words, acoustic landscape, is a blend of the physical environment regarding acoustical experiential qualities of sound and social environment that is reflected in the user's perception. Moreover, sound is considered to be a fundamental component of any space, and a perceived soundscape effects users overall experience(Ismail, 2014). In the latest ISO 12913-1:2014 international standard, the conceptual framework of a soundscape is structured according to three elements: person, activity, and place in time and space. According to these elements, the term "soundscape" is formed and defined as "the acoustic environment perceived or experienced and/or understood by a person or people, in context" (2014, p. 9). In addition, the "elements in the perceptual construct of a soundscape" are also presented by highlighting the integrated aspects, such as context, sound sources, acoustic environment, auditory sensation, perception, responses, and outcome (Iso, 2014).

Post occupancy evaluation (POE) is a tool for facility managers to identify and evaluate the behavior of a building. POE can then provide design guidance for future facilities. With the help of POE, facilities can have better space utilization and save time and money in operation and upkeep costs (Preiser, 1995; Tookaloo & Smith, 2015). Moreover, POE is the process of evaluating buildings in a rigorous manner and systematic procedures. The POE tool, besides space subjective characteristics investigation, it deals with occupants behaviours and their needs, at the same time, to reveal the results of building performance and consequences of past design decisions. The benefits of POE embodied related to the time in three terms the short term, medium, and the long term (Preiser et al., 1988).

The buildings could be evaluated according to three aspects.

- **Technical performance**

  The technical element that can be measured by specific instruments in the building at a particular time.

- **Behavioural performance**

  The behavioural element is related to the occupants' satisfaction within the sonic environment, which reveals how occupants affected by the context and space design.

- **Functional performance**

  The functional element is concerned with the occupant's activities in the space, which affect their needs and space design. The functional element has a direct impact on psychological and behavioural factors of space experience and soundscape perception (Preiser et al., 1988).

In order to find out the users qualitative feedback, their experience in negative or positive aspect with the sonic environment quality should be investigated through diverse methods of objective and subjective data collection (Hassanain, 2007). Within the scope of this research, firstly, soundscape perception and space experience studies are reviewed in general and previously presented classification models and factors are presented. The unification of such classifications has led to merged categories of both fields. These proposals of merged factors are performed through the detailed review of recent progress in soundscape perception and space experience studies. In addition, post-occupancy evaluation is explained and its methodological adaptation with soundscape perception and space experience factors is proposed as a study design. Within the scope of this study, critical literature review on the previously presented classification of soundscape research and space experience is included. A distinct focus is on the integration of post-occupancy evaluation tools within soundscape and space experience analysis to propose an initial study methodology that aims to form a basic tool to be followed by future researchers in the fields of indoor soundscape evaluation and design.

1.2 Problem Statement

Although the evaluation of soundscape is based on understanding how the soundscape affects users within context, it also considers three aspects that affect the perception and design of soundscape, which are spaces/functions, people, and sound sources (Kang, 2010; Zhang & Kang, 2007). Davies et al, have concluded their study and suggested that evaluating soundscape in positive or negative perspective (soundscape perception) needs to investigate four factors: human behaviour, attention, sound information and individual differences (Davies et al., 2013). The perception of soundscape depends most strongly on the listener activity. Whereas the evaluation of soundscape in the positive or negative side is related to different factors: Demographical factor, activity, time of listening, and space type (Jennings & Cain, 2013). In order to analyse a human perception in a sonic environment, understanding of psychological process should be considered. In the literature, the contextual experience variables have also been identified (Dokmeci, 2013). Moreover, the international standard organisation has created the conceptual framework of soundscape which includes different elements according to human perception (ISO 12913-1:2014 [E]). Sound is a phenomenon that affects our experience in everyday life. It helps us to define our location and our direction. It links with the quality of life within a space (Bernat, 2016; Bogusz et al., 2011; Hojan et al., 2012). Soundscape research is highly subjective as listening to sound sources is an activity that is arranged and comprehended by the human mind. Therefore, sounds interacts and intervenes in the connections of listeners and context, yet sounds are also influenced by physical, environmental and social elements (Truax, 1996). This means that cross-related factorial approaches are definitely needed to analyse soundscapes (M Raimbault, Bérengier, & Dubois, 2001). On the other hand, there is a suggestion that the perception of soundscapes can conjure an emotional reaction in brain activity to identify whether or not the heard sound is pleasant (Craig, Moore, & Knox, 2017). This complementation between sound and space components identifies the variances in the perception of soundscapes by humans. In addition to the spatial and sonic factors that affect soundscape perception, user related variables that can show variance by health (auditory problems, viral infections, etc.) and disabilities should also be addressed.

Whereas, the combination between acoustic comfort and visual images in the same space influences the perception of soundscape and space experience (Gozalo, Carmona, Morillas, Vílchez-Gómez, & Escobar, 2015; Solomon, 2012; Yang & Kang, 2005b). Due to the differentiation in identifying the perception of soundscape and its factors, this study will concern with affected factors and real ideas according to the previous studies.

1.3 Justifications of the Study

Based on the previous studies, in order to identify the gap in the literature, a systematic search and specific tool are required. The suggested gab is:

- Evaluation of the relationship between soundscape perception and space experience and its benefits (feedback), with respect to the visual factor considerations.
- Differentiation in identifying the perception of soundscape related to the difference in factors.
- Variations on classifications and categorizations regarding soundscape factors or frameworks.

Although post-occupancy evaluation (POE) is a tool basically concerned with building performance, it includes three elements, functional, behavioural and technical performance (Li, Song, Lv, & Wang, 2015; Preiser et al., 1988). The acoustical POE of building performance investigates users' behaviours and their satisfaction within subjective and objective variables (Ribeiro, Kortchmar, & Slama, 2001). This acoustic assessment tool is suggested to play a role in identifying the triangular contribution between three important variables: building acoustic performance (BAP) and related factors, soundscape perception, and space experience (Figure 1.1a, 1.1b). Consequently, in order to fit the gab in the literature, these three steps have been suggested to follow:

- Integrating soundscape perception factors and space experience factors.
- Creating a framework model for evaluating the relationship between soundscape perception and spatial experience.
- Acoustical post-occupancy evaluation (POE) is suggested to play a role in identifying the triangle contribution between three important variables

building acoustic performance and related factors, space experience, and soundscape perception (see Figure 1.1a and 1.1b).

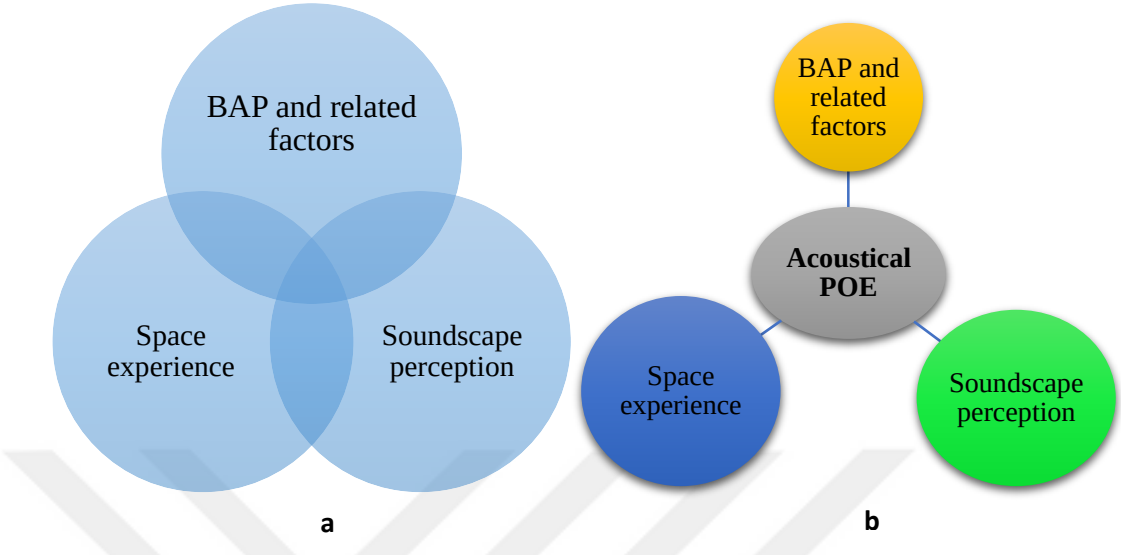


Figure 1.1 a. The contribution and gap, **b.** The evaluation tool

1.4 Aim and Objectives of the study

This study aims to identify factors that affect the relationship between soundscape perception and space experience, which help to determine the approach of design phase in building process in future projects. Also provides guidelines for future researches in the following steps:

- Synthesise the frameworks on soundscape classifications and schemes.
- Unify the factors of soundscape perception and spatial experience.
- Develop a combining framework for soundscape perception and spatial experience fields.
- Analyse a case environment in order to test the developed framework.
- Integrate acoustical post-occupancy evaluation for the assessment of the relationship between soundscape perception and spatial experience to find out benefits that help to improve future design of buildings' spaces.

These objectives of study represents the questions of this research which are:

Q1: What are the objective and subjective factors that affect the perception of soundscape?

a- Which sound sources affect the satisfaction of occupants?

b- How does past- experience affects the perception of soundscape?

c- How do the activities influence the perception of soundscape?

Q2: What are the objective and subjective factors that affect the experience of space?

a- Which environmental factors affect the space experience?

b- How does the past- experiences affect the space experience?

Q3: How does the usage of space affects its experience?

a- Does the interruption of space usage affects the perception of space? Is the effect positive or negative?

1.5 Hypothesis

The studies of soundscape and its applications on experience of spaces are identified by several variables that were categorized in a systematic search. Whereas the hypotheses are:

- The soundscape perception is affected by sound sources regarding:
  - ✓ Dominant Sound source.
  - ✓ Expectation of acoustic environment.
  - ✓ The activities in the space.
- The experience of space is affected by space components regarding:
  - ✓ Expectation of space quality.
  - ✓ The usage of space.
  - ✓ Demographical characteristics
- The usage factor of space moderates the relationship between soundscape perception and spatial experience.

1.6 Structure of the Thesis

This thesis is comprised of seven chapters as shown in figure 1.2. The first chapter presents the introduction to the study, which includes a brief definition of soundscape, experience of space. Moreover, introduces the methods of representation and documentations used in the study.

The second chapter includes a descriptive review of archival science literature about soundscape perception factors that presented by previous studies. A systematic search of recent progress has been done in order to identify new factors that will contribute to the formation of a multidisciplinary soundscape perspective for future research.

The third chapter presents a systematic review on space experience. Starting by addressing the diversity of previous studies that are concerned with the factors that influence the experience of space. Then related to the similar meaning and semantic elements, the merged factors are presented in order to form a merged framework model.

The fourth chapter presents the methodology that is used in the study, which includes the conceptual framework, POE process, the methods of data collection, and survey methods. The data collected by observation and measurement are determined. In addition, the collected data by interviews are presented and discussed.

The fifth chapter comprises of statistical analysis and findings. The method of data analysis is presented in different perspectives that are needed to reveal the interaction between the variables. In addition, the findings are explained according to the statistical analysis.

The sixth chapter is comprised of two sections. The first section explains the results of data analysis (reliability, factorability, correlations between the variables, test in between variables differences, moderation and mediation tests). The second section includes the discussion of the results regarding the previous studies and hypothesis of the thesis.

The seventh chapter presents the conclusion, which includes a summary of the thesis aims and objectives, an important explanatory of contributions between the main concepts, and recommendations for future studies that would benefit from this approach by integrating acoustical POE that could feed the programming, planning, and design phases of building process.

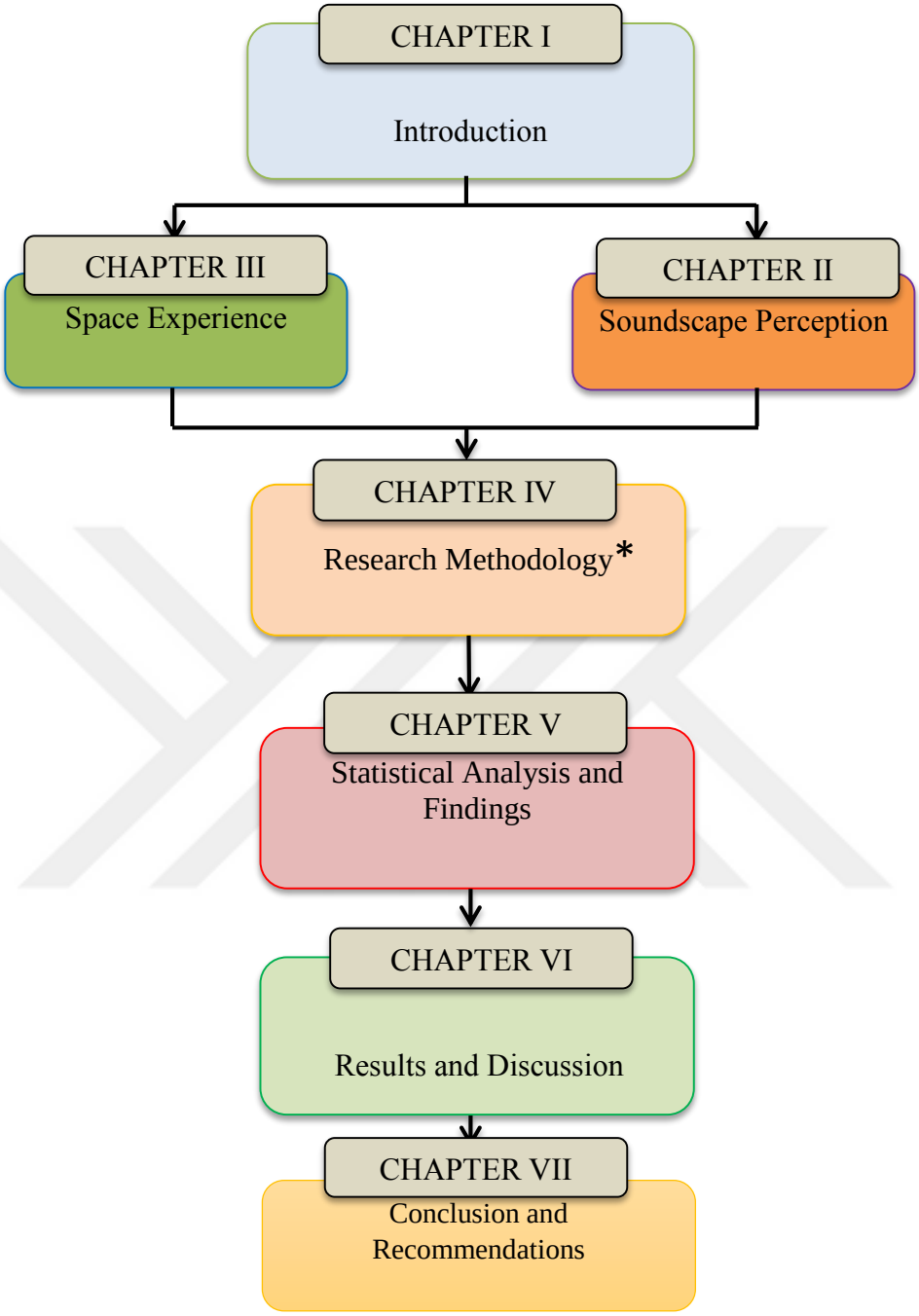


Figure 1.2. Structure of the thesis

(*) graphical visualization of the methodology in detail – p38

CHAPTER II

SOUNDSCAPE PERCEPTION

2.1 Review on Soundscape Perception

The soundscape is a recent idea, which had been presented in the 1970s by Murray Schafer, it is likewise acoustic landscape, which is a blend of physical environment, regarding acoustical experimental qualities of sound, and social environment measurement that reflected by human perception of sound. Soundscape occurs when human lives the encompass sonic environment, where a sound is considered as a fundamental component in the "scape" (Ismail, 2014) In order to establish a common language in soundscape studies, sound classification and related criteria should be addressed (Torija, Ruiz, & Ramos-Ridao, 2014). Accordingly, many studies have been published in the field of soundscape evaluation, soundscape perception, and soundscape classifications, and all of these terms include different factors that influence the research scope and objectives in varied dimensions. Therefore, it is important to identify soundscape factors in related multidisciplinary perspectives by involving not only physical attributes but also individual and social aspects (Kang et al., 2016). Variables of spatial acoustics and perceptual factors have been evaluated and presented in the literature, which forms a crucial base regarding the psychological approach towards soundscape analysis (Berglund, Eriksen, & Nilsson, 2001). Furthermore, space characteristics, functions, and sound sources have been presented as factors that affect the perception of soundscapes within given contexts (Kang, 2010; Zhang & Kang, 2007) that concentrate more on the environmental aspects. These diverse research fields and findings contribute to the formation of a multidisciplinary soundscape perspective for future researchers.

The search for articles started from a broader search to more specific in order to establish a narrow down approach related to the soundscape studies and their scope. The same approach is used for the space experience field. Within the structured search,

scientific online databases that covers highest quality journals that includes acoustical research namely, Clarivate Analytics, EBSCO, IngentaCONNECT, Science Direct, SpringerLink, Taylor & Francis Online, ProQuest, and Scopus are included.

Firstly, four keywords that are related with the scope of this study are identified that are soundscape, perception, factors, and classification. Secondly, narrow down keyword combinations are used as presented as;

1. soundscape
2. soundscape perception
3. soundscape perception factor
4. soundscape perception factor classification

A total of fifteen journals and 1694 articles are found. The table 2.1 explains a number of articles regarding the keywords used to search in the journals. The search process was started from an extensive to narrow searching, to get the more related articles. The first broad search was by the keyword *soundscape* that has resulted in 885 articles from the journals, a significant number of these articles are not related to the scope of this study. The second search with *soundscape perception* keywords was narrowing the search and led to find 439 articles, which were more related to the scope. The third search which was more narrowed by using the keyword *soundscape perception factor*, found 288 articles. Finally, search by *soundscape perception factor classification* was much more related to the scope of this study and 82 articles are found and referenced in this research.

Rather than listening being the end phase of a progression of mediations exchanges from source to audience, it can be comprehended inside of an arrangement of data exchange that is known as the "acoustic group", where sound intervenes the connection of the audience to the environment. A few studies identified with sound affections in urban territories demonstrates that sound affections from the viewpoint of audience members is influenced by elements identified with physical and social perspectives (Truax, 1996). The evaluation of soundscape based on understanding how the soundscape affects users within context, considering four aspects that affect the perception and design of soundscape spaces/functions, people, sound sources, and

visual characteristics (L. Brown et al., 2009; Kang, 2010; Zhang & Kang, 2007) (see figure 2.1).

Table 2.1 Narrow down search of selected keywords

Journal	H Index	Number of articles according to keywords			
		Soundscape	Soundscape Perception	Soundscape Perception Factor	Soundscape Perception Factor Classification
Science of the total environment	182	38	3	24	0
Journal of acoustical society of America	137	590	281	137	54
Journal of sound and vibration	121	17	8	5	0
Landscape and urban planning	102	27	27	23	0
Environmental psychology	97	24	20	17	0
Ecological indicators	78	18	5	5	1
Applied acoustics	49	99	59	51	21
Urban forestry & urban greening	48	18	15	13	1
Acta acoustica united with acoustica	42	8	6	3	0
Ecological informatics	36	21	2	2	2
Acoustical science and technology	26	12	5	3	0
Building acoustics	15	3	3	2	0
Archives of acoustics	13	4	2	0	0
Acoustics Australia	11	4	1	1	1
Frontiers of structural and civil engineering	9	2	2	2	2

How individuals consider distinctive sound is a vital variable in soundscape discernment. A key part of this is the way an audience classifies sounds. A scope of methodologies has been utilised to set up classifications and categorisations of both sounds and soundscapes (Davies et al., 2013). Sound criteria ought to be joined to enhance urban soundscapes. Planners, architects, and engineers need specific equipment that will offer them to settle on choices in configuring some assistance with processing and administration of sound in spaces (Torija et al., 2014). William J. Hall; et al, have concluded their study and suggested that evaluating a soundscape can be in positive or negative perspectives, yet it (soundscape perception) needs to investigate four factors: human behaviour, attention, sound information and individual differences (Davies et al., 2013) (see Figure 3). On the other hand, the soundscape has defined by Jennings and Cain in a scheme to help stakeholders facilitate their involvement in the development of new decision making in the earlier phases of the design process. Moreover, they illustrated that the perception of the soundscape is related to the personality affected by a unique set of experience and performance.

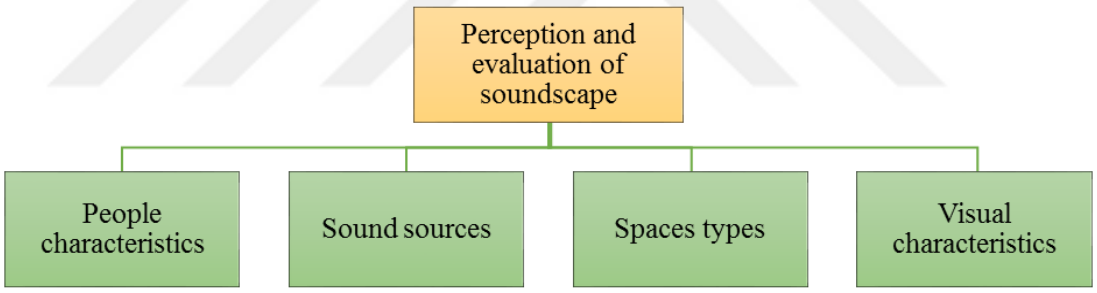


Figure 2.1. Factors affecting evaluation and perception of soundscapes (L. Brown, Kang, & Gjestland, 2009; Kang, 2010; Zhang & Kang, 2007)

Dependently, the perception is most strongly depending on the listener activity and what a person is doing while he or she is listening, accordingly, there are three states of listening: first, listening in search, which means that the listener is ready to listen to whatever they are listening. Second, listening in readiness, which means that the listener is ready to listen but their attention oriented elsewhere. Third, background listening when the listener is engaged and concentrated on other activities. Consequently, the authors established a framework about soundscape perception related to different factors: demographical factors, activity, time of listening, and space

type (Jennings & Cain, 2013). A framework is supported by Craig,Moure and Knox, who postulate that the variation in perception of soundscape is attributable to the contextual issues that face the listener (Craig et al., 2017) .

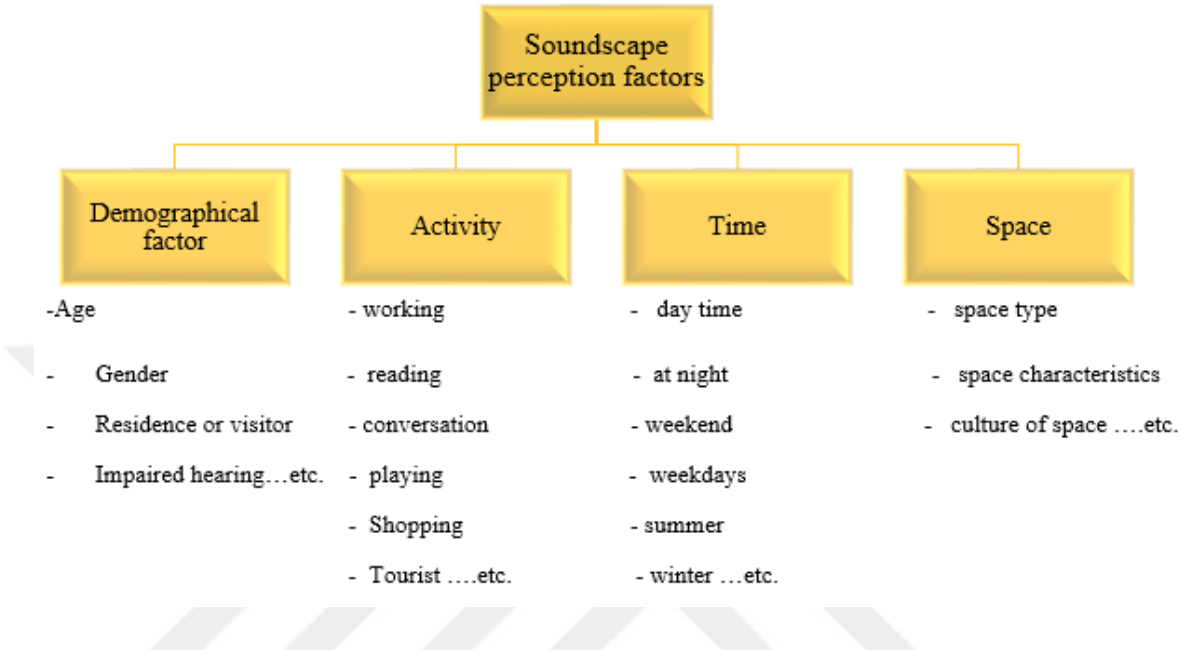


Figure 2.2. Soundscape perception factors (Jennings & Cain, 2013)

Similarly, a conceptual model of environmental experience was presented based on three concepts, namely person, activity, and place, all of which have interrelations with each other and affect the environmental experience (Herranz-Pascual, Aspuru, & García, 2010). Furthermore, dependent factors of soundscape perception are presented as (1) the physical properties of sound, (2) the psychological factor, (3) the socio-cultural factor and (4) past experience (Bild, Coler, Pfeffer, & Bertolini, 2016; Manon Raimbault & Dubois, 2005; Yang & Kang, 2005b). As can be clearly seen, for soundscape studies, users are the focal point and the evaluation process is structured around it. Therefore, when people are evaluating soundscapes, contextual conditions, attention, their knowledge and past experience will also be effectual (Schulte-Fortkamp, 2001). It is emphasized in the literature that the perception of the sonic environment depends heavily on auditory attention (Marry & Defrance, 2013). The international standard created a conceptual framework of soundscape and perception of sound environment (Iso, 2014) as shown in Figure 2.4.

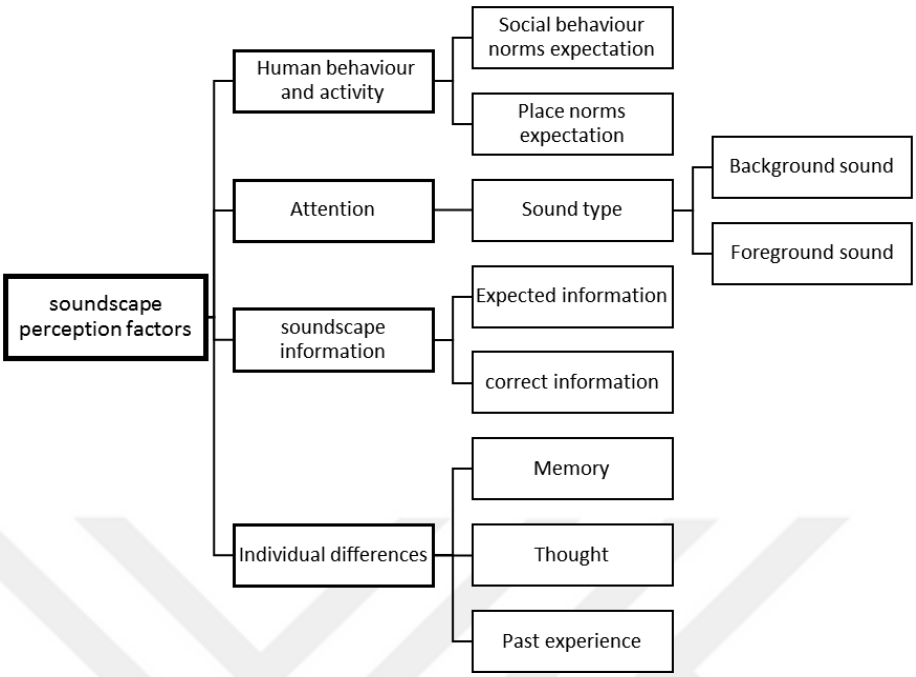


Figure 2.3. Soundscape perception framework (Jennings & Cain, 2013)

The expectation of soundscape can be defined as "A strong belief that something will happen or to be the case in the future, or the series of events which are anticipated prior to an experience". The expectation might form a significant part of the context (Bruce & Davies, 2014). To evaluate a sonic environment subjectively and how it has been perceived, the expectation of users who were in touch with a physical environment, should be understood (Dokmeci, 2013). In addition to psychological perspectives discussed above, sound evaluation also depends highly on the activities of the listener in a space (Lindborg, 2016).

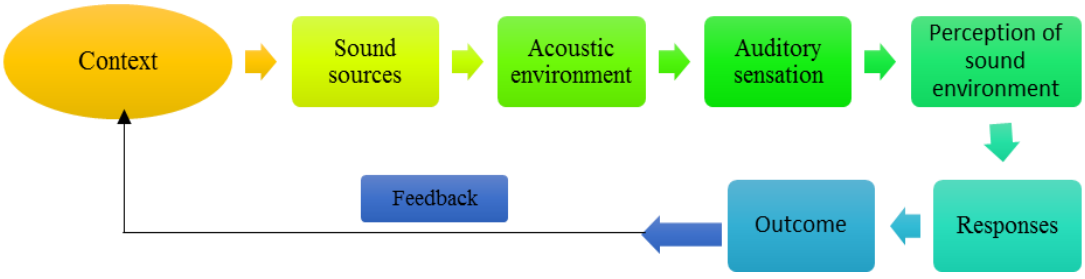


Figure 2.4. The conceptual framework of the soundscape (Iso, 2014)

Juergen Bauer Waterford Institute in 2016 has discussed the contribution between this triangulation Idea of soundscape that based on people, context, and acoustic environment versus "program – context – Idea" that proposed by architectural/urban design process. From this point of view, there are three premises that should be followed in the soundscape concept: Firstly, the location defined by the sound, secondly, comparing the location to the other locations regarding sound quality "sound benchmarks", and thirdly, how to get feedback to help the development of the concept (Bauer, 2016).

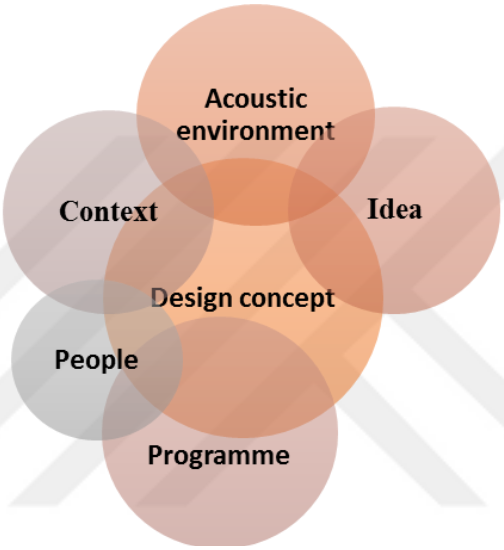


Figure 2.5. The architectural design process and soundscape triangulation combined to inform and strengthen the design concept (Bauer, 2016).

Therefore, an integrative soundscape evaluation approach could be adapted, while analyzing the contextual experience of users by concentrating on demographic data (individual characteristics, and socio-cultural aspects), space usage (preference, frequency of usage, and time spent), and psychological factors (expectation, perception, and reaction) (Dokmeci Yorukoglu & Kang, 2016). The soundscape can be classified according to three aspects; sound type, acoustical information, and information category (McGregor, Leplâtre, Crerar, & Benyon, 2006). Sound sources, sound level, and sonic environment quality are significant for describing soundscape. Because of that reason, establishing framework model and characterising soundscape components are desired (Aletta et al., 2016; Zhang & Kang, 2007).

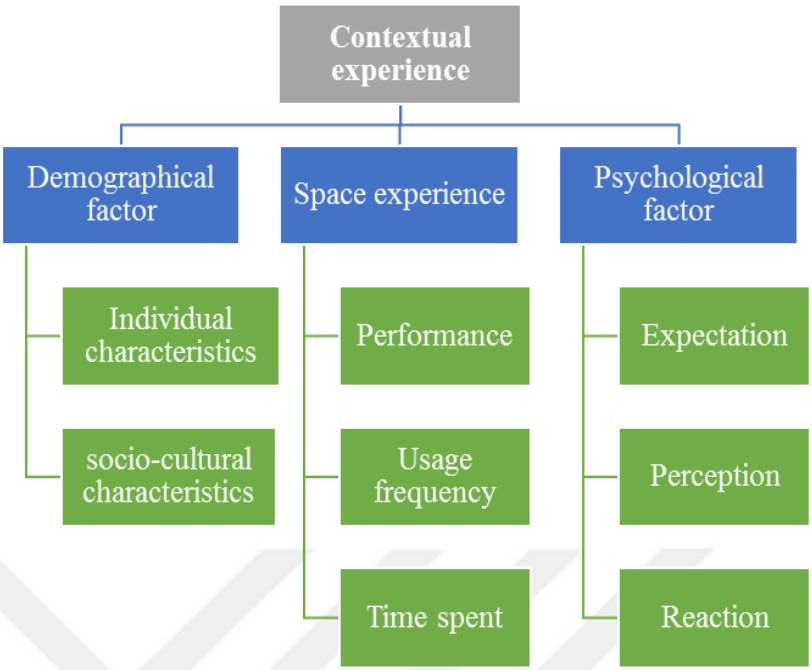


Figure 2.6. The framework of contextual experience variables (Dokmeci Yorukoglu & Kang, 2016)

2.2 Individual Perception and Social Perception of Soundscape

The perception of a particular space depends on an individual sense that gains on experiencing that space. Gathering the information of space is applied through five senses (vision, hearing, smell, tactility, and taste senses), which control the perceiving of space context. “A schema” that arises by these five senses refers to the reactions of individuals to a certain situation. On the other hand, the spatial perception has also been explained, as “our perceptions are not only the result of a mechanical process of vision but that they are filtered through our memory and intelligence”. The opportunities that the space offer, can be perceived individually, which attributed to the gained awareness by cognition (Dokmeci, 2013). For the different context of space, it is conceivable that the individual's desire of a setting is a key variable in their view of that space. It takes after that outline and arranging regulations ought to consider recognition and that they should be "founded on the suspicion that individuals expect diverse sonic environment for diverse space" (Bruce & Davies, 2014). In addition, the

perception of soundscape deals with seven general concepts: context, sound sources, acoustic environment, auditory sensation, interpretation of auditory sensation, responses, and results (Herranz-Pascual, García, Aspuru, Díez, & Santander, 2016; Kang & Schulte-Fortkamp, 2016).

On the other hand, there is an interaction between visual and soundscape perception that when we perceive visual information in the space it will modify the perception of the soundscape at the same time (McGurk & MacDonald, 1976; Offenhuber & Auinger). The visual and sonic variables work as a pair (audio-visual), which means that they have interactions. It is reported in a related study that, "the attention to the visual form reduced the conscious perception of sound, and vice versa" (Yang & Kang, 2005b). In another study, significant correlations were found between landscape and acoustic satisfaction, between visual and acoustic satisfaction, as well as between view and quietness (Kang, 2010). Moreover, sounds affect the perception of a landscape and identify the contribution of acoustic and visual input (Giuliani, Scopelliti, & Capirci, 2001).

Whereas the impacts of individual soundscape components on the subjective evaluation of charm and excitement were contrasted and related physiological reactions, heart rate (HR), respiratory rate (RR) and electromyography (EMG) levels (Hume & Ahtamad, 2013).

2.3 Merged Model of Soundscape Perception Factors

Through the detailed review of the studies in the literature, it has been noted that, there is a difference in the levels of categorization in the soundscape field according to the aim of the study and to the capability of the authors (Niessen, Cance, & Dubois, 2010). Therefore, in this research, and according to the soundscape related studies, the scope of soundscape research and soundscape perception categorizations have been reviewed by the integration of different studies and unified to form a merged framework model. In order to establish this model, reviewed classifications are first presented in Table 2.1, by noting the previously defined soundscape and perception factors of each reviewed study. Secondly, factors are merged under six basic factors and detailed items are exemplified in Figure 2.7.

Table 2.2. The produced six factors of soundscape perception

Previous studies related with soundscape and perception	Previously defined factors on soundscape and perception		Merged factors for soundscape perception
(Brown, Kang & Gjestland, 2009; Kang, 2010; Zhang & Kang, 2007)	Sound sources		1. **SONIC** 2. **SPATIAL** 3. **TEMPORAL** 4. **PSYCHOLOGICAL** 5. **BEHAVIOURAL** 6. **PERSONAL**
	Space type		
	Visual information		
	Personal characteristics		
(Davies, 2013)	Soundscape information		
	Human behaviour		
	Attention		
	Individual differences		
(Jennings & Cain, 2013)	Space		
	Time		
	Activity		
	Demographical factors		
(Dokmeci Yorukoglu & Kang, 2016)	Space usage factors (preference, frequency of usage, time spent)		
	Psychological factors (expectation, perception, reaction)		
	Demographical factors (individual characteristics, socio-cultural aspects)		
(Lindborg, 2013, 2015)	Expectation		
	Preferences		
	Mood		
	Activities		
(Bild et al., 2016; Manon Raimbault & Dubois, 2005; Yang & Kang, 2005b)	Physical properties of sound		
	Psychological factor		
	Socio-cultural factor		
	Past experience		
(Herranz-Pascual et al., 2016; Kang & Schulte-Fortkamp, 2016)	Sound sources		
	Acoustic environment		
	Auditory sensation		
	Interpretation of auditory sensation		
	Responses		
	Results		
	Context		
(Marry & Defrance, 2013)	Auditory attention		
(Schulte-Fortkamp, 2001)	Contextual conditions		
	Attention		
	Knowledge		
	Past experience		

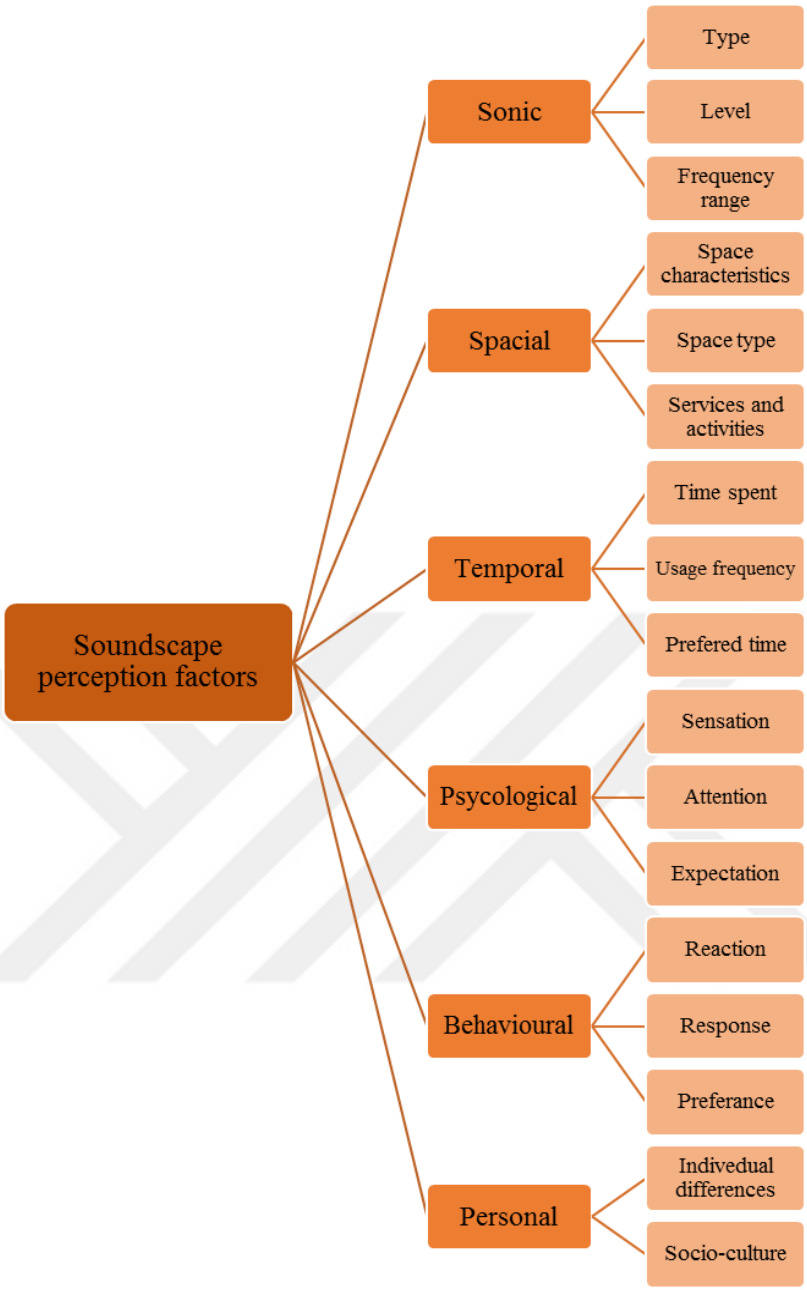


Figure 2.7. The produced six factors of soundscape perception and their details to be tested by acoustical post-occupancy evaluation.

Based on these previous studies and the variation of identifying soundscape perception, this study creates a detailed framework of soundscape perception factors that will be tested by acoustical POE and would be beneficial to emphasize the ranging structure of soundscape field and design-related fields within this multidisciplinary content.

CHAPTER III

SPATIAL EXPERIENCE

The combination between acoustic and visual images in the same space influences the perception of soundscape and space experience (Gozalo et al., 2015; Solomon, 2012; Yang & Kang, 2005b). Yet, through the use of all senses spatial awareness is created and overall space experience is built. Heidegger has inspired a particular approach to understand the social processes of space construction. He focuses our attention on the way in which places "are constructed in our memories" and affections through repeated encounters and complex associations. He emphasized how place experiences are necessarily time-dimension and memory-qualified (Harvey, 1996). The perception and emotional response to space are based on multi-sensory inputs embodied in visual and auditory inputs among the other interacted senses to establish the sense of space (Dumyahn & Pijanowski, 2011). Spatial experience can be distinguished by a compound of senses and thought to work in conjunction together to create experience (Kinayoglu, 2009; Tuan, 1977; Turner, McGregor, Turner, & Carroll, 2003).

3.1 Review on Space Experience

A systematic review of space experience is made based on the database from a range of journals. The articles were being in database by searching in Science Direct, and Scopus for top journals related to the following key words;

1- Space

2- Spatial

3- Experience

4- Factors

5- Classifications

Table 3.1. The article of space experience in top journals

Journal	H. Index	Number of articles regarding the keywords				
		Space	Spatial	Space Experience	Space Experience Factor	Space Experience Factor Classification
Journal of memory and language	118	629	335	0	0	0
Cognitive psychology	100	497	408	0	0	0
Social science research	66	502	459	2	0	0
Archives of acoustics	16	65	0	15	1	1
Scientific Research and Essays		197	_	7	0	1

In this second phase search for the space perception field, the search process was also structured from an extensive to narrowing down approach in order to find more related articles. The first broad search was by the keyword space that led to find 1890 articles. The second search is done by the keyword, spatial and 1202 articles are found. In order to do more narrowing down search other restricted search has been done by space experience than space experience factors, and finally, by space experience factor classification in order to find more specific articles related to the scope of this study.

3.2 Space Quality and Contextual Experience

The ecologically focused clarification of sense of place can likewise be translated from a phenomenological point of view. In spite of the fact that sense of place is to some extent an Inalienable property of the environment, individuals encounter this sense through physical contact with the environment, by occupying it. Moreover, from this

perspective, sense of space portrays the significant features of vicinity that people can sense through a personal ordeal of a space. (Kinayoglu, 2009). Most of the studies have concerned with urban experience based on formal and structural measures of the visual image the main factor, while the sonic environment qualities play a secondary role in the experience of urban spaces. Visual sense is different to hearing sense, almost the visual attention is focused on an object which has influenced by the distance between the observer and the object. On the other hand, the hearing sense covers about 360 degrees of direction. Consequently, the sonic environment affects us more directly than the other factors of space experience (Offenhuber & Auinger). Spatial capacity gets to be spatial knowledge when developments and changes of the area can be imagined. Strolling through the space creates ability to get information from different events such as looking to different images and wayfinding. That information is transferable to someone else through unequivocal guideline in words, with charts, and when all is said in done, by indicating how complex movement comprises of parts that can be dissected or imitated (Tuan, 1977). Moreover, there is a combination between soundscape and space that any changing on space will make changes in the soundscape itself and the opposite will be these changes can be measured by investigating the experience of occupants in a space (Jennings & Cain, 2013). In order to analyse a human perception in a sonic environment, understanding of psychological process should be illustrated as shown in Figure 3.1 (Dokmeci, 2013). However, the framework could not identify the interaction between soundscape perception and experience of space, whereas it can be used as approached framework.

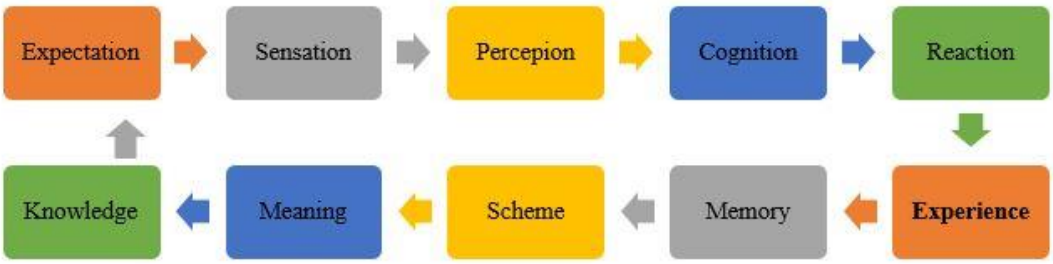


Figure 3.1. Psychological process (Dokmeci, 2013).

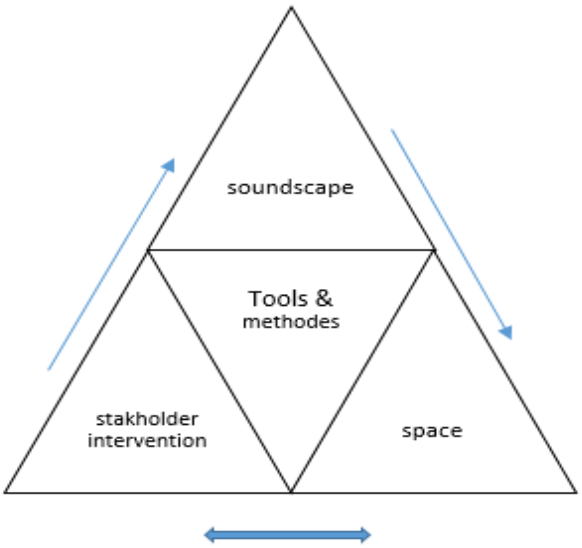


Figure 3.2. The impact of stakeholder intervention (Jennings & Cain, 2013)

Moreover, there is a combination between soundscape and space that any changing on space will make changes in the soundscape itself and the opposite will be, these changes can be measured by investigating the experience of occupants in a space(Jennings & Cain, 2013)

3.3 Factors Affecting Experience

The place experience is multisensory; there is still a considerable bias towards a visually centred approach in all of these disciplines. This is related to the widespread acceptance of vision as the primary sense (Kinayoglu, 2009). On the other hand, other factors affect the experience of space in the buildings, include space design (materials, colours, architectural plan design, furniture, etc.), environment quality (temperature, noise, smell, light, air quality, etc.), space complexity (shapes, triangulation points, colours, graphics, lights, and configurations), and social factors (gender, age, education, past experience, etc.). The most important thing in the complexity factor of space components that are being effective at the first time of perceiving then will lose their

effectiveness by time spent in the space (Hidayetoglu, Yildirim, & Cagatay, 2010). the overall experience of space is achieved through the integration of different social and psychological factors such as place satisfaction, previous experience, familiarity, expectation, space identity, and information (Herranz-Pascual et al., 2010). Therefore, in order to improve public spaces, the environmental variables integrated with the perception and expectation of space should be investigated in combination with the

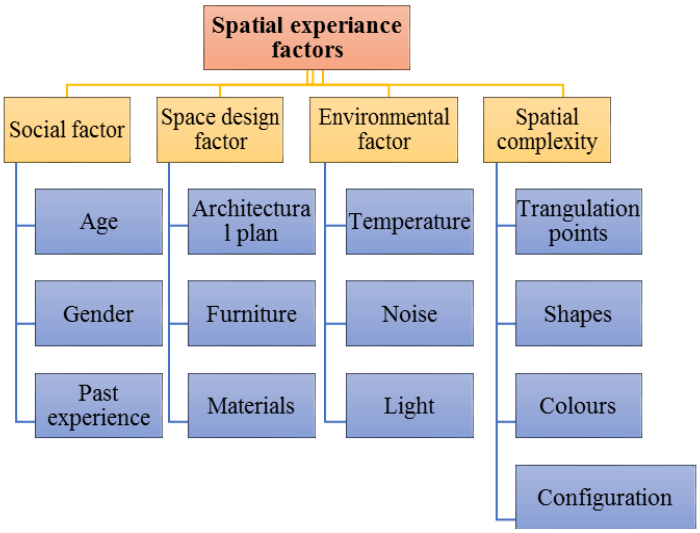


Figure 3.3. Spatial experience factors

social perspectives (Aspuru, Fernandez, García, & Herranz-Pascual, 2013). The sonic environment makes important differences on the experience of spaces (Adams, Davies, & Bruce, 2009).

3.3.1 Spatial Memory

Heidegger has inspired a particular approach to understanding the social processes of place construction. He focuses our attention on the way in which place "are constructed in our memories and affections through repeated encounters and complex association. Also his study emphasised how time-dimension and memory-qualified are necessary for place experiences (Harvey, 1996).

On the other hand, spatial experience and time are largely subconscious. The user has a sense of place because he can move during a time through space, this movement that gives us a sense of space is the resolution of tension (Tuan, 1977). Most of the previous studies have considered the time spent as an essential variable, they presumed that length of time of stay in the space and recurrence of travel are impact the connection with space.(Kang, Chung, & Ip, 2006). Another comparable study observed that time spent by users in the food court of a shopping centre demonstrated a huge positive correlation between noise and time spent (Dökmeci & Yılmazer, 2012). These studies enhance that the time spent is essential element that influences user experience and soundscape perception (Dokmeci, 2013). Space can be identified as a conglomeration of shapes, forms, colours and appearances, which appreciated by vision, the other suggestion that space is also made out of sounds, smells, tastes, and textures.

Ecologically, these modalities operate in conjunction with each other in place experience (Kinayoglu, 2009). The sense of being somewhere can be created by soundscape, which compares very favourably with the real places (Turner et al., 2003). The soundscape composition then is a new place of listening, meaningful precisely because of its schizophonic nature and its use of environmental sound sources. Its location is the electroacoustic realm. Speaking from that place with the sounds of the living environments inevitably highlights the surrounding world, and the relationship to it (Westerkamp, 1999).

3.3.2 Visual Perception

As a common saying: "*seeing is believing*", the vision has long been considered as the most dominant of all the senses (Kinayoglu, 2009). The idea that when you are perceptually aware of the things around you through vision, your experience has a qualitative characteristic that is often called that of presenting its objects "from a point of view". For instance, the experience of looking at a chair from one side is different than that of looking at it from the other, and when you move with respect to an object of visual experience your experience of that object changes in a range of predictable ways. What's more, and as seems necessary if the visual experience is going to play the roles that it must in the motivation and guidance of action, among the things you are visually aware of are the spatial relations that perceived objects bear to your own body (Schwenkler, 2009). The combination between acoustic comfort and visual images in the same space influences the perception of soundscape and space experience. (Gozalo et al., 2015; Solomon, 2012; Yang & Kang, 2005b).

The basic elements of architecture is also presented in the literature for architectural design as; light, colour, temperature, ventilation, sound, smell, texture and touch, scale and time (S, 2009). Furthermore, architectural design approach is explained in detail by the basic aspects such as; plane and volume, form, space, organization, circulation, proportion and scale, and ordering principle (Francis & Ching, 1996). Functional (purpose, services), spatial (formal organization, spatial relationships, circulation patterns, shapes and dimensions), indoor environmental (air quality, lighting quality, acoustic quality, crowd level) factors under built entity variable of indoor soundscape framework also highlights the importance of architectural evaluation in user oriented studies (Dokmeci Yorukoglu & Kang, 2016). Whereas aesthetics, global comfort, and functionality of space were discussed (Manon Raimbault, Lavandier, & Bérengier,

2003). These exemplified variables and factor together constitute the formulation of architectural base and therefore be integrated in any analysis regarding space and spatial experience.

3.4 Merged Model of Space Experience Factors

According to the previous studies and the variation of spatial experience factors' categorization, this study has defined new merged factors chart regarding the similarity of the content and from a linguistic point of view. Therefore, in this research, the space experience categorizations have been reviewed from different studies and unified to form a framework model. In order to do that, firstly related classifications are presented in Table 3.2, and factors on soundscape perception are merged as presented in Figure 3.4. Two articles were clear in defining the space experience factors, and overall seven factors were presented. The factors that have similar meaning related to semantics or related to its sub factors were merged. For instance, demographical factors and social factors include similar sub categories thereby addressed under demographical factor as a generalized term. These sub categories can help the researchers to get more accurate results in evaluating the experience of space through an occupant, and help to facilitate proper evaluation tool POE working in high efficiency.

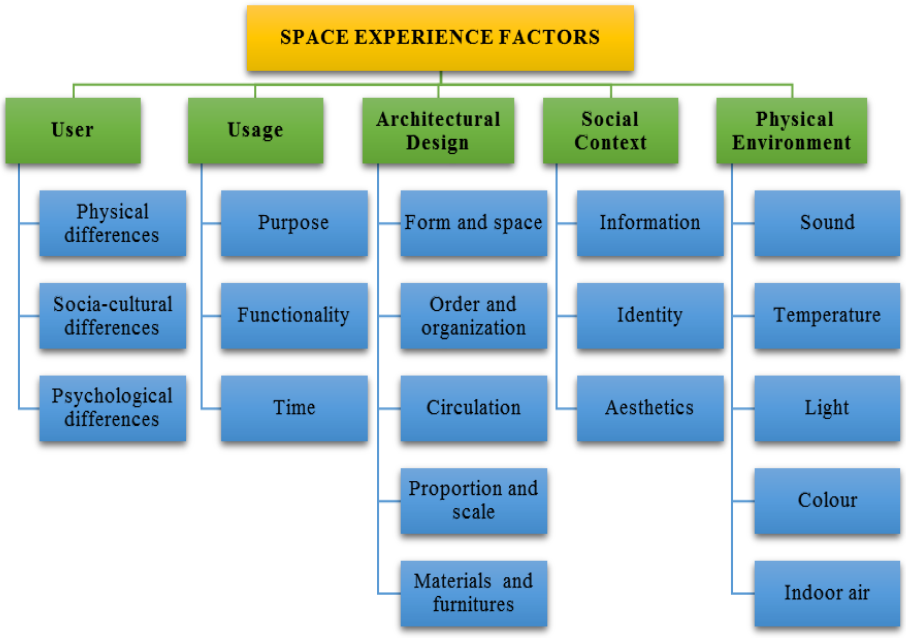


Figure 3.4. The produced five factors of space experience and their details

Table 3.2. The produced five factors of space experience

Previous studies related with space and experience	Previously defined factors on space and experience		Merged factors for space experience
(Hidayetoglu et al., 2010)	Environmental factors (temperature, noise, light)		1. **USER** 2. **USAGE** 3. **ARCHITECTURAL DESIGN** 4. **SOCIAL CONTEXT** 5. **PHYSICAL ENVIRONMENT**
	Space design factors (architectural plan, furniture, materials)		
	Social factors (gender, age, past experience)		
	Spatial complexity (triangulation points, shapes, colours, configurations)		
(Herranz-Pascual et al., 2010)	Place satisfaction		
	Previous experience		
	Familiarity		
	Expectation		
	Space identity		
	Information		
(Manon Raimbault et al., 2003)	Aesthetics		
	Global comfort		
	Functionality of space		
(Aspuru et al., 2013)	Perception		
	Expectation		
(Adams, Davies, & Bruce, 2009)	Sonic environment		
(Tuan, 1977; Kang, Chung, & Ip, 2006; Dökmeci & Yılmazer, 2012)	Time		
(Unwin, 2009)	Light		
	Colour		
	Temperature		
	Ventilation		
	Sound		
	Smell		
	Texture and touch		
	Scale		
	Time		
(Ching, 1996)	Plane and volume		
	Form		
	Space		
	Organization		
	Circulation		
	Proportion and scale		
	Ordering principle		
(Dokmeci Yorukoglu & Kang, 2016)	Functional factors (purpose, services)		
	Spatial factors (formal organization, spatial relationships, circulation patterns, shapes and dimensions)		
	Indoor environmental factors (air quality, lighting quality, acoustic quality, crowd level)		

Due to the related previous studies, the relationship between place and soundscape can be extrapolated. Relatively, the effect of soundscape positively or negatively on the perception of space, its experience will be effected successively, which will be the main concern of this study.

Integration framework model is crucial. This framework deals with two main concepts; soundscape perception is integrated with space experience, which will formulate the acoustical post-occupancy evaluation study proposal. Also adapting POE tool is to construct the relationship between soundscape perception and spatial experience. Thereby, user decides whether a space and its components are suitable within the given context or not.

CHAP TER IV

METHODOLOGY AND CASE STUDY

4.1. Conceptual Framework

Soundscape perception and spatial experience studies are closely related to user pleasantness and satisfaction. Whereas, acoustical post-occupancy evaluation (POE) process is concerned with more on user satisfaction and intended to find out their qualitative feedback according to their experience with the sonic environment in space, in negative or positive aspects through diverse methods of data collection (Hassanain, 2007). POE is normally used to assess building performance considering a wide range of performance criteria. In order to evaluate the relationship between soundscape perception and overall spatial experience, it is important to establish an integrated framework that concentrates on data collection and factorial evaluation.

In this study, POE tool is proposed to construct a relationship between soundscape perception and spatial experience. Hence, the key element between POE and space characteristics is the user. Therefore, the user could be decide whether a space and its components are interested or not within the given context. At early stages of design or spatial planning and programming, soundscape should be included as a crucial design aspect. Therefore, in this study soundscape perception and related factors are integrated with space experience and formulates the acoustical post occupancy study proposal.

As presented in Figure 4.1, an integration framework is proposed. This framework concentrates on the two different aspects mentioned in this study, which are soundscape perception and space experience. It is based on applying a proper tool to evaluate the relationship between two concepts; perception and experience in order to assess the relationship regarding the variation of physical elements and social differences that are considered under each variable. The crucial point in this framework is how to categorise the factors and collecting data from user and the

environment, in order to form an integrated evaluation that would feedback the future design project.

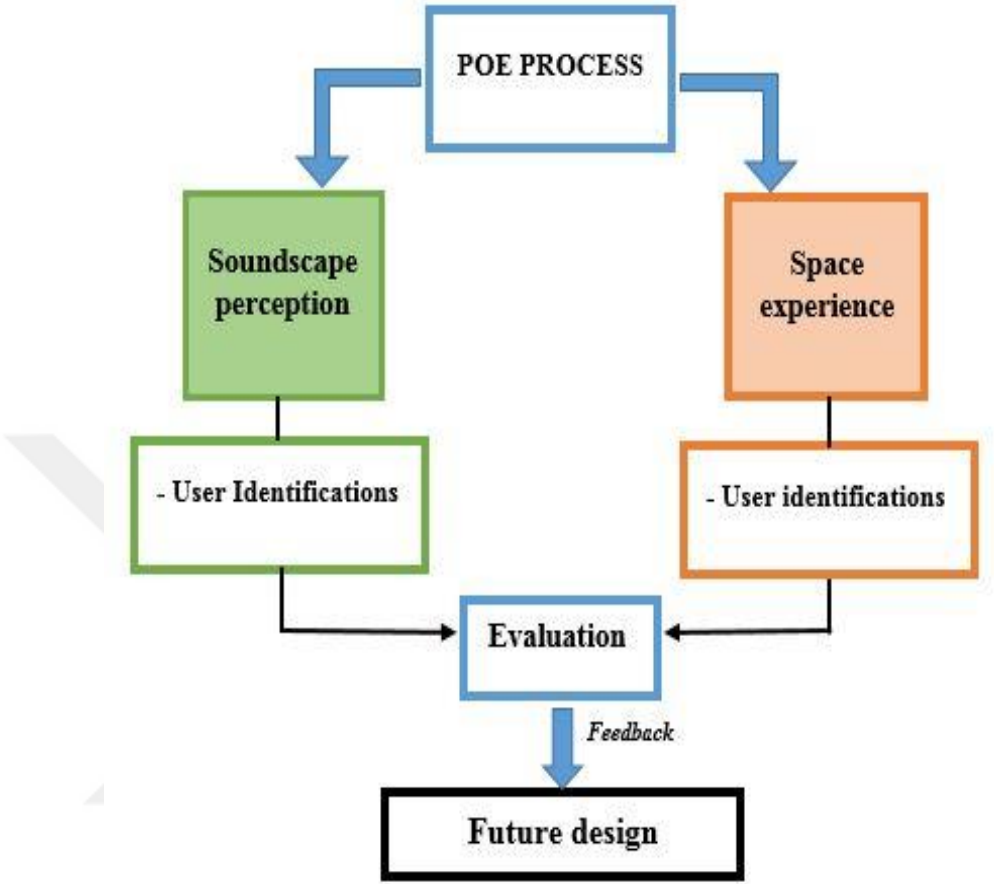


Figure 4.1. Conceptual framework of evaluating the relationship between space experience and soundscape perception

The POE process is a sequential of relative methods conducted in three stages indicative, investigative, and diagnostic. Besides investigating space and usage characteristics, POE also deals with occupant behaviours and their needs, to reveal results of building performance and consequences of past design decisions (Preiser et al., 1988). Acoustic POE term was first been used to evaluate buildings in tropical climates (Ribeiro et al., 2001), yet the approach was not been adapted to soundscape evaluation and used as a case specific evaluation tool. Therefore, this study aims to propose a more applicable methodological design that could lead to an archive of comparable studies in the future.

POE process has been used in building industry to influence all phases of the building process (Figure 4.2). In the term acoustics, the POE used to evaluate the built environment of space in order to improve the future projects acoustically (Figures 4.3, 4.4). Firstly, applying POE on the first project will feed the similar next project by reporting the problems that could influence the building process in the construction phase. In the second project applying POE will feed the earlier phases of building process in the programming and design phase, which allow the stockholders and decision makers to improve building performance in acoustic disciplinary.

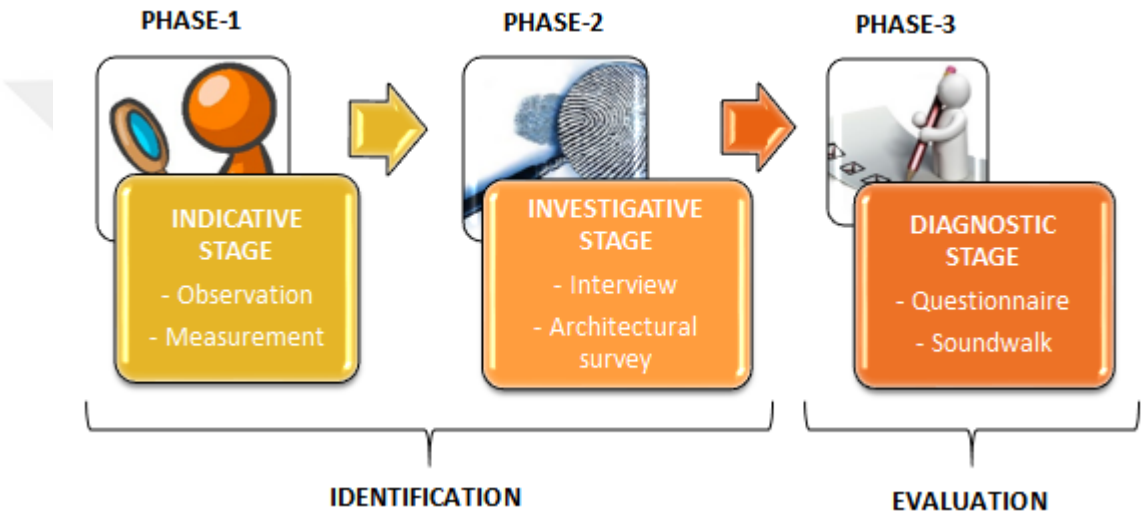


Figure 4.2. POE process levels and methods.

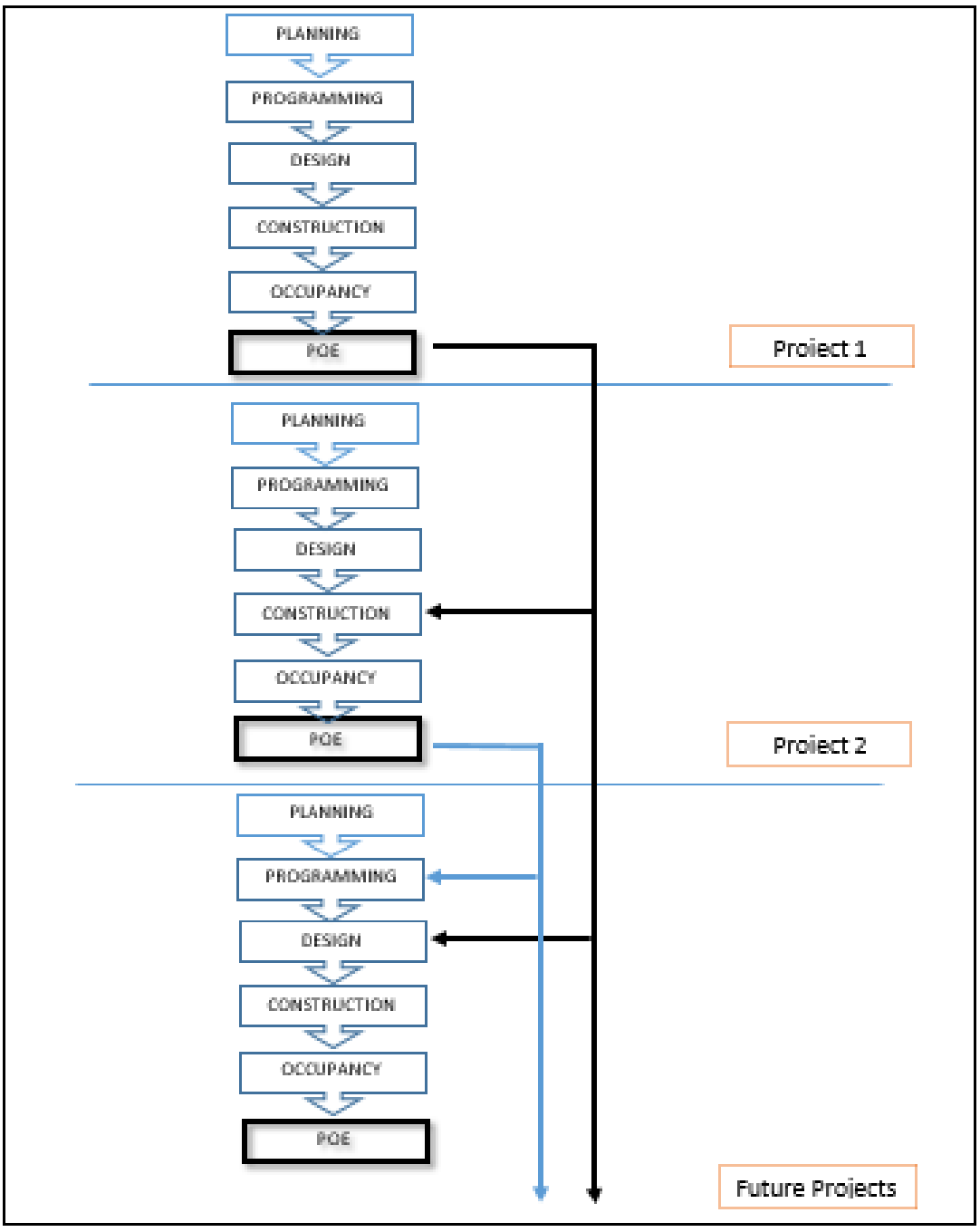


Figure 4.3. POE feeds building process to improve future project (Preiser et al., 1988)

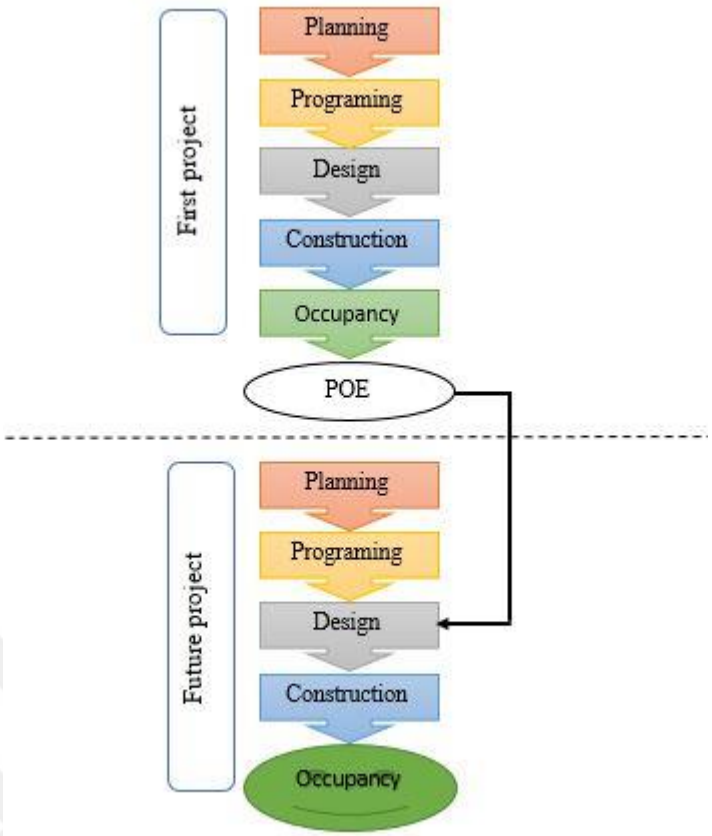


Figure 4.4. POE feeds design stage in future building process (Preiser, Rabinowitz, & White, 1988)

4.2 Methods and Data Collection

A proper tool could be used to test the research hypothesis through diverse methods. In this study, the POE process is proposed in order to evaluating the relationship between space experience and soundscape perception within their factors are intended to be carried out in the office spaces of architectural faculty in Cankaya University. The spaces were classified into two types; shared spaces, and single use spaces. The POE process will be applied in three stages:

1- The first stage includes observation and measurements in order to form the base of the study.

2- The second stage is to investigate the characteristics that were observed in the first stage, and other related factors in detail by using the interview protocol.

3- The third stage includes questionnaires to diagnose the factors that affect the experience of space according to the results of the 1st and 2nd stages to derive a final evaluation for feedback.

The collected data will be divided into subjective and objective variables (Jensen & Arens, 2005).The sonic environment is combined with three aspects according to the relationship between the perceived and the physical properties (experienced in situ, recalled in memory, and reproduced data) (see Figure 4.5) (Aletta et al., 2016).

According to the Aletta's scheme for data collection, we can create a modified structure for the sonic environment data to suit the research considerations. The changes are in the three stages; measurable data instead of reproduced data, using questionnaire and measurements as methods, the sound measurement will be used as a tool (Figure 4.6).

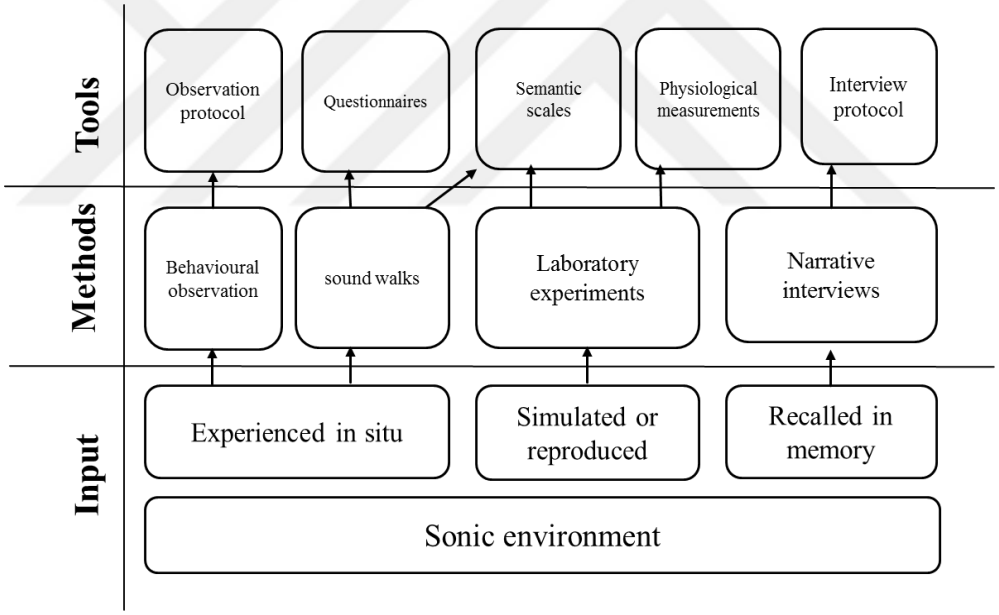


Figure 4.5. A schematic diagram of the relationship between data collection methods and used tools for soundscape (Aletta, Kang, & Axelsson, 2016).

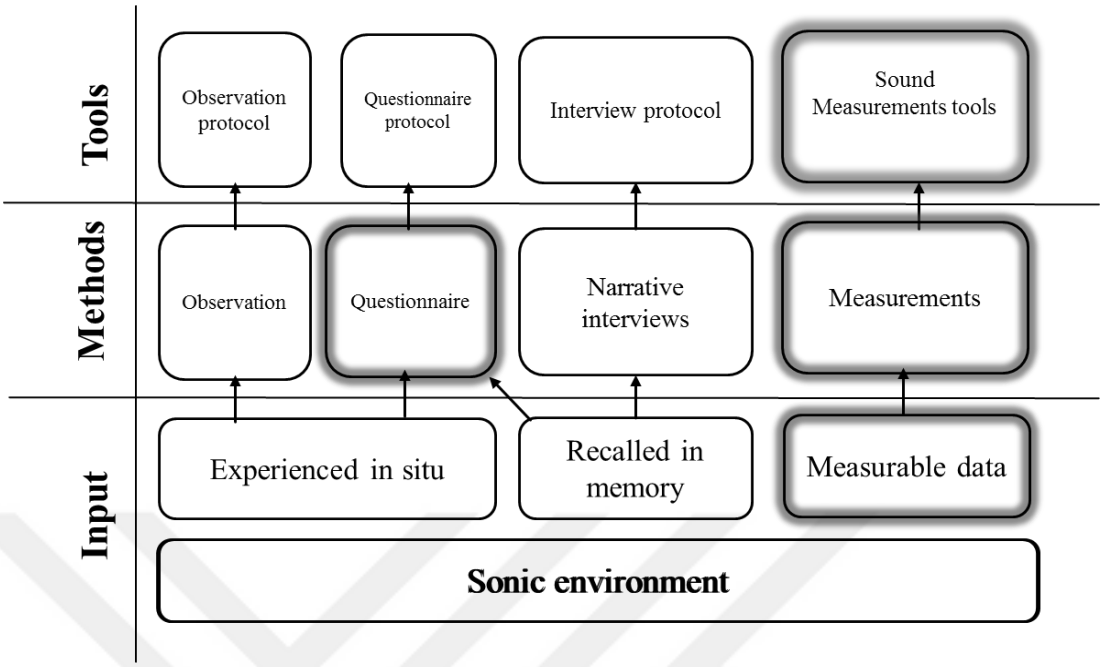


Figure 4.6. The modified scheme for data collection of soundscape

In the design of POE three phases; each phase builds upon one another by conveying information to the next phase from the collected data of the previous phase. Therefore, it is proposed that the data collected from the indicative phase will be evaluated and the information from the analysed data will be conveyed to the development of the interview content. Similarly, data collected from the interviews will be interpreted for the design of the questionnaires in the diagnostic stage. This proposed study design is based on the occupant's judgement of their surrounding environment and aimed for the testing of the proposed merged factors classified under soundscape perception and space experience. In the first indicative stage, observation method is proposed to collect data on spatial, behavioural, and usage related factors.

Table 4.1. Proposed study design to test merged factors of soundscape perception and space experience.

PHASE	POE STAGE	METHOD	TYPE OF DATA	EVALUATED SOUNDSCAPE PERCEPTION FACTOR	EVALUATED SPACE EXPERIENCE FACTOR
1	INDICATIVE	**Observation**	Qualitative	Spatial / Behavioural	Usage
		Measurement	Quantitative	Sonic	Physical environment
COLLECTED DATA USED TO STRUCTURE 2ND PHASE					
2	INVESTIGATIVE	**Interview**	Qualitative	Psychological / Temporal	User / Social context
		Architectural survey	Quantitative	Spatial	Architectural design
COLLECTED DATA USED TO STRUCTURE 3RD PHASE					
3	DIAGNOSTIC	**Questionnaire**	Qualitative	All soundscape perception and space experience factors are integrated for further statistical analysis	

In addition, measurements on sonic characteristics and physical environment are proposed for identifying environmental conditions. In the second investigative stage, data on psychological and temporal factors, in addition to user and social context related factors are proposed to be collected by interviews. Architectural surveying is also one major part of this stage to collect data on spatial factors and architectural design. In the final third phase on diagnostic stage, overall evaluation of the previously mentioned factors is altogether integrated. Questionnaires and soundwalks are proposed to collect data to understand the specific relationship between soundscape perception and space experience factors (Table 4.1). It is important to highlight that data collected from each phase should be used to structure the next phase, so that each phase could be linked with each other and therefore feeds one another.

Onsite surveys are used in order to get further information from the occupants. By the observations and interviews, amount of data has been collected in a relatively short period. Moreover, survey method can be created quickly and managed easily (Tookaloo & Smith, 2015). Surveys can be used to collect data on a wide range of themes, including aesthetics, temperature, acoustics, lighting, etc. Therefore, establishing an adequate survey is crucial in this research.

The survey on POE in this study starts with general questions, and move towards more specific questions within identification and evaluation methods. The general gaol of the survey is to cover areas discussed or discovered in the literature review to find their accuracy and their impact on the users of space. However, that is not only the goal of this survey, the pilot survey revealed points previously hidden in observation and interviews, this can help the researcher to structure the next step of the survey to analyse the data more rigorously.

All these methods (observation and measurements, interview, and questionnaire,) are related and complementary. Each method supports one other and increases the reliability of the overall study. However, it is important initially to apply each method separately in order to evaluate its validity and reliability. For example, there are points highlighted in observation and interview, which help to structure the questionnaire questions as shown in Figure 4.7.

Figure 4.7. POE process methods

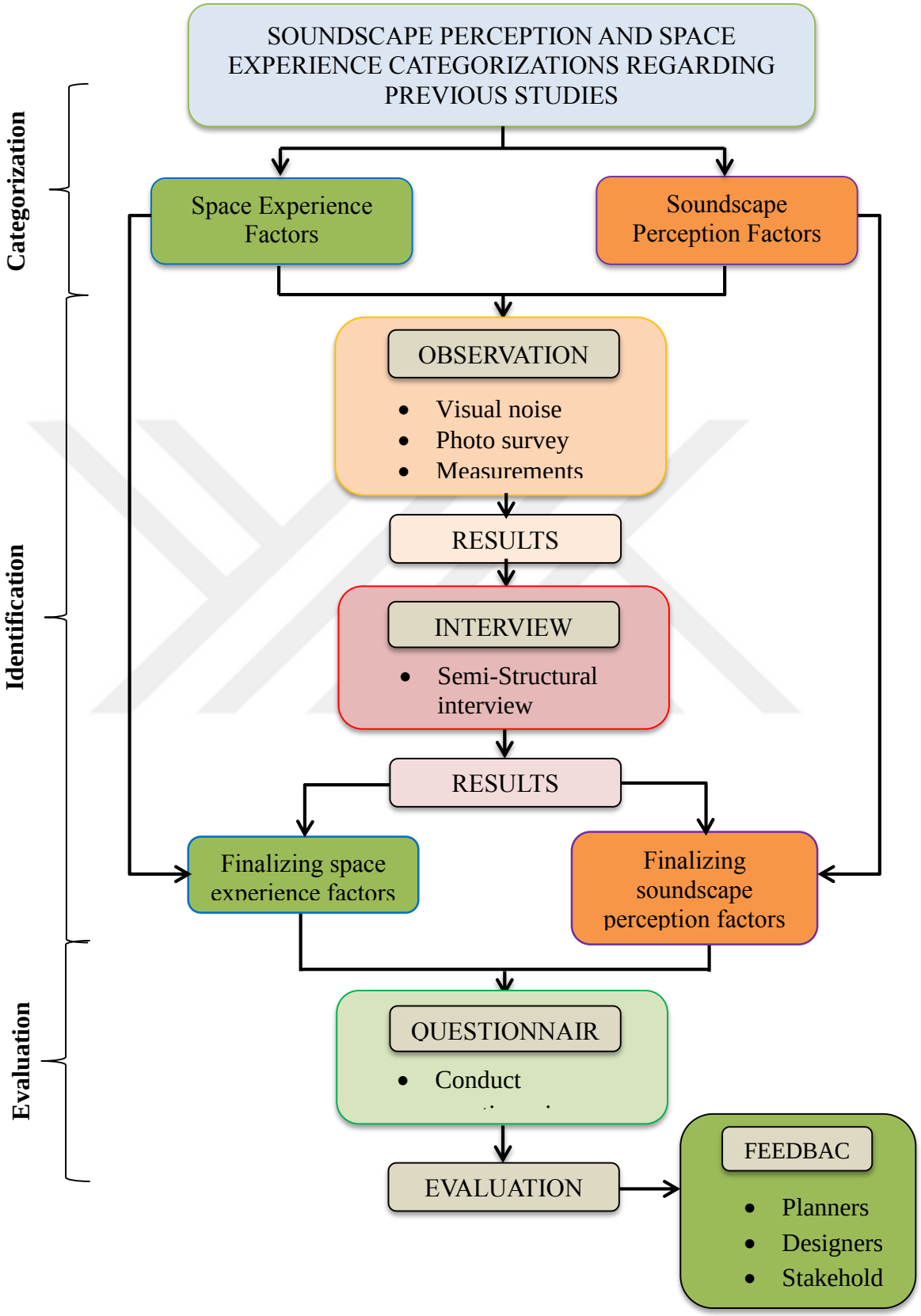


Figure 4.8. Methodology schema

4.3 Case Study Site

The case study spaces are chosen to be the offices of the instructors in the Faculty of Architecture in Çankaya University in Ankara. The complex is located in surroundings of gardens in the north and east, and schools in south and west direction Figure 4.9. The architecture faculty is on B block in the campus, it is surrounded by car parks and interior traffic roads in three directions. There are 38 offices in different stories with various orientations; every office has its specific characteristics Figures 4.10 and 4.11.

Figure 4.9. Site plan for the case study

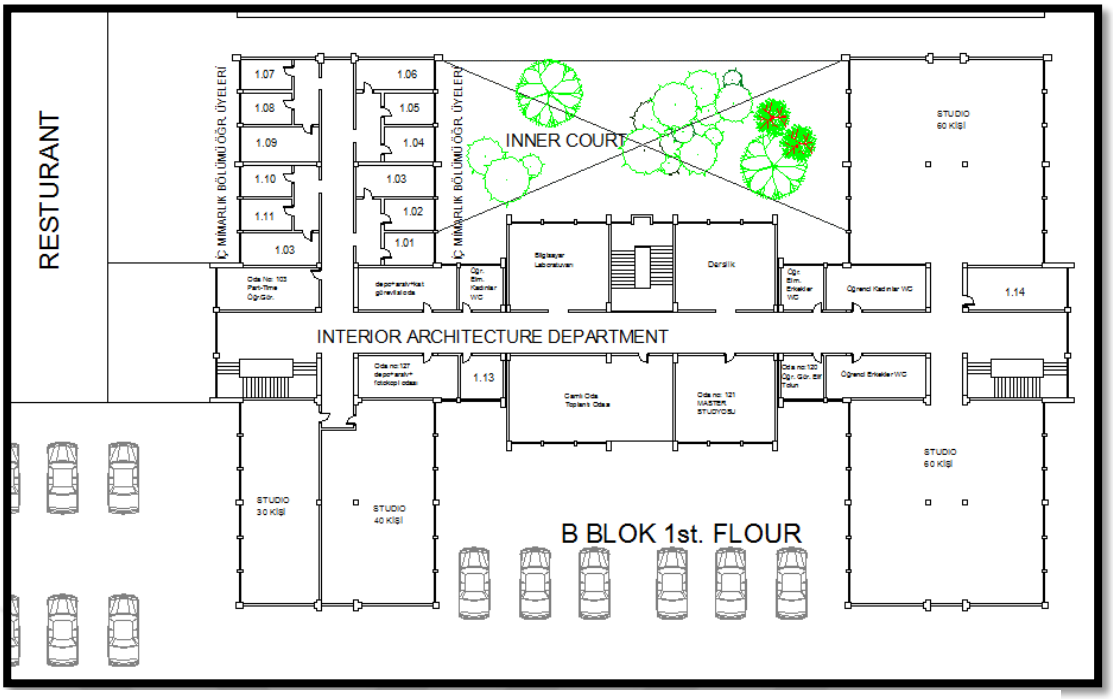


Figure 4.10. First floor plan of faculty of architecture building

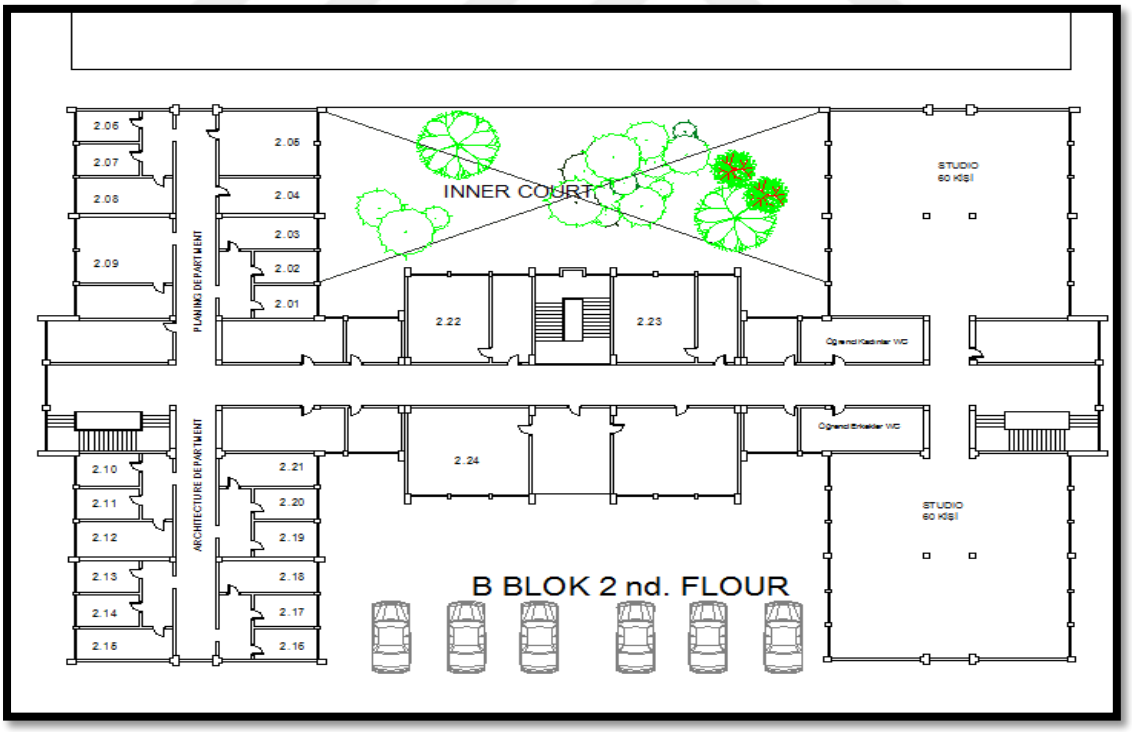


Figure 4.11. Second floor plan of faculty of architecture building

The population of interested for the pilot study are exist in the faculty of architecture where the building includes 38 offices. The context of these spaces has been observed.

4.3.1 Observation

The observation is the first step in the POE process in order to get an indication about space characteristics such as space type, colors, finishing materials, proportion and other subjective factors such as sound types, temperature, lighting, orientation,and aesthetics that can be observed by human senses (Figures 4.14 and 4.15).

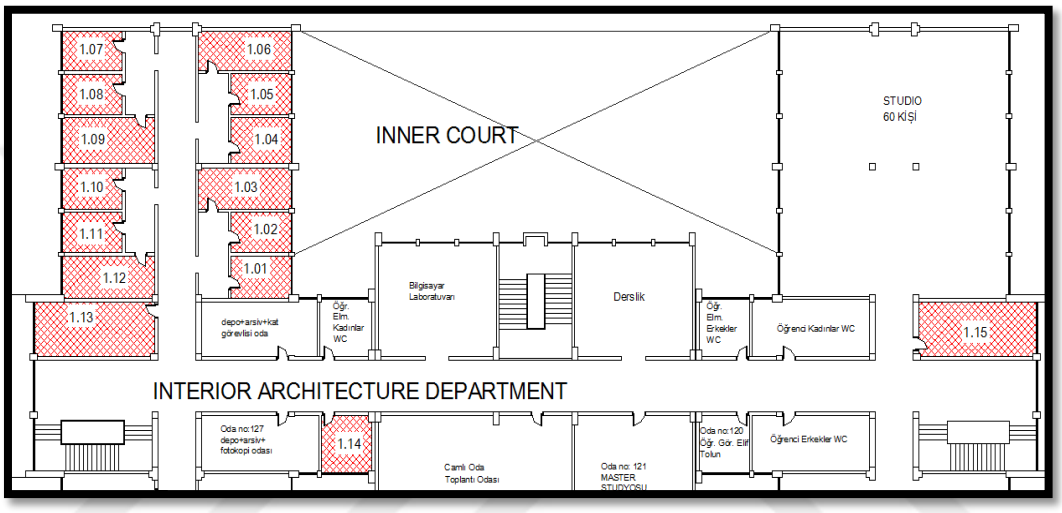


Figure 4.12. First floor: Department of interior architecture

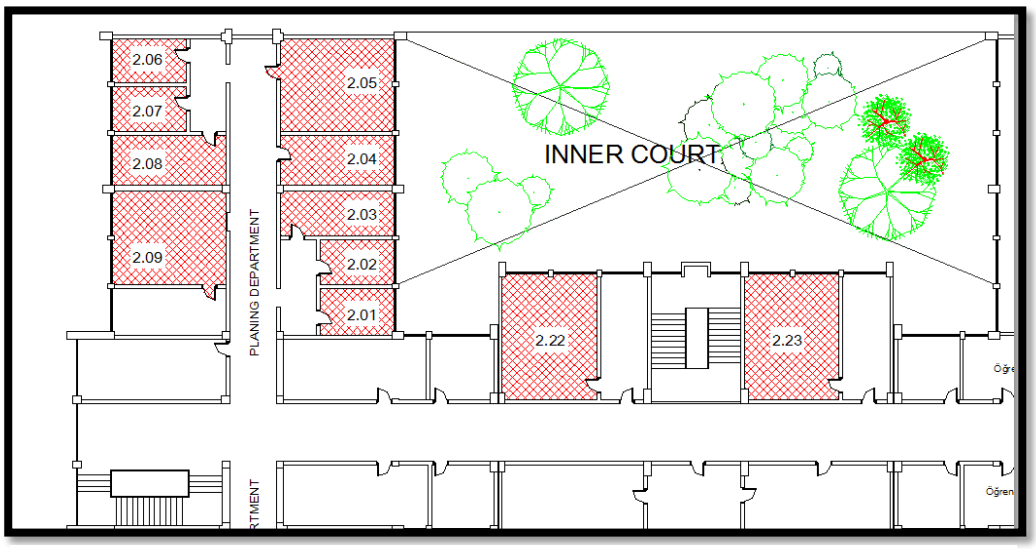


Figure 4.13. Second floor: Department of planning

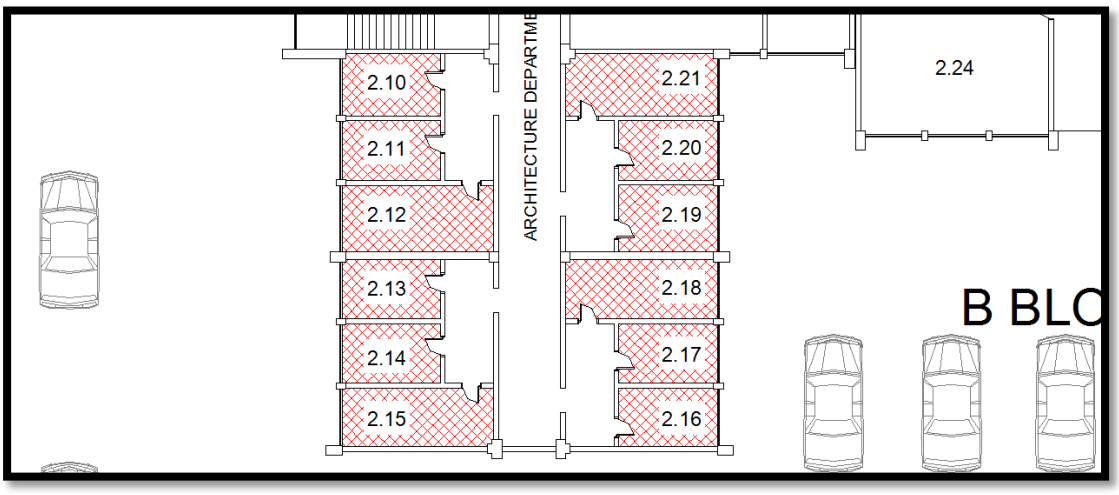


Figure 4.14. Third floor: Department of architecture

The data were collected from 38 offices in Çankaya University in the faculty of architecture. The collected data were included information about the time, room number, number of users, room design, room size, photographs, sketches, space finishes materials, sonic environment, environment quality, description of furniture. The benefits of this stage of survey is to get indication about spaces' environment and characteristics in order to start the identification level of survey within interviews. The observations are focusing on the subjective elements that are related to space design and quality, sonic environment, and environmental factors. The observed spaces are divided into two according to their types; shared spaces, and private spaces as shown in table 4.2 and table 4.3.

The spaces (offices) are distributed in the first and the second floor in small clusters of three private offices. These clusters of offices are linked by private and close ended corridors that open to the main corridor in the building. There are different types of sound sources that can be heard in the offices such as, talking and walking on the corridors, cars and people shouting outside the building. The furniture is organized in different ways according to the user and made from combined materials (wood and steel) and parts with three colors (beige, black, beige-black combined) in most of the spaces. Whereas the observation was applied in different times along the day, the lighting has been indicated that the luminance is being better at mornings but get lower and lower when the evening time is imminent, for that reason the users of spaces mostly use artificial lighting and desk light. On the other hand,

most of the offices that are located in the south direction use curtains to reduce sunshine and glare.

The observation data is analyzed by Excel software. Several similarities of observed factors in the case spaces were found. Therefore, the spaces are classified according to the similarities and differences of factors for the interview stage.

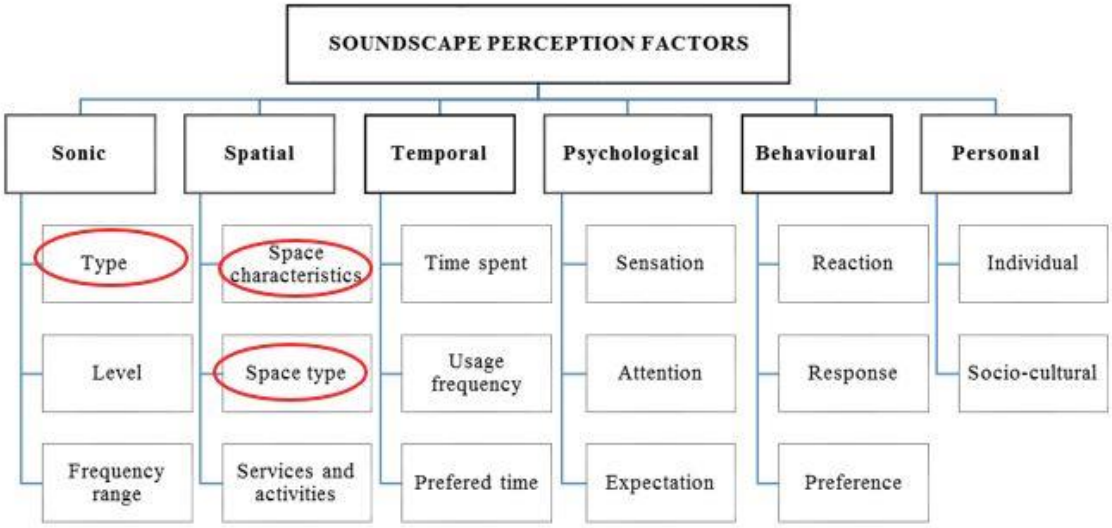


Figure 4.15. Observed factors regarding soundscape perception

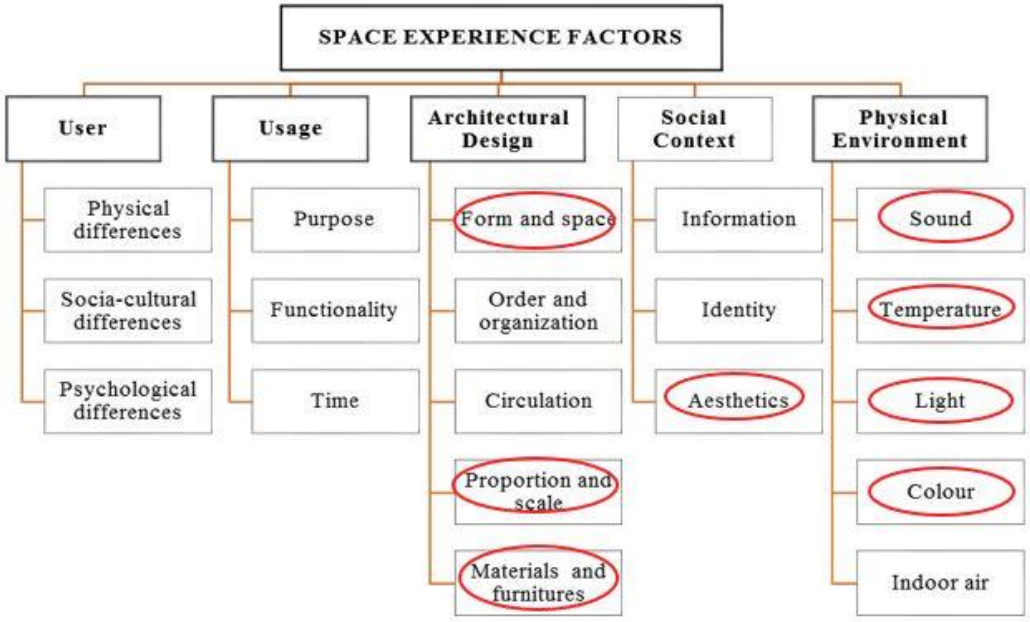
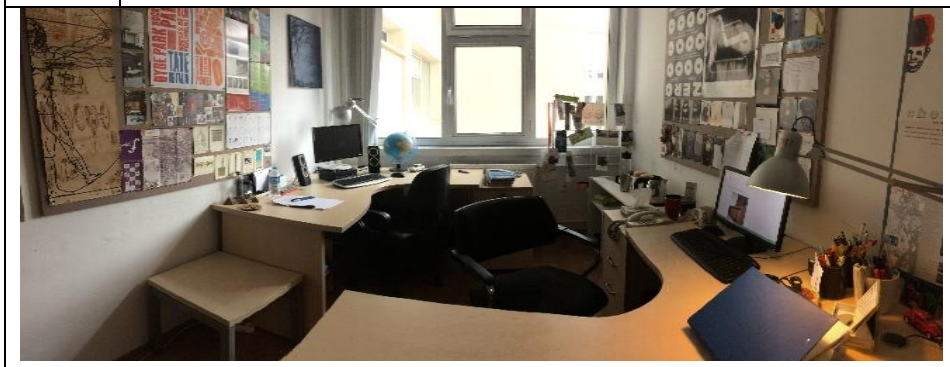
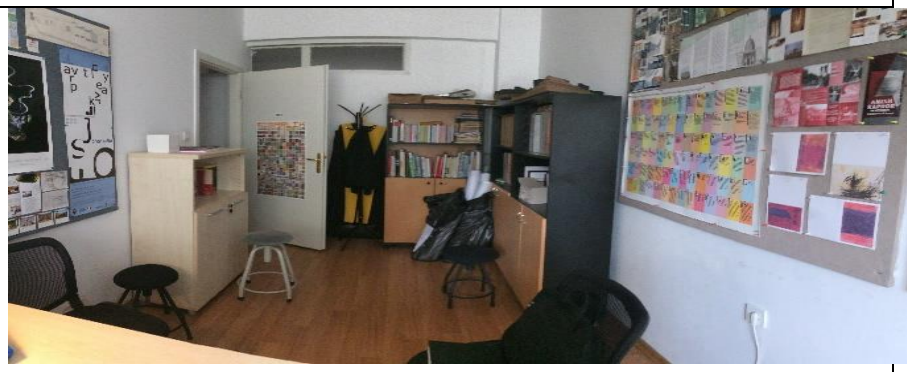
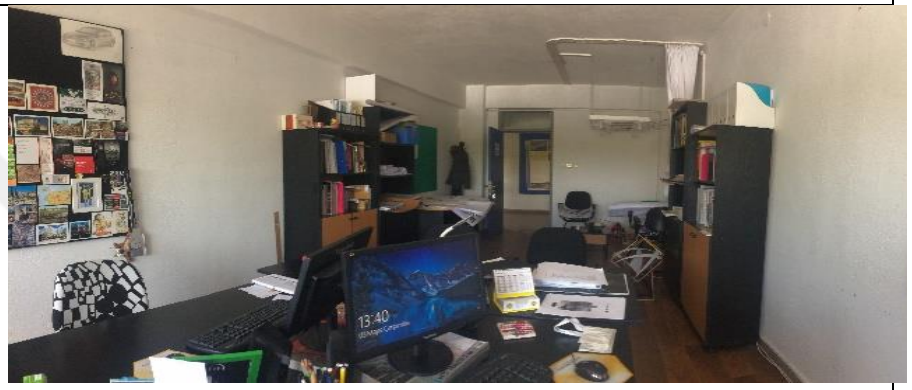


Figure 4.16. The observed factors regarding space experience

Table 4.2. The observed shared offices

Office code	Office description
2.12	This office is located on the second floor, shared by two people, overlooking to car park. It seems crowded and deep because the proportion of space is inappropriate.
	
2.21	This office is shared by two occupants, overlooking to main entrance and car parking. The space looks crowded and its size is inappropriate.
	

1.15	This space is on the first floor near the classes, and overlooking to car park. The space is open to the main corridor directly.



2.05	The office (11.0), is another kind of shared space. There are four persons in the office, overlooking to inner atrium, to north direction, the same furniture style can be observed.

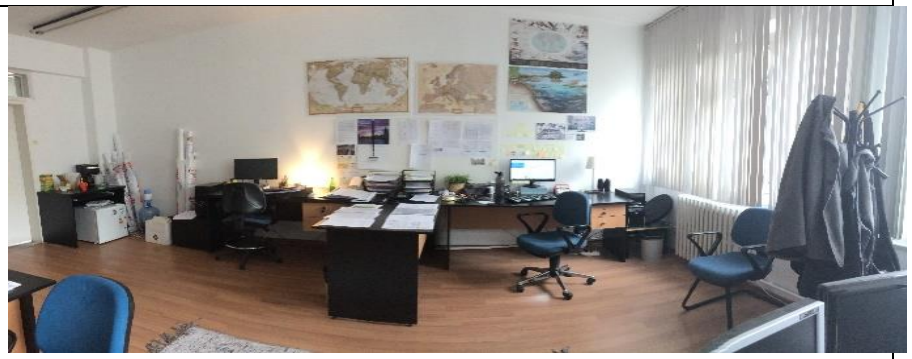
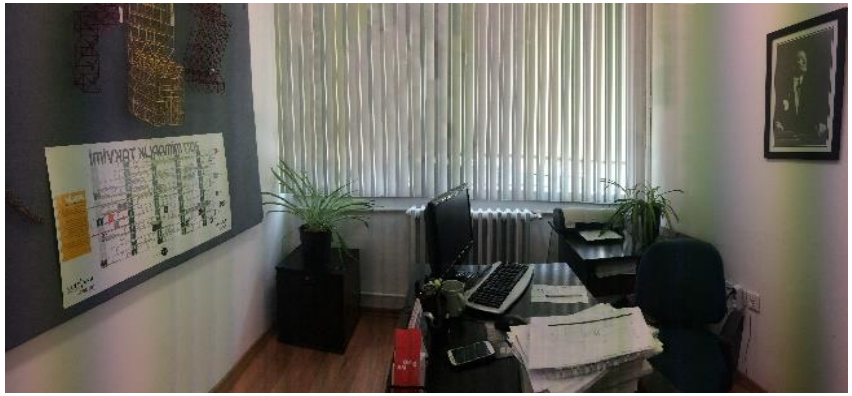
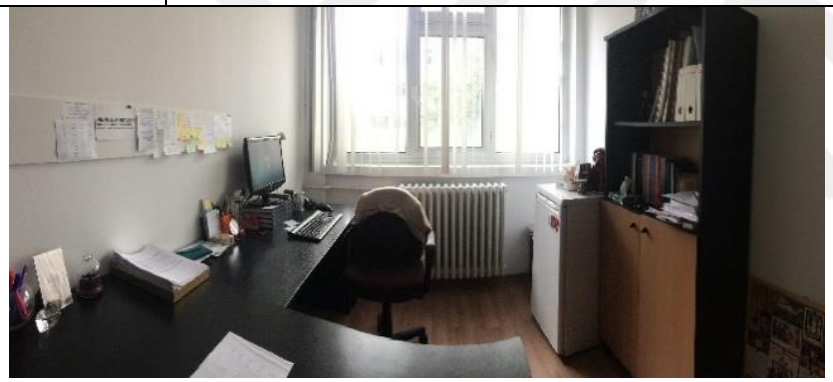


Table 4.3. The observed private offices

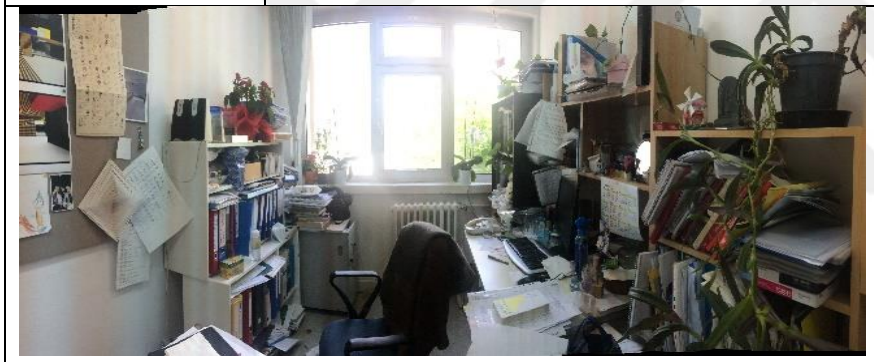
2.11	The picture was taken in the afternoon on the second floor. The occupant closed the plastic strip curtains to prevent the glare. The table arranged in diagonal position in the space. The office overlooks to the car park.
	
2.14	This office has the same location with the previous office 5.02, with a difference in its furniture layout. The occupant of space use plastic strip curtains to prevent glare.
	

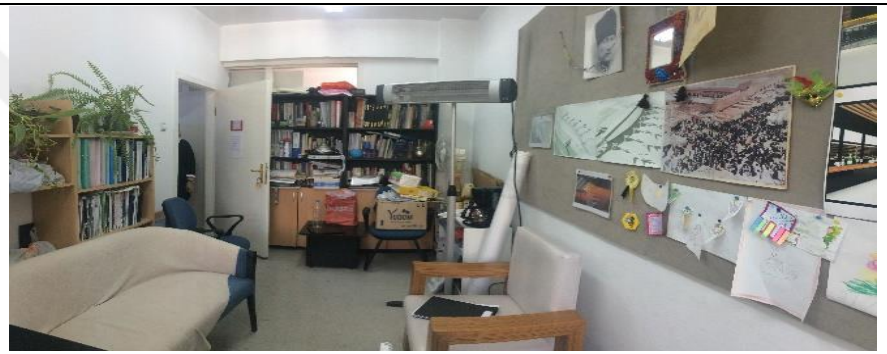
2.04	The orientation of this space is to north, and overlooking to inner atrium towards the green view. One user uses the space but the shape is rectangular with inappropriate proportion.



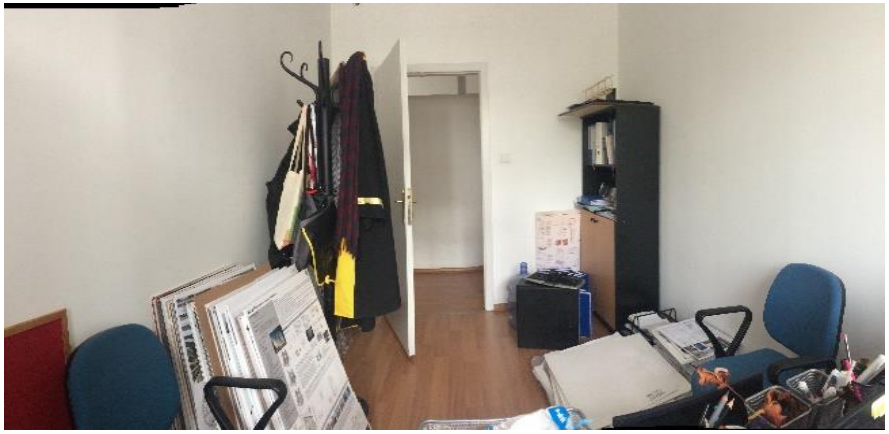
2.16	This office is on the second floor, with an orientation to north, and overlooking to car park and entrance. This is the first office with vegetation inside the space.

1.06	The office located on the first floor, looks crowded and too deep because of dimensions. It overlooks to inner atrium and desk does not face the door.





2.17	The office is located on the second floor, and overlooks to car park and main entrance of the building.



The results of the observation provide initial indications about the differences and correlations between spaces' variables, which will feed the interview questions. For instance, some spaces have enough luminance while other spaces do not have; the reason is the orientation of space, whereas the southern spaces have good lighting, the northern and western oriented spaces have less lighting most of the daytime.

The variables could be grouped into seven groups according to the objectivity of the factors, for instance the sound sources with the sound type, orientation with natural light and luminance, furniture (style, material, color), building finishes (walls, ceiling, roof), space shape, and privacy.

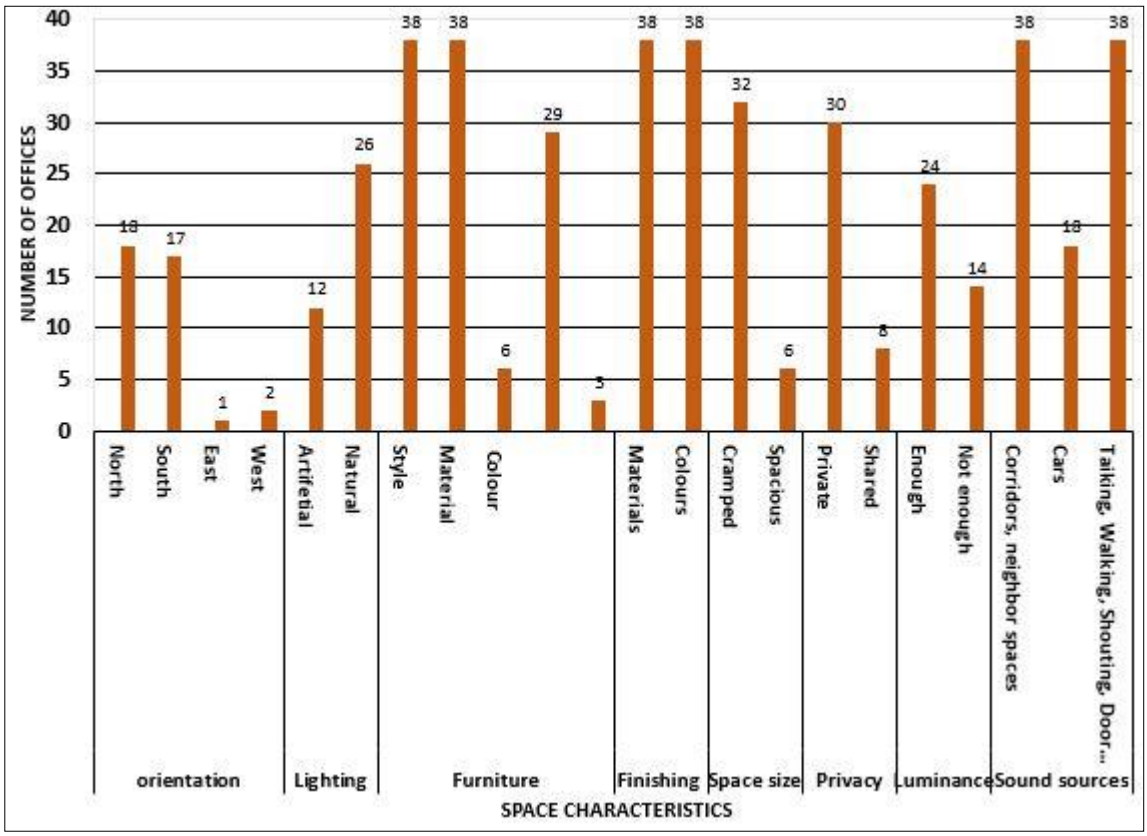


Figure 4.17. The observed space characteristics

Figure 4.17 illustrates the observed space characteristics and the frequencies of similarity in the spaces. This notes reveal the hidden characteristics of spaces which have a direct effect on user of space.

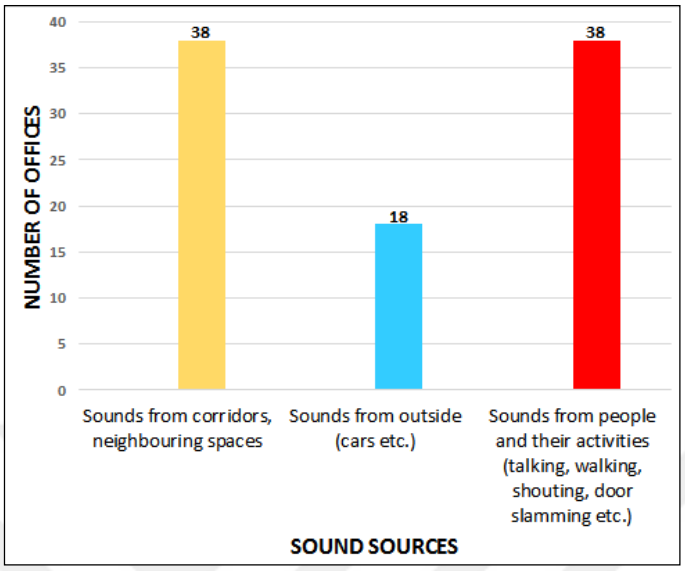


Figure 4.18. Sound sources and types

Sound sources and sound types in every space separately are noted that will help to measure the sound level of different type of sounds and its effect on users. Figure 4.18 shows two sources of sounds 1) from corridor 2) from outside and different types of sounds.

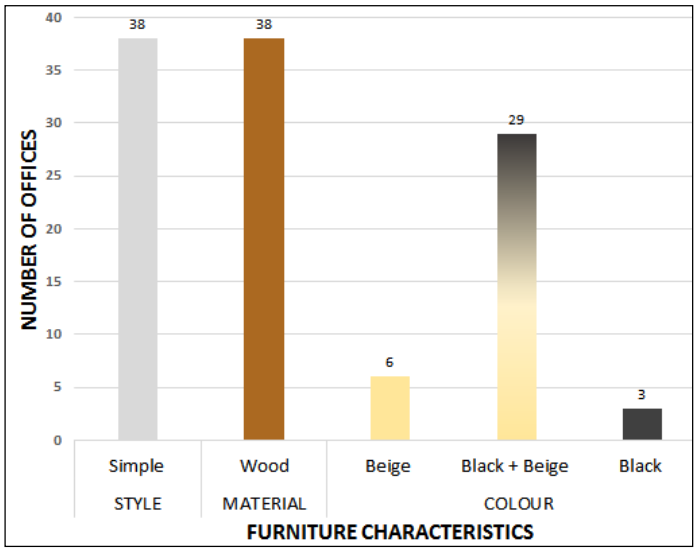


Figure 4.19. Furniture style, materials, and colours

Furniture style, furniture materials, and furniture colors are observed in every space in order to collect the based documentation notes about the spaces as shown in Figure 4.19.

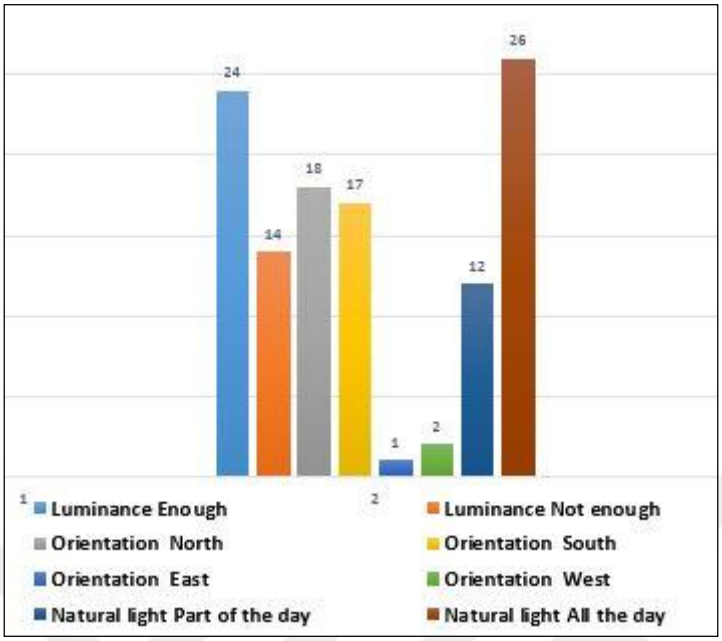


Figure 4.20. Lighting in the spaces

The observed spaces have different types of lighting. Some of these offices have enough natural lighting, whereas the others have insufficient natural light, the reason was according to the orientation of space, the color of furniture, and finishing materials as shown in Figure 4.20.

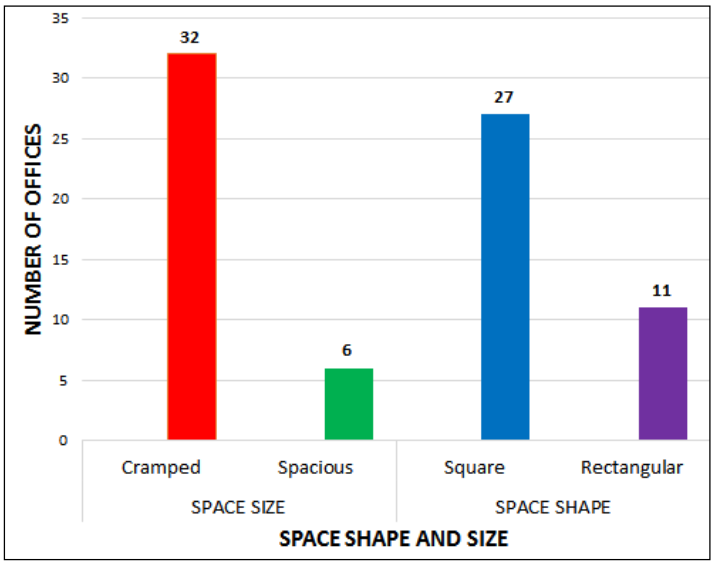


Figure 4.21. Space shape and size

The observation includes notes about space shape and size Figure 4.21, whereas 32 offices are cramped and 27 offices have square shape, also information about the space state whether is cramped or spacious. All of these space characteristics influence user's experience of the space. The observation notes show that most of the spaces have similar finishing materials for ceiling and walls, the difference in materials are in floors, which 23 offices have woody floors whereas 15 offices have PVC floors.

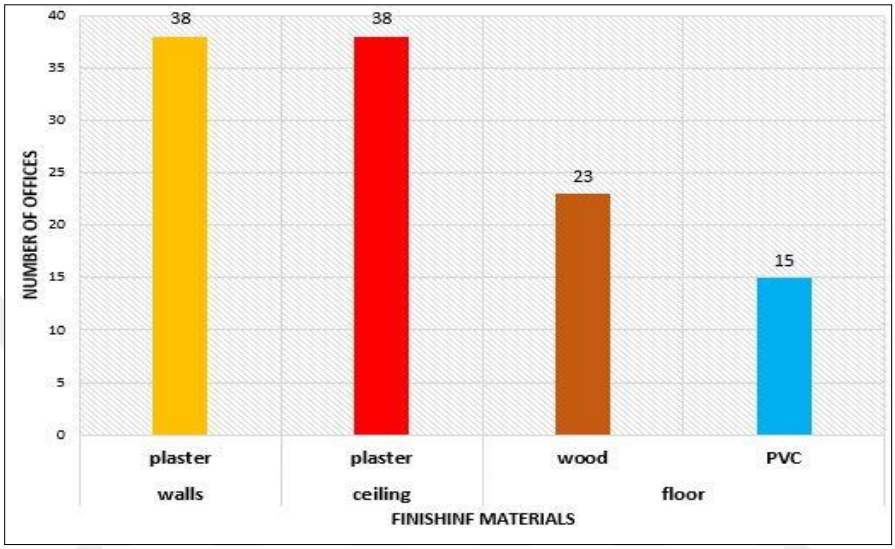


Figure 4.22. Finishing materials

Furthermore, the observation analysis shows that there is a relationship between variables related to the similarities between spaces and other related factors. For example, 26 of 38 offices have good natural light all the daytime, and have white color painting and most of them oriented to south direction. On the other hand, all of the finishing materials in the spaces reflect the sound waves because of surface properties Figure 4.22. Consequently, the observation concludes that:

1. The offices have different facades with different orientation and overlooking.
2. The offices that have south façade have good natural light most of the daytime.
3. Some occupants use a desk light at the afternoons because of low luminance.
4. Most of the spaces have indirect link to the main corridor.
5. Most of the spaces have the same furniture for material, style and colors.
6. None of the spaces have decorations or aesthetic elements.
7. The finishing materials on walls and ceilings are the same which is white colored paint for all offices.

8. More than one user occupies some of the offices that leads to less privacy.
9. The furniture does not fit to the space properly because of space size and width-length proportion.
10. The sound sources are various, comes from outside or inside the building.

The average number of rooms that have similarities according to the identified factors is 20 rooms; this number will be used as a sample size in the interview method.

4.3.2 Measurements

Four types of measurements (sound level, temperature, humidity, and lighting) have been applied at the case spaces to find an initial indication about the physical environment by using 4IN1 multi-function environment meter DT8820 from the Çankaya University, Faculty of Architecture, Environment and Building Science Lab (See Appendix G). The measurements were taken in seven locations in the building of Faculty of Architecture at Çankaya University as shown in (Figure 4.23a and 4.23b), during three times a day (10:00 morning, 01:15 noon, and 03:30 afternoon) at each location to present an overall indication regarding the physical conditions. The measurement points were established in accordance with the orientation of the space and the spatial variation of the sound sources in the last observation of the case space. The overall measurement time at each location is approximately 5 minutes. The measuring device is located at 1.2 m from the ground. In the case spaces M1, M3 and M6 measurements were taken in the spaces that overlooking to inner atrium, and M5 overlooking to parking area in north direction. In the case spaces M2 and M7 measurements were taken in the space that overlooking to the neighbouring restaurant block, and M4 overlooking to parking area in south direction.

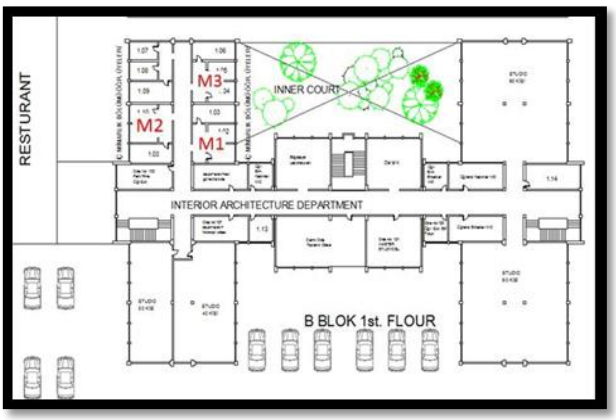


Figure 4.23a. The locations of measurements in first floor

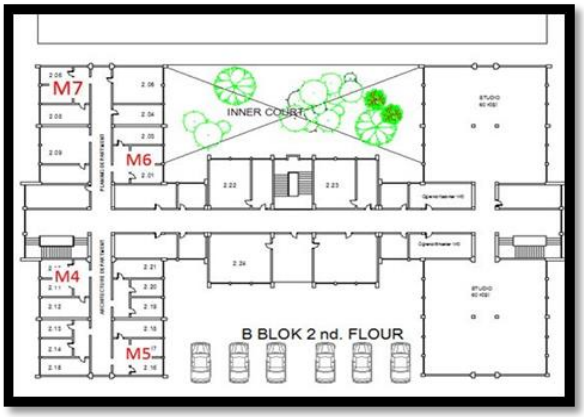


Figure 4.23b. The locations of measurements in second floor

Table 4.4 shows the measurements of sound pressure level in the observed spaces, which are higher than the standard levels. Whereas, the temperature, lighting, and humidity levels are found to be within the standards' range (Comite'Europe'en de Normalisation, 2007; Ministery, 2013).

Table 4.4. The measurements of different locations

NO	SPL dB(A)	Regulations dB(A)	Temperature C°	Standards C°	Humidity %	Standards %	Lighting Lux	Standards Lux
M1	42.5		24		39		Nat:440 Art: 857	
M2	48		26		36.9		Nat:407 Art: 1120	
M3	48.6		26.5		35.5		Nat:128 Art: 1361	
M4	51	<35 dB(A)	26	Winter: 20-24 C° Summer: 22-27 C°	35	≈34%	Nat:320 Art: 535	>500 lux
M5	43		25		34		Nat:272 Art: 741	
M6	44		25		33.5		Nat:383 Art: 813	
M7	47		23		35.5		Nat:196 Art: 618	

As a result of the first POE indicative stage, observations have led to the formation of seven categories that are, (1) sound sources, (2) orientation, (3) lighting and luminance, (4) furniture (style, material, colour), (5) building finishing materials (walls, ceiling, roof), (6) space shape, and (7) privacy. In addition, the physical measurements of the environment have shown that only the sound levels are above the standards.

In order to feed the next method (interview), the observations and measurements are reviewed and factors are indicated to be included in the interviews. All of the items that are observed are planned to be considered in the interviews with the addition of other related factors that have been previously presented in the literature review section, in order to achieve a detailed scope.

4.3.3 Interview

The second level of POE process is investigative phase with the application of interviews to the users of the spaces who occupies 20 offices in the case study. This level will emphasize the results of an indicative level of POE and which identify more details about the variables, and increase reliability. The samples were chosen according to the results of the observation in different locations in the building (see Figures 4.23, 4.24). Whereas, the interview is applied on the areas where the interviewee works. The participants have to answer six structured questions that were based on the observation results in order to identify the specific factors that affect the user's experience of space regarding soundscape perception and other related factors (Appendix B).

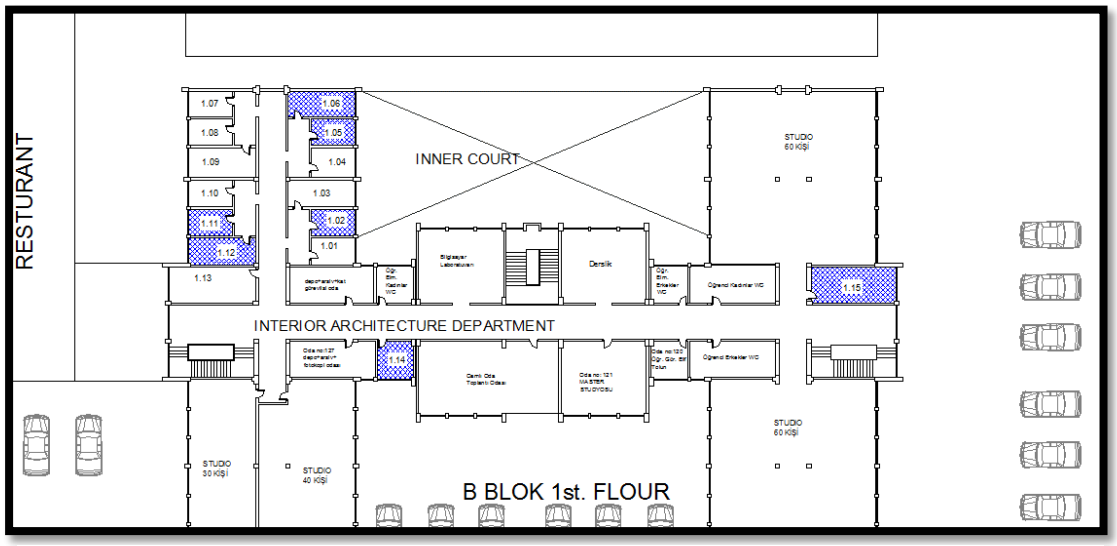


Figure 4.24. Investigated offices on first floor

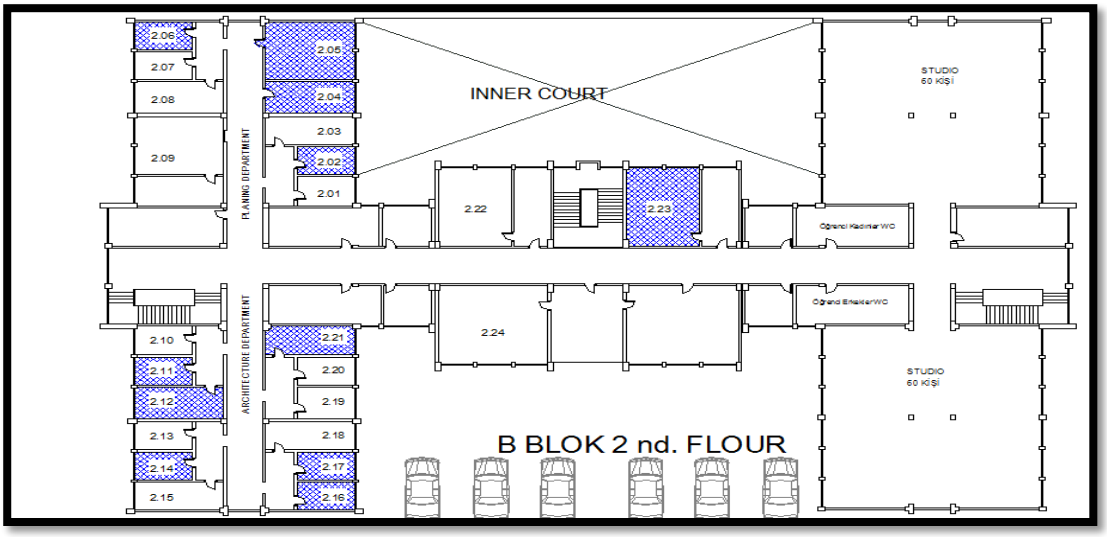


Figure 4.25. Investigated offices on second floor

The interview questions start first with general information about the interview date, time, and about space location, orientation, and overlooking. The second part includes questions to reveal the responses of users to their work environment. First question asked about the preferred time of using the space. The second question was about the types of sound sources and the dominant sound. The third question is about the past experience of spaces in order to reveal the similarities and differences between the experienced spaces. The fourth question is about the space characteristics. The fifth question asked about the activities that could done in the space. The sixth question was about environment factors that affect the user's experience of space.

The interview applied in the spaces where the interviewee works, whereas the participants have to answer six structured questions that were based on the observation results in order to identify the specific factors that affect the user's experience of space regarding soundscape perception and other related factors. The qualitative data collected from the responses are analyzed by the grounded theory content analysis method. Moreover, to find out accurate meaning and specific results. All the answers are inserted in one table to help coding the qualitative data and counting the quantitative data as shown in Table 4.5. All the variables that affect the occupant perception of space are investigated. Whereas, the figures illustrate the variance in frequency of variables mentioned by the participants in the interviews. In all the figures below, the columns represent the total number of frequencies of variables, which were mentioned by the participants in order to feed the next step of data collection by questionnaires. As POE procedures, the indicative and investigative stages are made to identify the factors that affect the experience of space within perception of

soundscape. The observation of 38 offices showed that there are differences and similarities in space characteristics, which determined the sample size of interviews. The number reduced to 20 offices to represent the total sample. Moreover, the results of observation fed the design of interview's questions for instance, asking about the sound sources (talking, walking, traffic, etc.) and sound types, space characteristics (lighting, colour, furniture, etc.) and the reasons to prefer some of these characteristics. The important observation was the orientation of space, which affects the luminance and proximity to outside noise sources for instance the users of spaces in south side use the curtains to reduce the luminance and glare. Whereas, the users in the opposite side do not use it. The measurements confirm this as there is a significant difference between two sides in natural light. On the other hand, there were significant readings of sound levels related to space location. In the interview, the participants have to answer a detailed question about their space environment and its characteristics in order to identify more factors affect the soundscape perception and space experience.

Table 4.5. The responses from the interviews

Variables	Related Questions	Clustered Responses	Related Figures
Space usage	During the daytime, which time period do you prefer to do your office works? Why?	Quite - less interruption - mood.	Figure 4.26
Sound sources	What kind of sounds you can hear while you are being in this space, please list them? Which one is the most dominant?	DOMINANT: talking on the corridor, computer fan, Lawn mower, cars, tables squeak on the upper floor. OTHER SOURCES: birds, walking, door slamming, coffee machine, cleaning trolley, telephone ringing, aquarium sound, lighting source, refrigerator, other closed spaces.	Figure 4.27
Expectation	Do you have any past usage experience similar to this space? Which one do you prefer? Why?	Space experience criteria: light - good view - ventilation - space size - privacy - controlling temperature - quite - natural light - natural sounds - bad soundscape - easy access to other spaces - overlooking to green area.	Figure 4.28
space characteristics	Please choose which characteristics in the table below affect your perception of this space? (You can add more characteristics).	Colors, Lighting, Furniture style, Furniture layout, Space proportion, Space size, Finishing materials quality, Smell, acoustic performance, Past experience, amount of indoor vegetation, building style, data infrastructure, environmentally comfort, privacy, space height, type of finishing materials, usage time.	Figure 4.29
Activities	What are the activities you often do in this space? Please list all of them?	Administrate tasks, chatting, discussion, drinking, eating, lecturing, listening, preparing lectures, reading, socialize, studying, taking rest talking, using computer, writing.	Figure 4.30
Physical environment	What are the physical comfort factors (such as: temperature, light …) that affect your experience of space?	Acoustics - aesthetics - decoration - lighting - temperature - smell - airflow - humidity - Speciousness - ventilation.	Figure 4.31

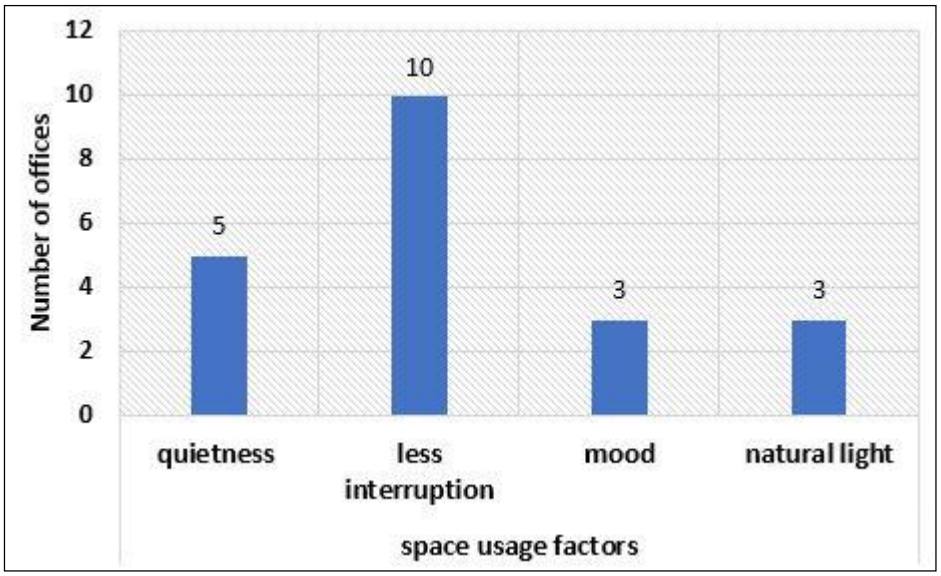


Figure 4.26. Space usage factors, the related question is (*During the daytime, which time period do you prefer to do your office works? Why?*)

The participants were asked why they prefer to do their work in the specific time. 5 responses mentioned the quietness as a reason for preference, whereas 10 responses mentioned the reason is less interruption, another 3 responses mentioned the mood affect preferring the time of using space.

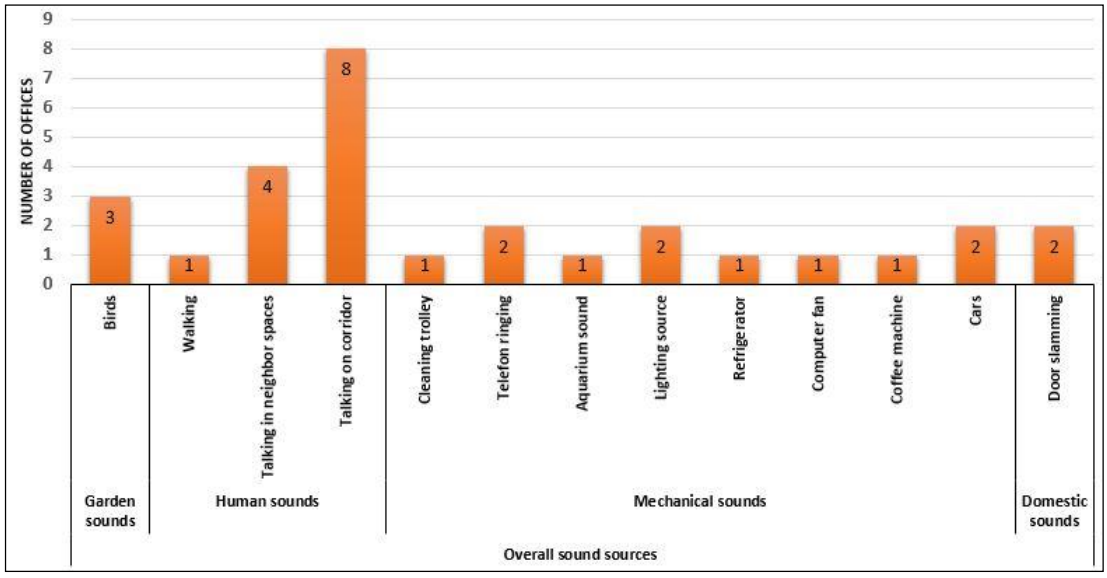


Figure 4.27. Overall sound sources, the related question is (What kind of sounds you can hear while you are being in this space, please list them? Which one is the most dominant?)

In order to determine the sources of sounds and the dominance sound that affect the space as shown in Figure 4.26. 9 responses mentioned that there are six sources of sounds affect the space environment, whereas the talking in the corridor is the dominance sound source.

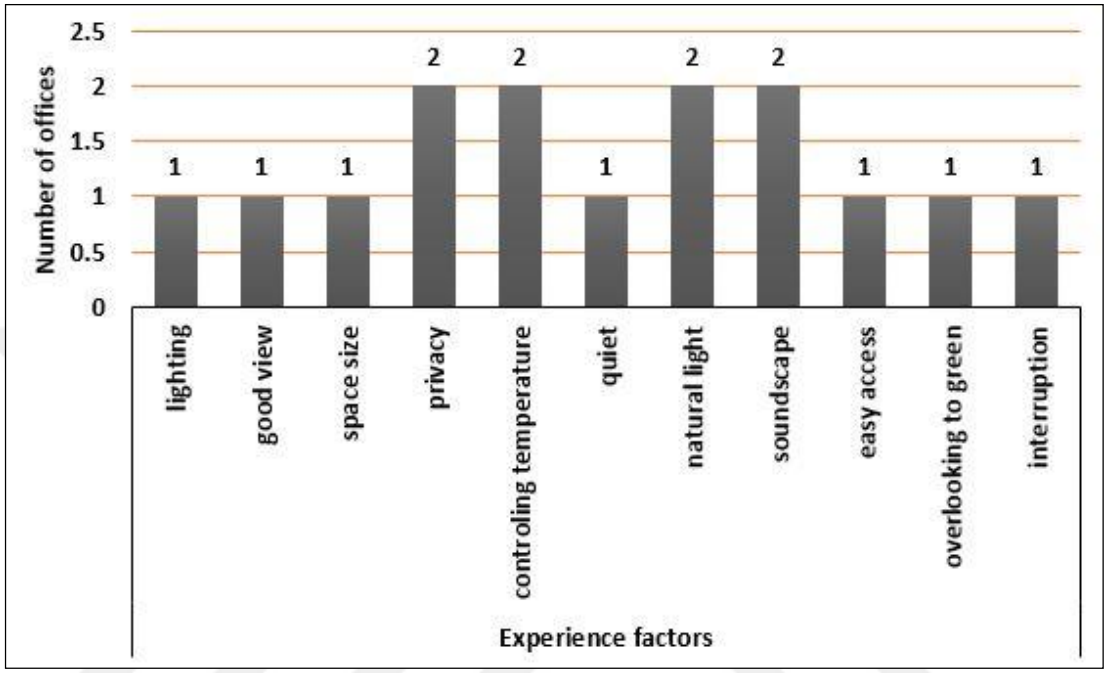


Figure 4.28. Factors affecting space experience, the related question is (Do you have any past usage experience similar to this space? Which space do you prefer? Please explain the reasons?)

Every space has specific characteristics, for that reason the participants were asked about the hidden characteristics that could affect their experience of space as shown in Figure 4.29 such as colours, lighting, furniture style, furniture layout, space size, space proportion, finishing materials, and indoor visitation. These characteristics will be used in the evaluation stage.

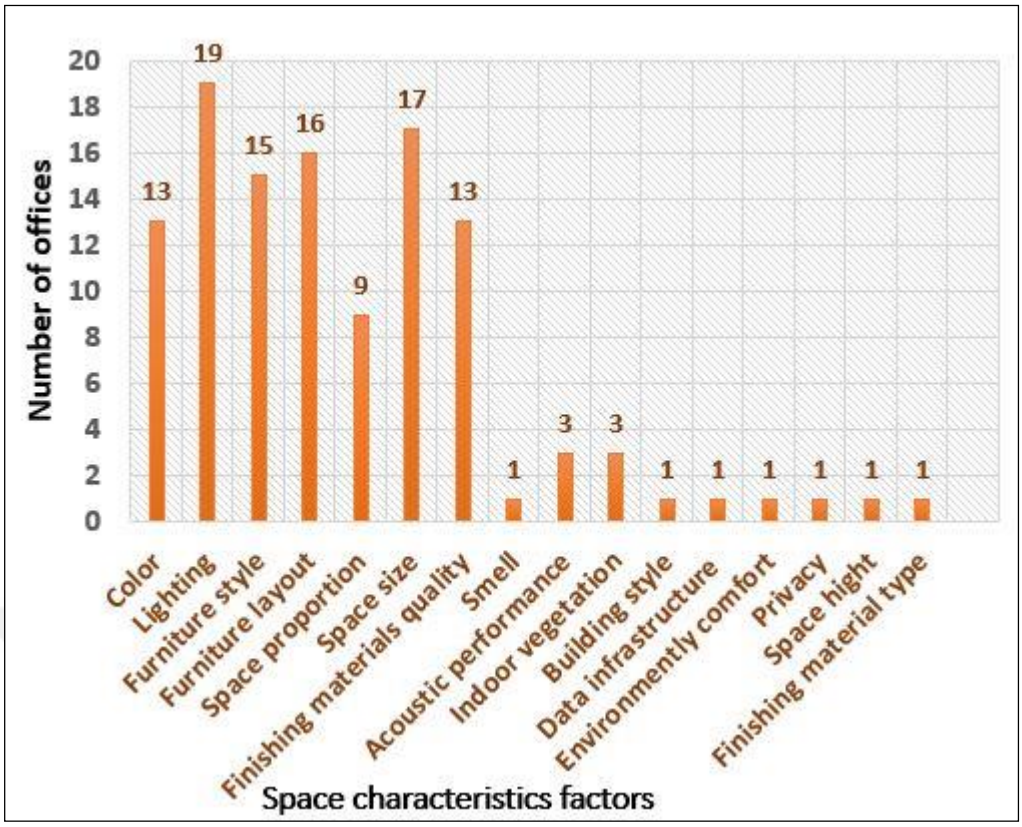


Figure 4.29. Space characteristics factors, the question related is (Please choose which characteristics in the table below affect your perception of this space (you can add more characteristics?).

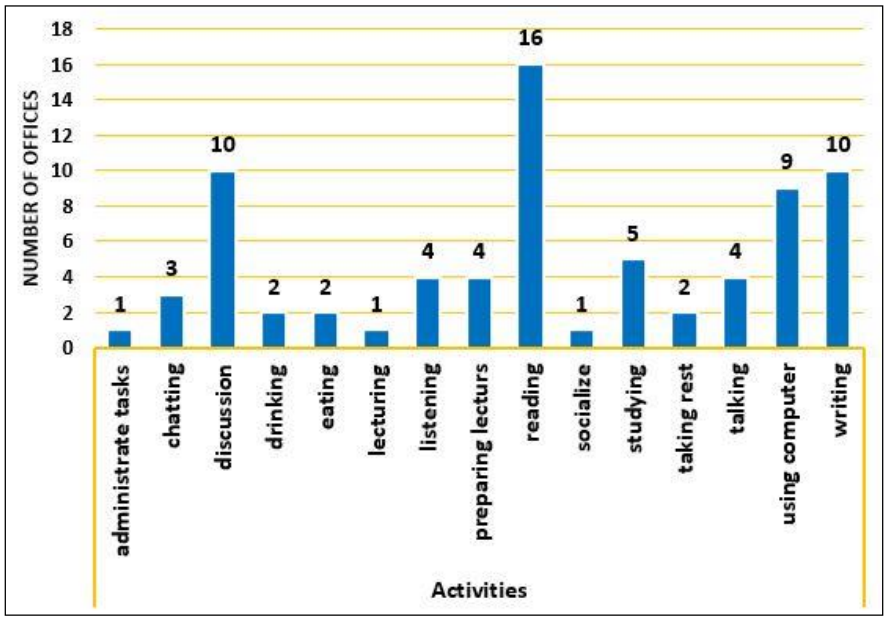


Figure 4.30. Activities, the related question is (What are the activities you often do in this space? Please list all of them?)

Figure 4.30 presents the activities that the users were doing while they are in thire offices. These activities such as writing, using computer, studing, reading, drinking and eating, lecturing, socializing, and adminestrate tasks. All of these activities could affect the perception of soundscape and experience of space.

The responses in Figure 4.31 shows two variables (lighting and temperature) are the most important physical comfort factors affect the experience of space. The other less important factors (acoustics and ventilation) are found.

The aim of the semi-structured interviews was to gather the required detailed data in order to enrich the classification of factors. The following results were obtained from valuable responses obtained from semi-structured interviews with twenty offices in the building of Çankaya University, during the period from 15 of March 2017 to 25 of April 2017. These responses were analyzed and summarized according to the objectives of the questions of survey. According to interview analysis, the scheme of soundscape perception and space experience will be defined by sub factors in order to finalize the classification of soundscape perception and spatial experience (Figures

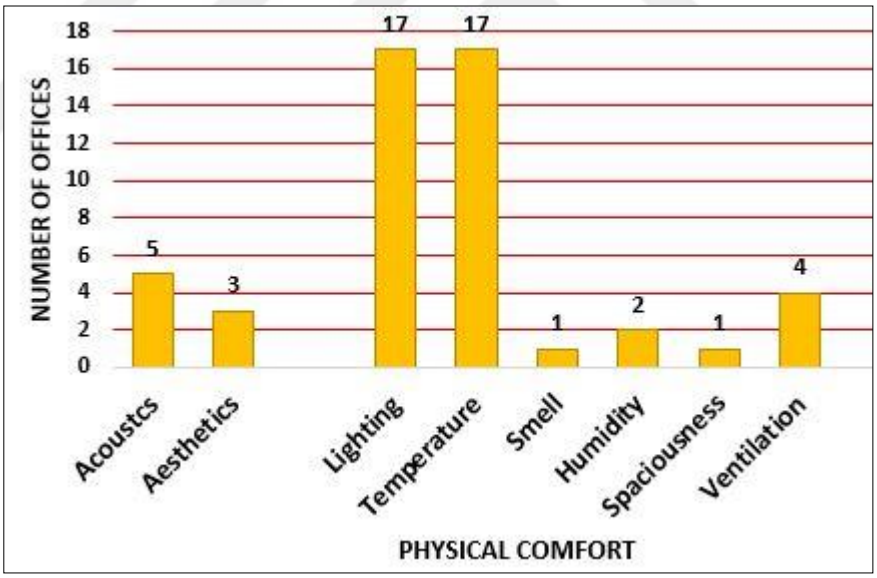


Figure 4.31. Physical comfort factors, the related question (What are the physical comfort factors (such as: temperature, light …) that affect your experience of space?

4.31 and 4.32). The results of interviews provide clear details about spaces' characteristics and other related factors that affect the perception of soundscape and experience of space. These factors would finalize the classification scheme that was initially introduced in the literature review.

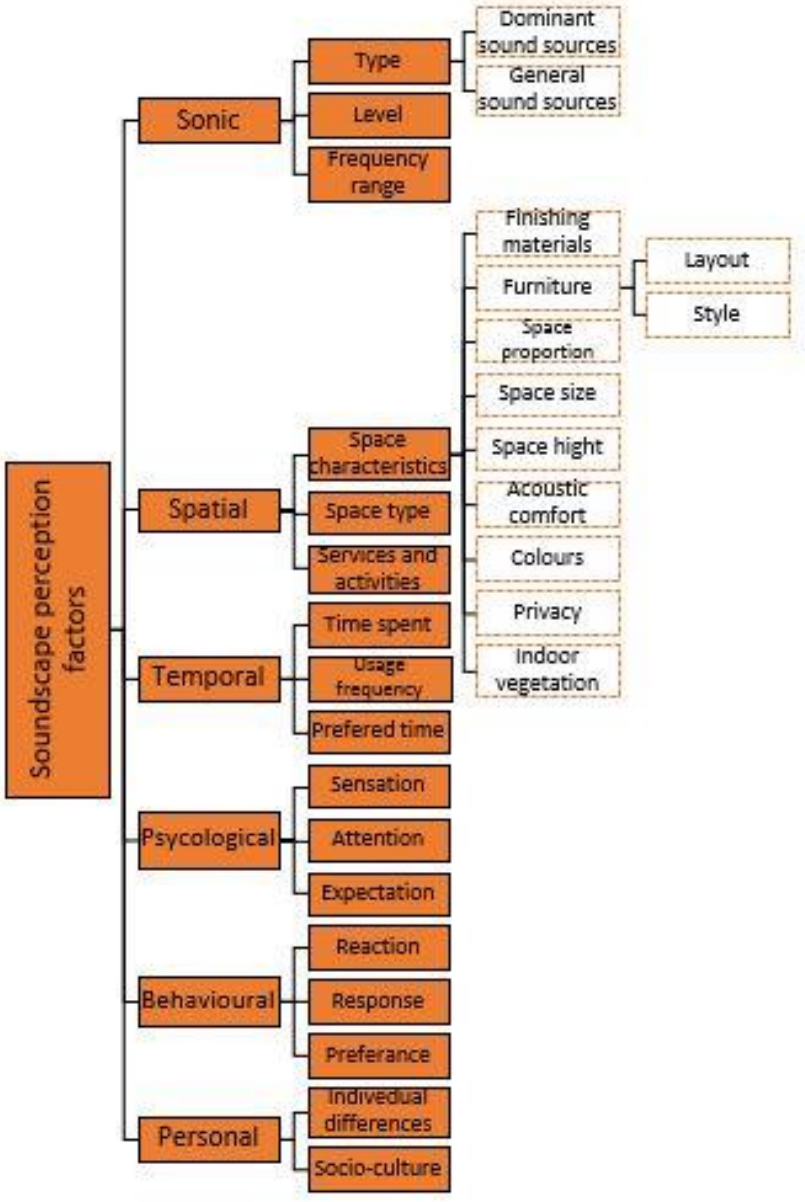


Figure 4.32. Finalized Soundscape perception factors after interview analysis.

The most important benefits of interview are adding more detailed factors to the scheme of soundscape. These factors are about sound sources such as (dominance of sounds, and types of sound sources). Moreover, other factors about space characteristics such as, finishing materials, furniture style and layout, space proportion, space size, space height, acoustic comfort, colours, privacy, indoor vegetation as shown in Figure 4.32 are also included.

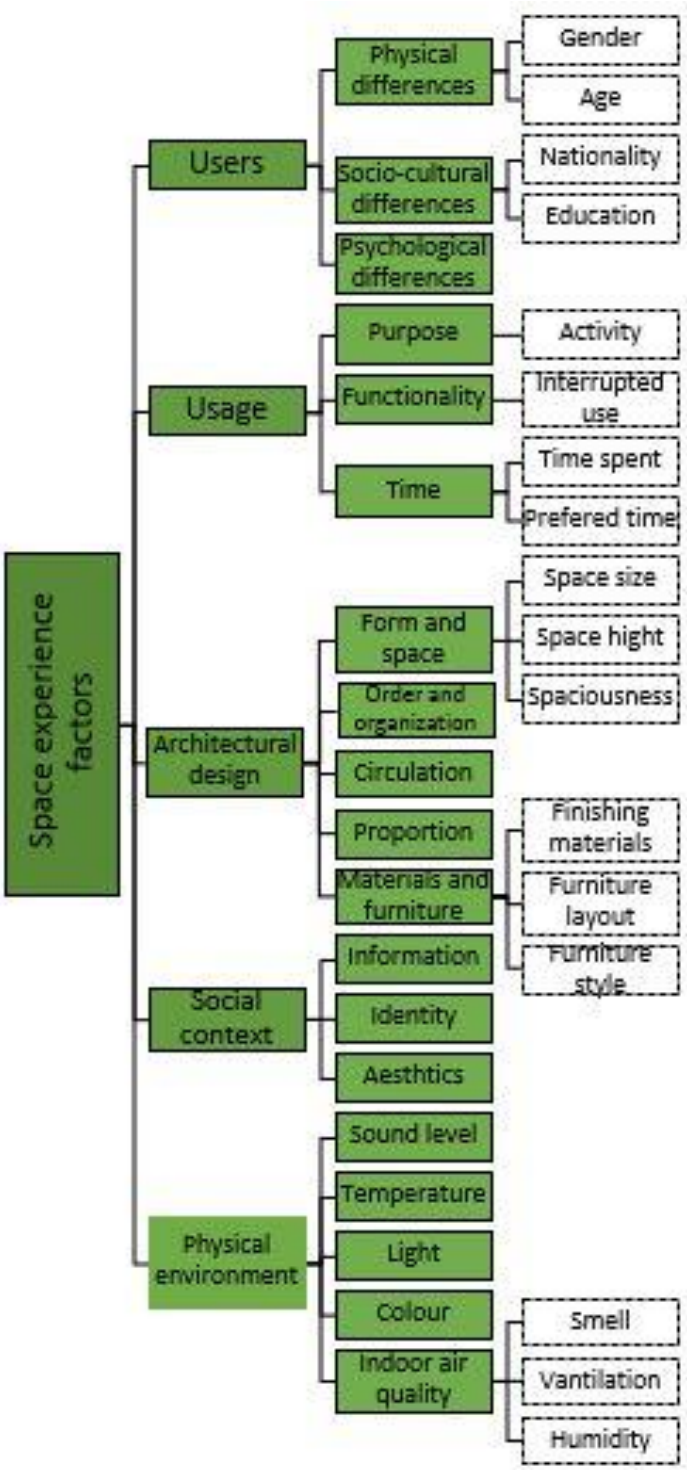


Figure 4.33. Finalized Space experience factors after interview analysis.

Figure 4.33 presents the detailed factors of space experience such as, gender and age, nationality and education, activity, interrupted use, time spent and preferred time, space size, space height, and speciousness, finishing materials, furniture layout, and furniture style, smell, ventilation, and humidity.

4.3.4 Questionnaire

The appropriate definition of user experience has been created by ISO in 2011 as “a person's perceptions and responses that result from the use or anticipated use of a product, system or service”. In order to create a survey about users’ experience, need to investigate their variance in judgement concerning their experience of space. Subsequently, user experience is viewed as a comprehensive idea that incorporates a wide range of emotional, cognitive or physical responses concerning the concrete or even just the accepted use of an item.

Aletta et al, adapted a scheme to collect data of sonic environment regarding the perceptual approach. An observation, interview protocol, and questionnaire is needed to identify soundscape attributes (Kang et al., 2016). A questionnaire survey and objective measurements carried out in order to find out an evaluation of acoustic comfort, identifying sounds on the site, and classifying the auditory sounds and indicating the sounds from wanted and unwanted point of view (Yang & Kang, 2005a). Chen & Kang in 2017 mentioned that a questionnaire survey was carried out to investigate the acoustic comfort in different two large dinning spaces, and adapted a five-point scale. On the other hand, the collected data was processed and analysed by SPSS software, to obtain results for three situations in the survey; the first, determine the correlation between the factors and sound sources affecting diners’ comfort, and the influence of sound sources as background noise on the diners’ comfort by t-test. Second, determining the affection of the factors on the acoustic comfort of independent sound sources by using regression analysis. Finally, determining the effect of demographic and social factors on acoustic comfort of diners by using one-way ANOVA analysis (Chen & Kang, 2017).

User experience questionnaire UEQ were investigated regarding to two items; reliability (the consistency of the scale) and validity (the scale really measure what they intend to measure) (Laugwitz, Schrepp, & Held, 2006). Accordingly, The first German rendition of the UEQ was made by a data analytical approach (Laugwitz, Held, & Schrepp, 2008). An underlying item set of 229 potential things identified with the idea of user experience was created in several brainstorming sessions with usability experts (Laugwitz et al., 2009). This underlying set was then decreased to an 80 items raw version of the questionnaire by an expert assessment. Nowadays, UEQ contains 6 scales with 26 items. Attractiveness (annoying / enjoyable, good / bad, unlikable /

pleasing, attractive / unattractive, friendly / unfriendly, unpleasant / pleasant). Perspicuity (not understandable / understandable, easy to learn / difficult to learn, clear / complicated, confusing / easy). Efficiency (fast / slow, inefficient / efficient, organized / cluttered, impractical / practical). Dependability (meets expectations / does not meet expectations, secure / not secure, obstructive / supportive, unpredictable / predictable). Stimulation (valuable / inferior, not interesting / interesting, motivating / demotivating, boring / exiting). Novelty (conservative / innovative, inventive / conventional, usual / leading edge, creative / dull (Laugwitz et al., 2008; Laugwitz et al., 2006; Laugwitz et al., 2009; Schrepp, Hinderks, & Thomaschewski, 2014).

Likert scale was used by Rensis Likert to measure the psychological attitudes in a scientific way or metric scale. Some of the recent works utilizing numerous arrangements other than the customary five-point characterizations; a few specialists utilize a considerable number of classifications and erasing the impartial reaction (Nemoto & Beglar, 2014; Uebersax, 2001).

The Likert scale comes in four forms regarding the way of scale measurement: nominal, ordinal, interval and ratio scale. Each of these forms is useful for the purpose of questionnaire design.

- **Nominal scales** categorize. A nominal scale can be based on natural categories like gender (male or female) or artificial categories like education level (bachelor, master, doctor etc).
- **Ordinal scales** order or rank things. For instance, an item might ask for instance students to rank ten types of classroom activities from most to least interesting (from 1 through 10).
- **Interval scales** show the order of things, but with equal intervals between the points on the scale.
- **Ratio scales** differ from interval scales in that they have a zero value and points along the scale make sense as ratios (J. D. Brown, 2011).

Consequently, the Likert scale is made up of a limited range of possible responses such as Disagree/Agree, I am not like this/I am like this, I am not willing/I am willing, or Not useful/Useful, Most of Likert scales should be made up of four or six points. However, 6-point scales should be used as they permit the possibility of increased measurement precision (Nemoto & Beglar, 2014).

The questionnaire was designed based on soundscape perception factors and space experience factors that were obtained from the previous studies and the finalized investigative study by the interview method. The questionnaire has 5 separate parts as;

(1) Demographical and social questions,

(2) Space usage and time spent,

(3) The dominance of sound sources,

(4) The effect of sound sources on soundscape perception,

(5) The effect of space components on space experience.

The starting part of the questionnaire includes the individual demographics and social characteristics (age, gender, education, occupation) as nominal questions, in order to make grouping test to compare these individuals and its effect on space experience.

The second part includes questions on frequency of usage of the space and time spent in the space that will show its effects on soundscape perception and experience of space.

The third part includes two different questions about sound sources. The first question asks about the importance of 17 different sound sources that can be heard by the participants related to human sounds (walking, talking, shouting); natural sounds (birds, tree leaves, rain); mechanical sounds (cleaning trolley, telephone, refrigerator, computer, coffee machine, florescent lamp, lawn mower, traffic, music, construction); and domestic sounds (door slamming).

The fourth part is about the effect of these 17 sound sources on the perception of soundscapes. Moreover, it includes other two questions about the expectation and activity as independent variables affecting soundscape perception, and its ability to be moderators in the relationship between the main two concepts.

The fifth part includes questions on the effect of space characteristics on experience of space. The 17 different variables of space components that produce the concept (experience) for instance: physical comfort factors (acoustics, lighting, colours, temperature, indoor air quality, humidity, odours); and architectural design (building

style, room area, room height, room proportion, finishing materials, furniture style, furniture layout, indoor vegetation, privacy level, spaciousness).

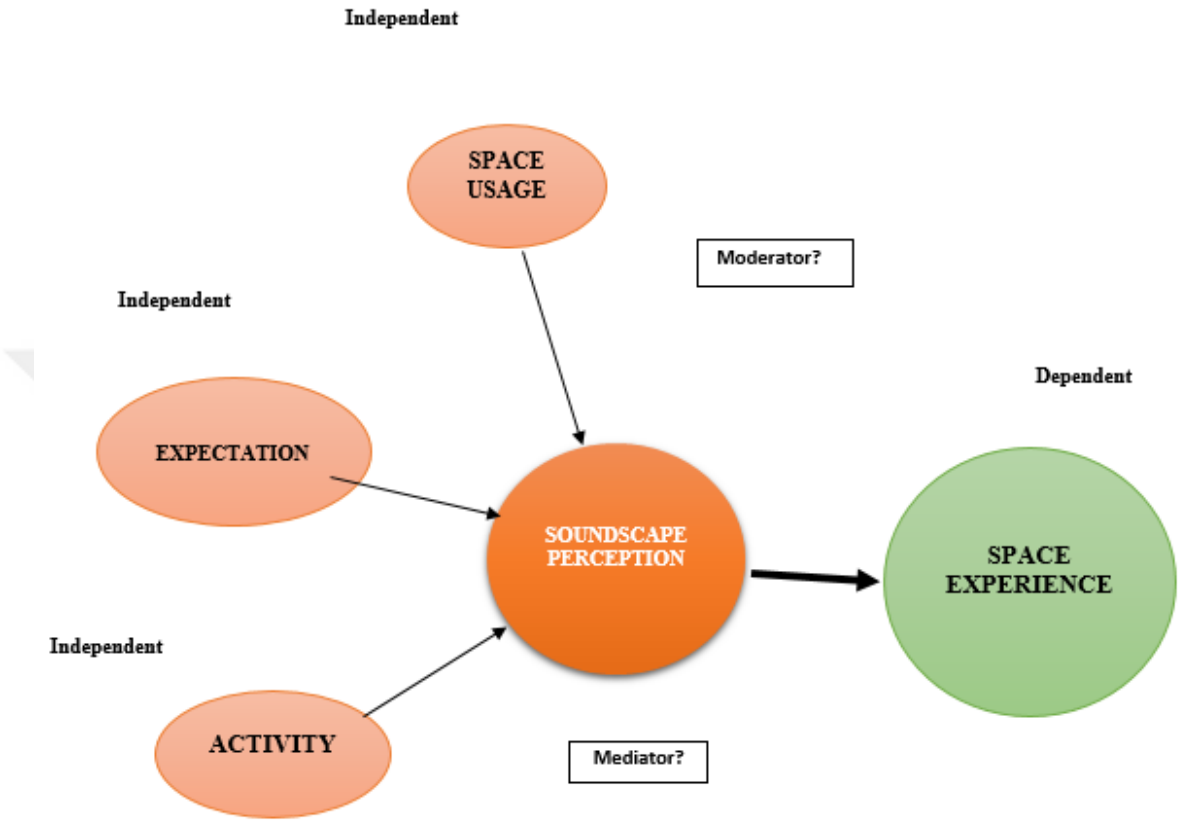


Figure 4.34. Evaluation model

In this model (Figure 4.33), the relationship between the variables (soundscape perception, activity, expectation, and space usage) and space experience will be tested. On the other hand, to test which variable could make changes on the relationship between the perception of soundscape and other factors (moderation)? And could the soundscape perception work as a mediator between the variables (space usage, expectation, activity) and space experience? The first step, the correlation between main concepts soundscape perception and space experience should be tested. If the correlation is significant, the other testes will be applied between the other variables. If there is not significant correlation, none of other testes is required.

4.3.5 Pilot questionnaire

A pilot study was applied and questionnaire is conducted for academic staff of faculty of architecture in Çankaya University, where 36 responses are collected. The participants' offices were located in the first and second floor with different orientations, in order to get different responses according to different variables.

The collected data were analysed by SPSS in order to test the reliability of responses with the designed model, and to test the relevance of scale to test the correlations between the main concepts and the related variables as shown in Table 4.6. The results indicate good scales that can be used in measurements of the identified variables.

Table 4.6. Reliability scores of questionnaire items.

Questionnaire Items	Reliability Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Soundscape perception	0.745	0.750	17
Space experience	0.949	0.953	17
Space characteristics vs soundscape perception	0.867	0.853	17
Office activities	0.767	0.791	8

** The correlation is significant at 0.05 level*

Table 4.7. Correlation between soundscape perception and space experience

		Space experience
Soundscape perception	Pearson Correlation	0.121
	Sig. (2-tailed)	0.526*
	N	30

The correlation is significant at 0.05 level

The results showed:

1- There is no significant correlation between the main concepts as shown in Table 4.7 due to the small sample size, it will be clear in a larger sample size;

2- A significant correlation was found in between number of components of the two main concepts that indicate the correlation of the whole model, which can also be improved with a larger size of sample.

3- Some of questions need to be revised in the questionnaire according to the statistician comments and recommendations.

4.3.6 The case study

The questionnaire is carried out on 300 participants who occupy the offices in 6 Universities in Turkey (Atilim University, Cankaya University, Karabuk University, Hacettepe University, Kastamonu University, Yildirim Bayazit Univesity).

According to the results of pilot study, two parts were added to the questionnaire, which are about activities and expectation. The questions distributed into 7 parts; first part is about personal characteristics (age, gender, nationality, occupation type, education level). The second part is about space type and usage (space type, space location, time spent per day, preference time, spent time per week, interruption of usage). The third part is about the dominance of sound sources, which includes 17 sound sources and participant have to rate the sound sources according to the dominance. The fourth part is asking about rating the expectation of soundscape and space quality, the fifth part of questionnaire is about the effect of 17 of sound sources on soundscape perception that will be rated by the participants. The sixth question asking on the level of activities that the user mostly does in the space, and the seventh part of questions is about the effect of space characteristics on space experience (see Appendix C).

4.4 Research strategy

The factors can be distinguished to independent variables and dependent variables according to the previous studies. Table 4.8 below, illustrates the contribution between different complementary aspects of the research in order to find out the accurate results for the evaluation. Moreover, defining the detailed factors of soundscape perception and experience of space will provide realistic evidence of the relationship between the variables.

Table 4.8. Research strategy

Research questions	Hypothesis	Type of data	Data collection method			
			Observation	**Interview question**	**Questionnaire question**	**Measurements**
1- What are the objective and subjective factors that affect the perception of soundscape? d- Which sound sources affect the satisfaction of occupants? e-How does the past-experience affect the perception of soundscape? f- How do the activities influence the perception of soundscape?	• The soundscape perception is affected by sound sources regarding: - Dominant Sound source. - Expectation of acoustic environment. - The activities in the space.	Qualitative and Quantitative data (subjective and objective data collection)	Observing: - Types of sound sources. - Overall, sound environment.	- What kind of sound you can hear while you are being in the space? Please list all of them. - Do you have past experience of similar space? Which space do you prefer? Why? - What are the activities you often do in the space?	- Please rank the dominance sound source that you can hear in your office. - Please rate the effect of the following sounds on the perception of soundscape in your office. - What was your expectation of space at the first time of usage? - Rate the effect of activities on perception of soundscape.	Sound level measurement
2- What are the objective and subjective factors that affect the experience of space? c-Which environmental factors affect the space experience? d- How does the past-experiences affect the space experience?	The experience of space is affected by space components regarding: - Expectation of space quality. - The usage of space. - Demographical characteristics	Qualitative and Quantitative data (subjective and objective data collection)	Observing: - Space components for instance: furniture, colours, materials, and luminance. - Environment characteristics (temperature, light, sound).	- Do you have past experience of similar space? Which space do you prefer? Why? - What are the environmental factors affect the experience of space?	- Please rate the effect of space characteristics on your experience of space.	measurements of Environmental factors: Temperature, light and humidity.

Research questions	Hypothesis	Type of data	Data collection method			
			Observation	**Interview question**	**Questionnaire question**	**Measurements**
3- How does the usage of space affect its experience? a- Does the interruption of space usage affect the perception of space? Is the effect positive or negative?	• The usage factor of space moderates the relationship between soundscape perception and spatial experience.	Qualitative and quantitative data (subjective data collection)	Applying the observation in deferent times during the day.	Which time do you prefer to do your office works? Can you explain the reason/s?	- How much time do you spend in your office? - Which time during the day do you prefer to do your office works? - Asking about time spent - Asking about interval usage time.	

CHAPTER V

STATISTICAL ANALYSIS AND FINGINGS

5.1. Descriptive Statistics of Personal Characteristics

The data is obtained from a random sample of 300 respondents. Descriptive statistics of the sample on personal characteristics is given in detail in Table 5.1.

Table 5.1. Descriptive statistics of personal characteristics.

Personal characteristics		Frequency	Percent	Valid Percent	Cumulative Percent	
Gender	Male	178	59.3	59.3	59.3	
	Female	122	40.7	40.7	100.0	
	Total	300	100.0	100.0		
Age	21 - 30	27	9.0	9.3	9.3	
	31 - 40	145	48.3	50.0	59.3	
	41 - 50	93	31.0	32.1	91.4	
	51 - 60	25	8.3	8.6	100.0	
	Total			290	96.7	100.0
Occupation type	Academic staff			178	59.3	59.3	59.3
	Administrative staff			84	28.0	28.0	87.3
	Student			38	12.7	12.7	100.0
	Total			300	100.0	100.0	
Education level	High school			10	3.3	3.3	3.3
	Bachelor's			74	24.7	24.7	28.0
	Master's			48	16.0	16.0	44.0
	PhD			168	56.0	56.0	100.0
	Total			300	100.0	100.0	

Gender distribution in Figure 5.1 shows that, 59.3% of the participant group is males and 40.7% is females. Age distribution in Figure 5.2 showed that 59.3% of respondents are below 41 years of age. 59.3% of respondents are academic staff members as shown in Figure 5.3. The majority of respondents (96.7%) are holders of university degree or above as shown in Figure 5.4.

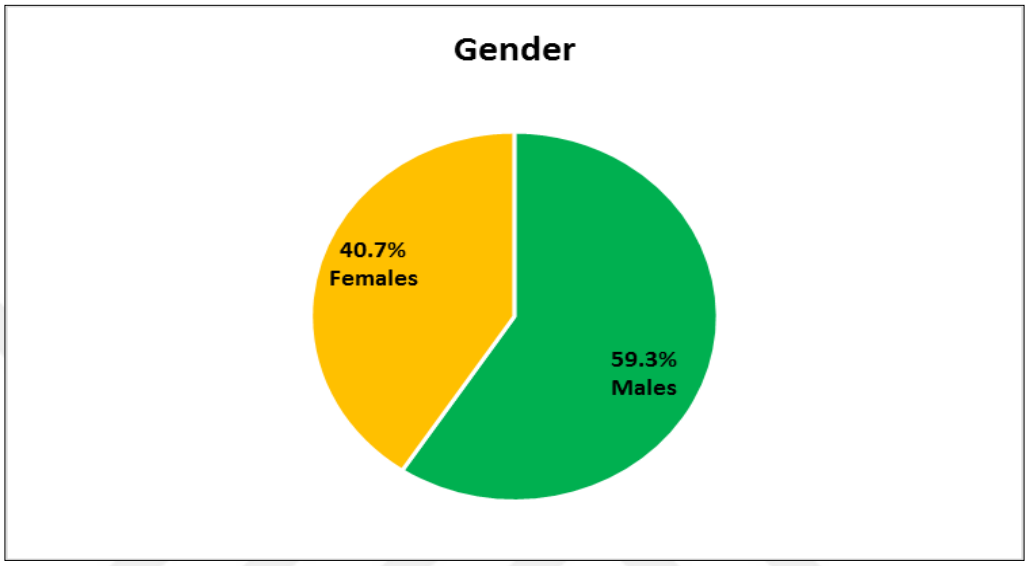


Figure 5.1. Representative percentage of gender distribution of the participant group in the study

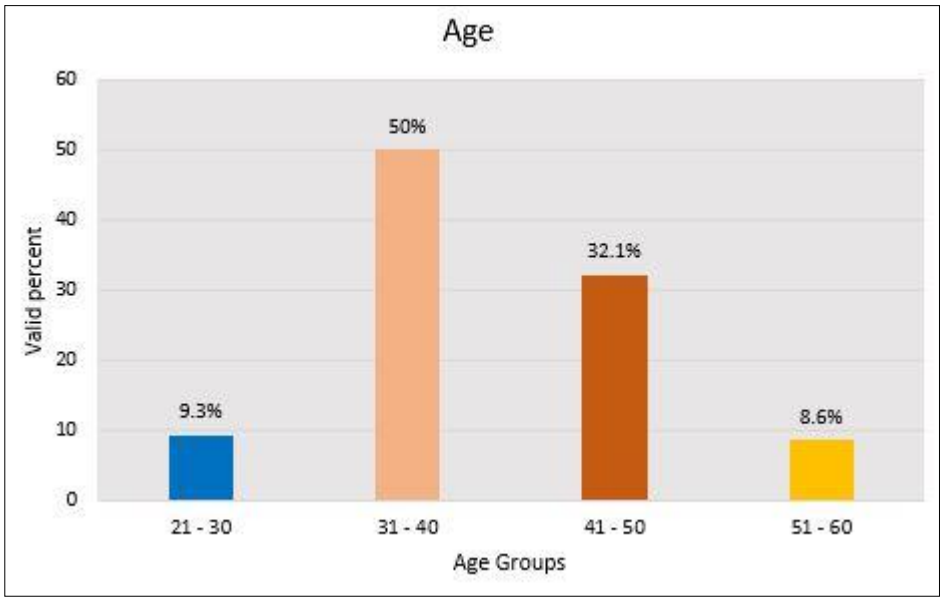


Figure 5.2. Age groups of the participant of the study.

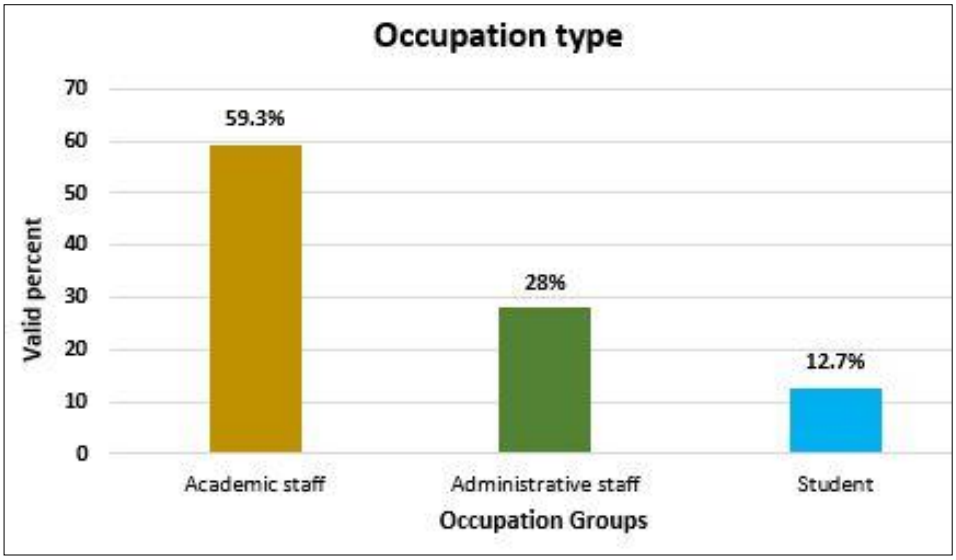


Figure 5.3. Occupation type of the participants of the study.

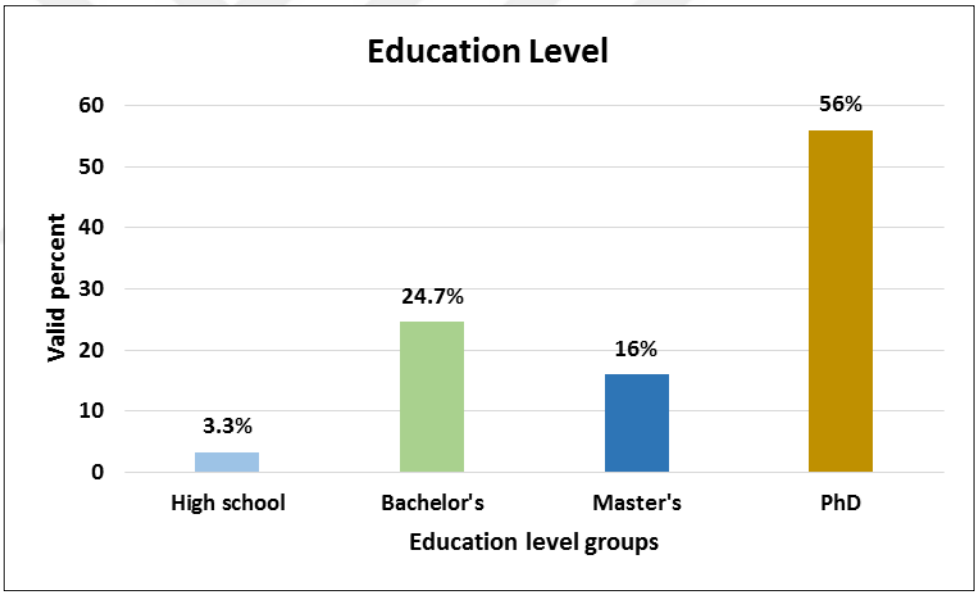


Figure 5.4. Education level of the participant group of the study.

5.1.1. Descriptive Statistics of Space and Usage Characteristics

Descriptive statistics of the sample space and usage characteristics, as shown in Table 5.2. Revealed that respondents came from six universities in Turkey. Distribution of respondents according to universities shows that 37.7% of respondents came from Atilim University as shown in Figure 5.5.

Table 5.2. Descriptive statistics of space and usage characteristics.

Space and usage characteristics		Frequency	Percent	Valid Percent	Cumulative Percent
Universities	Karabuk	88	29.3	29.3	29.3
	Cankaya	69	23.0	23.0	52.3
	Atilim	113	37.7	37.7	90.0
	Kastamonu	10	3.3	3.3	93.3
	Hacettepe	14	4.7	4.7	98.0
	Yildirim Bayazit	6	2.0	2.0	100.0
	Total	300	100.0	100.0	
Space type	Single office	182	60.7	60.7	60.7
	Shared office	118	39.3	39.3	100.0
	Total	300	100.0	100.0	
Space location	Ground floor	32	10.7	10.7	10.7
	First floor	88	29.3	29.3	40.0
	Second floor	105	35.0	35.0	75.0
	Third floor	60	20.0	20.0	95.0
	Fourth floor	15	5.0	5.0	100.0
	Total	300	100.0	100.0	
Time spent	1 hour	4	1.3	1.3	1.3
	1-2 hours	4	1.3	1.3	2.7
	2-4 hours	14	4.7	4.7	7.3
	4-6 hours	20	6.7	6.7	14.0
	6-8 hours	222	74.0	74.0	88.0
	6-8 hours	36	12.0	12.0	100.0
	Total	300	100.0	100.0	
Time preference	8:00 - 12:00	144	48.0	48.0	48.0
	12:00 - 16:00	115	38.3	38.3	86.3
	16:00 - 20:00	41	13.7	13.7	100.0
	Total	300	100.0	100.0	
Time spent per week	2days a week	6	2.0	2.0	2.0
	3days a week	4	1.3	1.3	3.3
	4days a week	26	8.7	8.7	12.0
	5days a week	236	78.7	78.7	90.7
	> 5days a week	28	9.3	9.3	100.0
	Total	300	100.0	100.0	
Interruption use	without interruption	84	28.0	28.0	28.0
	with interruption	216	72.0	72.0	100.0
	Total	300	100.0	100.0	

Figure 5.6 shows that 60.7% of respondents use a single office while 39.3% share offices. 29.3% of respondents work in the first floor while 35% of respondents work in the second floor as shown in Figure 5.7.

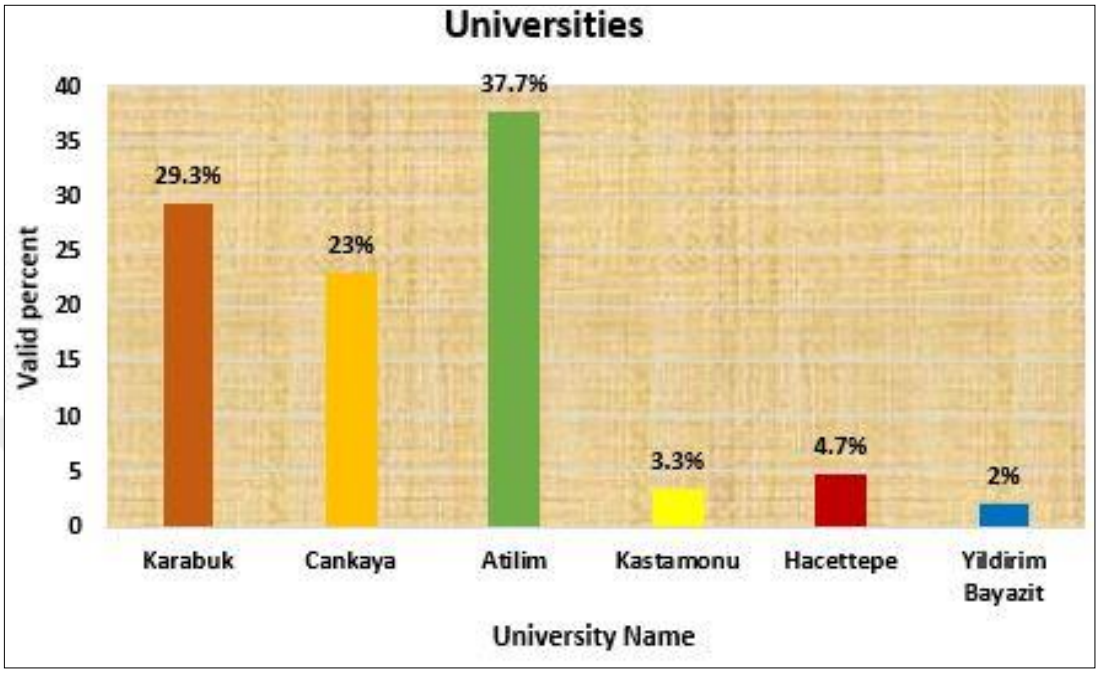


Figure 5.5. Participation distributions from different universities that are included in the study

As shown in Figure 5.8 74% of respondents work between 6 to 8 hours a day. 48% of respondents prefer to do your office works between 8:00 and 12:00 O'clock as shown in Figure 5.9.

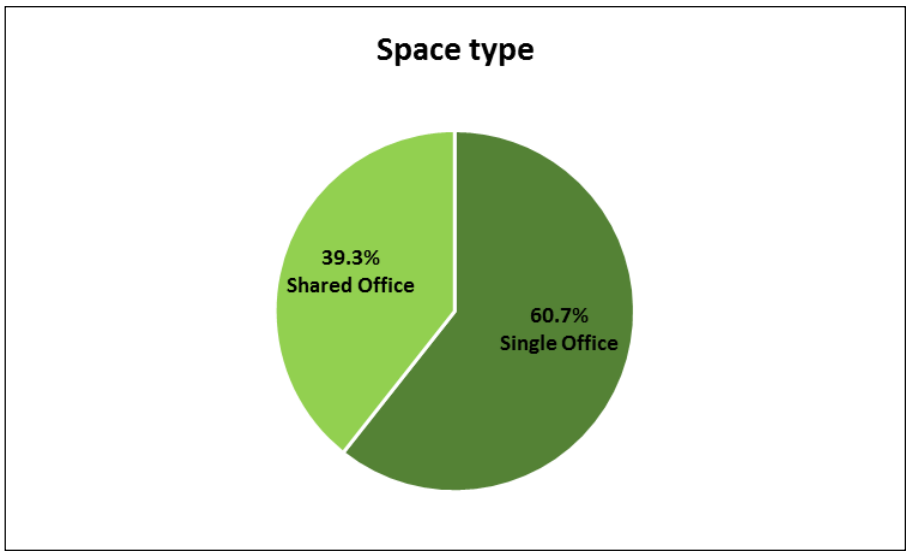


Figure 5.6. Percentages of different space types considered for the study

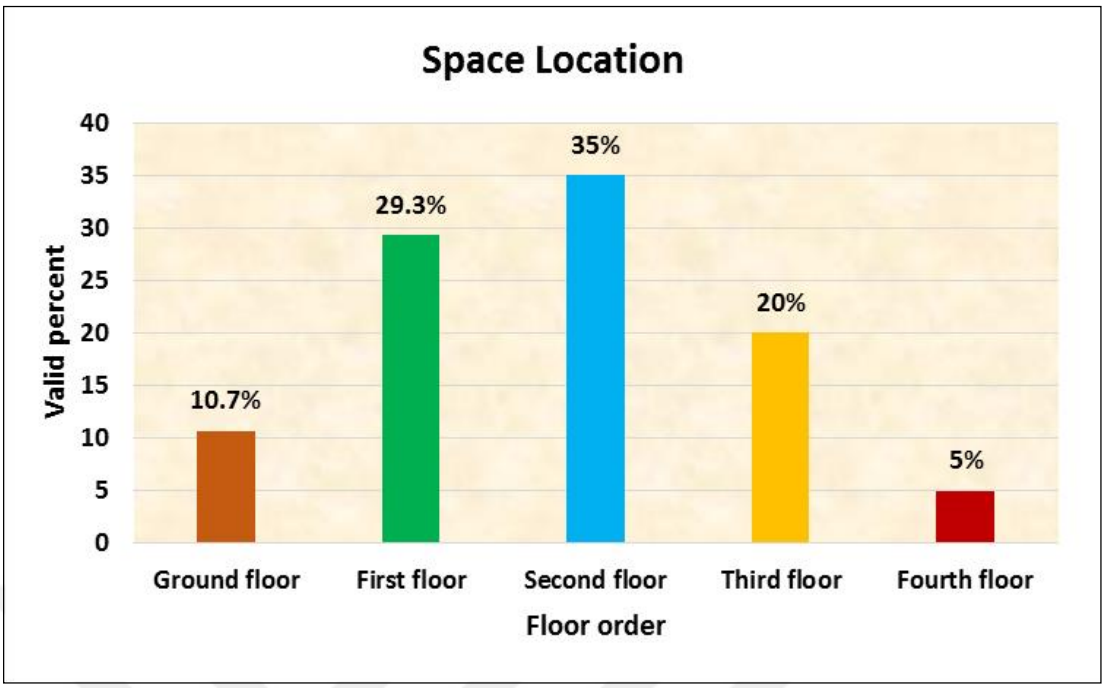


Figure 5.7. Distribution of the different space locations that are considered in the study.

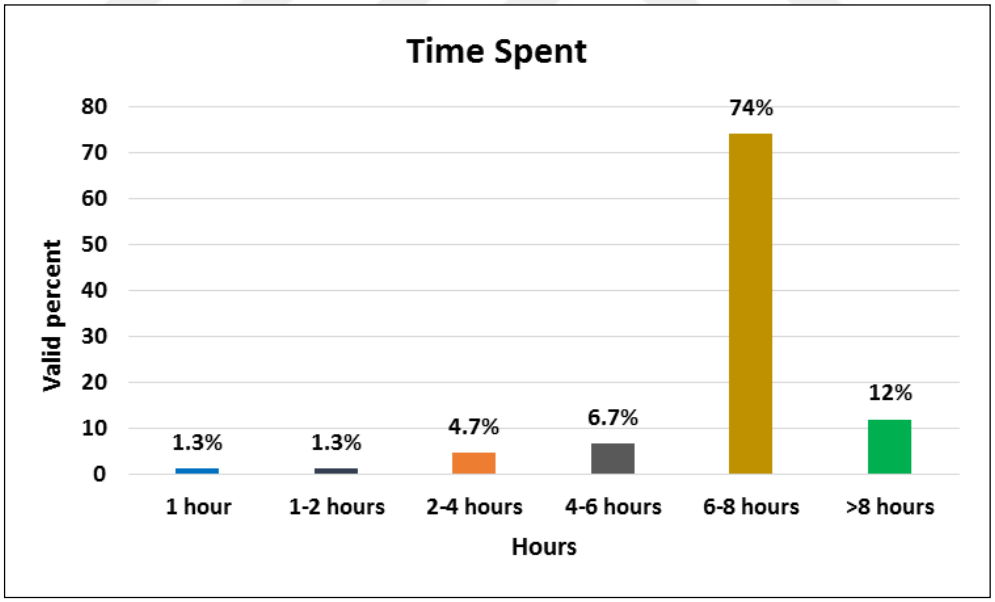


Figure 5.8. Time spent characteristics in the case spaces of the participants.

Figure 5.10 shows that 78.7% of respondents work for five days a week. Only 28% of respondents can use their offices during the office hours to do their office works without interruption as shown in Figure 5.11.

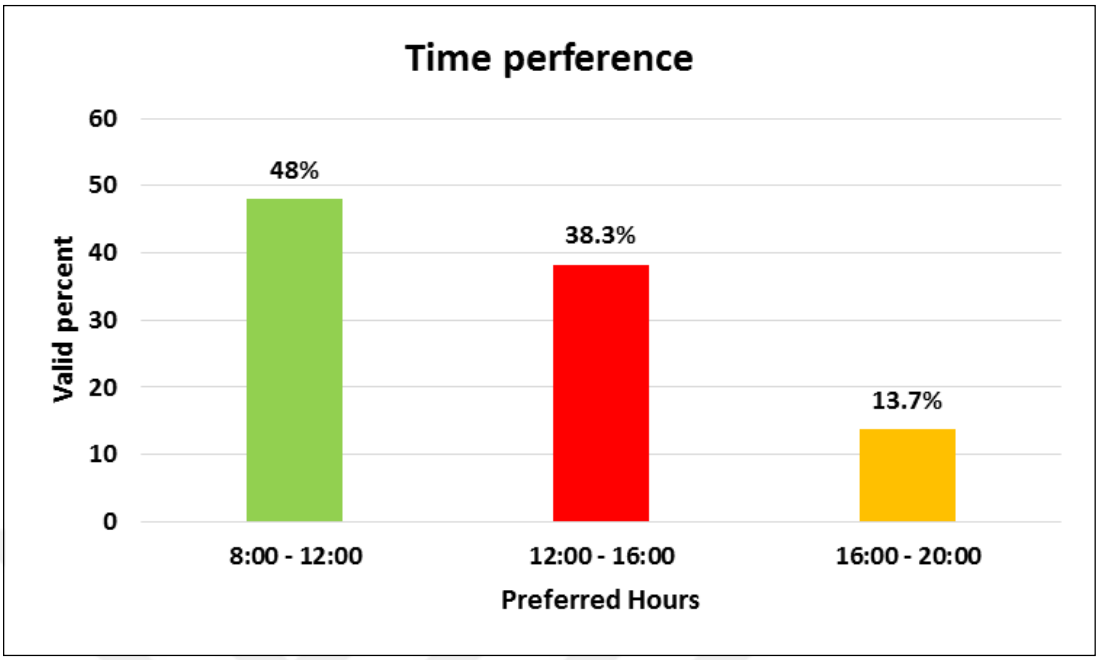


Figure 5.9. Case space usage time preferences of the participants.

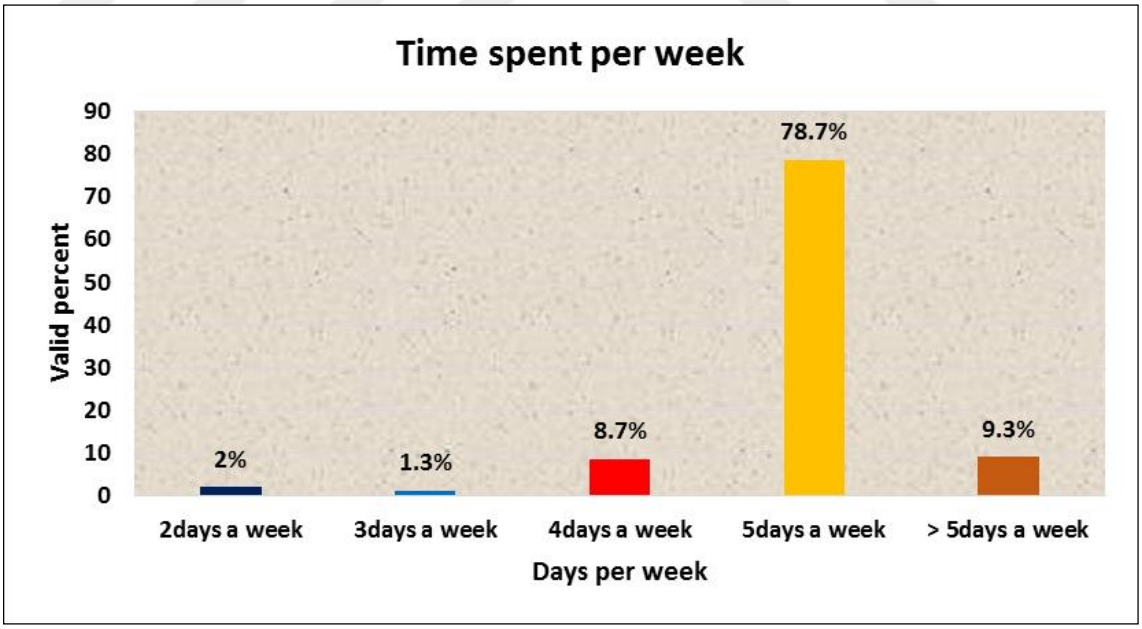


Figure 5.10. Weekly time spent characteristics in the case spaces of the participants.

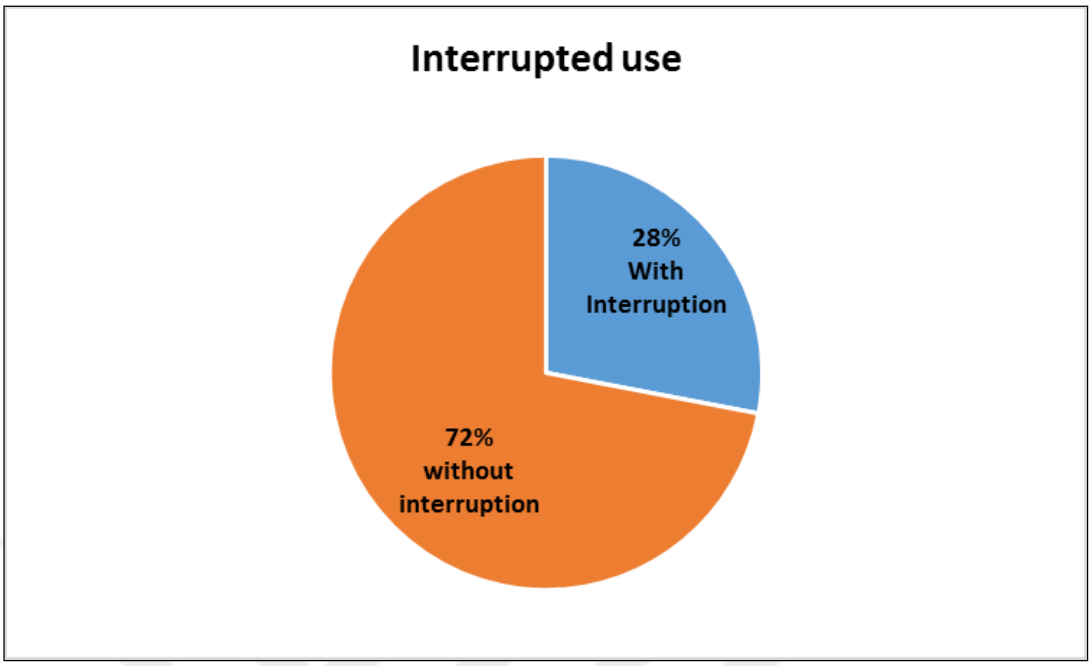


Figure 5.11. Percentages of case space usage by interruption by the participants.

5.2. Validity and Factorability of Measures

A principal components factor analysis was used to test validity and factorability measures. Two criteria for the number of factors to extract are utilized. They are Latent Root Criterion and Monte Carlo PCA test criterion.

5.2.1 Sound Sources Dominance Scale

Table 5.3 shows mean and standard deviation of the sound sources dominance scale and its factors. The sound sources dominance scale has shown a mean score of 2.1467 in a scale between 0 to 6, with a standard deviation of 0.65320.

Table 5.3. Descriptive Statistics of Sound Source Dominance Scale

Scale and factors	N	Mean	Std. Deviation
Sound Sources Dominance	300	2.1467	.65320
Talking	300	4.47	1.342
Shouting	300	3.17	1.443
Walking	300	3.86	1.463
Computer fan	300	3.94	1.463
Coffee/tea machine	300	2.36	2.063
Florescent lamb	300	1.00	1.252
Refrigerator	300	.33	.971
Telephone	300	2.79	1.298
Doors slamming	300	3.02	1.214
Cleaning trolley	300	2.29	1.364
Music	300	1.59	1.022
Birds	300	.87	.877
Tree leaves	300	.72	.839
Rain	300	.93	.924
Lawn mower	300	1.71	1.426
Traffic	300	2.66	1.425
Construction	300	.78	1.143
Valid N (list wise)	300		

A principal components factor analysis was conducted on the 17 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .804. four factors in combination explained 58.722% of the variance. Table 5.4 shows the minimum and maximum factor loadings after rotation. The items that cluster on the same factor suggest that sound sources dominance scale is best represented by four components.

Table 5.4. Factor Analysis for Sound Source Dominance

Factor(s)	Number of Items	Factor Loadings	Explained Variance (%)
Sound Sources Dominance	17	.447-.861	58.722
Component one	6	.447-.861	28.516
Component two	4	.611-.789	14.119
Component three	3	.610-.790	8.606
Component four	4	.478-.699	7.482

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: .804

Barlett Test of Sphericity: Approx. Chi-Square= 1870.508; df = 136; p=.000

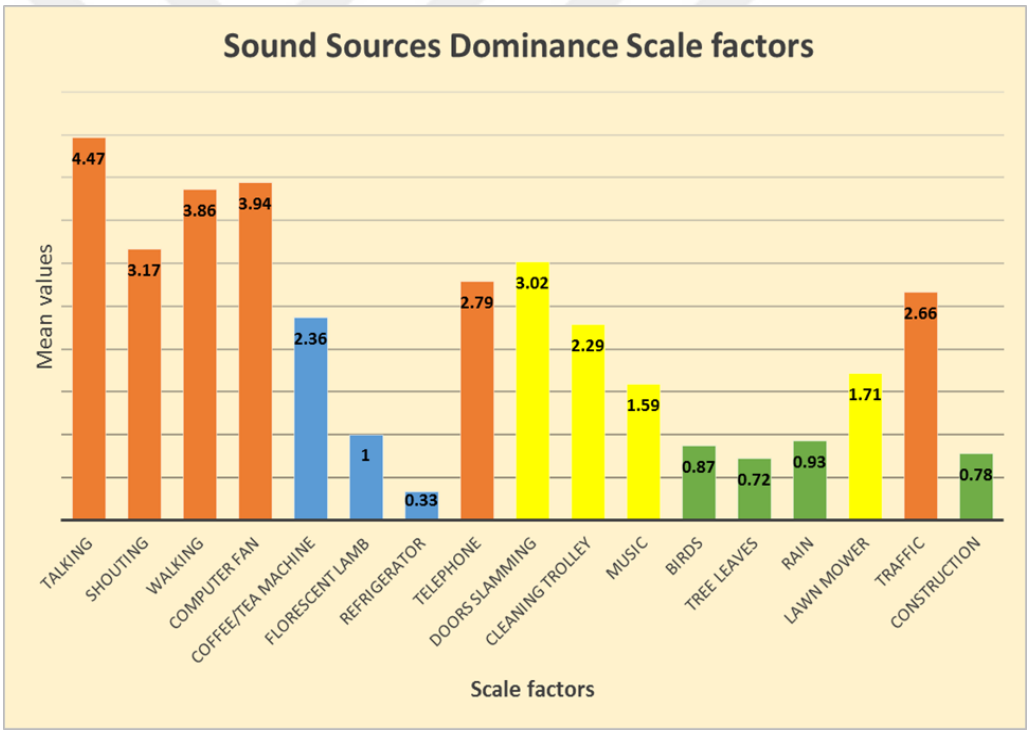


Figure 5.12. Sound source dominance scale factors.

This section presents analysis of factor in order to cluster the 17 components of sound source dominance, the analysis shows 4 groups of components that can be represent the sound sources dominance as;

1- The first component contains 6 items (Table 5.5), (walking, talking, shouting, computer fan, telphone, traffic). These items were grouped related to the frequency of sound source and how closed or far from the user of the space.

Table 5.5. Sound source dominance components

Pattern Matrix [a]

	Component			
	1	2	3	4
Walking	.861			
Talking	.854			
Shouting	.821			
Computer fan	.652			
Telephone	.505			
Traffic	.447			
Birds		.789		
Tree leaves		.758		
Rain		.753		
Construction		.611		
Florescent lamb			.790	
Refrigerator			.617	
Coffee/tea machine			.610	
Lawn mower				-.699
Cleaning trolley				-.524
Doors slamming				-.499
Music				.478

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.[a]

a. Rotation converged in 24 iterations.

2- The second component conducts on 4 items (birds, tree leaves, rain, construction), all of these sound sources out side the building and far from the auditor. Moreover, they mostly have same sound level.

3- The third component conducts on 3 items (Florescent lamb, Refrigerator, Coffee/tea machine) these sound sources are very closed to the auditor, and have same sound level.

4- The fourth component contains 4 items (Lawn mower, cleaning trolley, Doors slamming, Music), these sound sources mostly are outside the office space with the same sound frequency. This classification of sound sources could be representing its dominance considering the distance between sound source and auditor. Moreover, sound type and sound level are considered to determine the dominance of sound.

Table 5.6 shows the reliability analysis for sound sources dominance. The scale had a good reliability with Cronbach's α value of 0.815.

Table 5.6. Reliability Analysis for Sound Source Dominance

Scale	Reliability Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Sound Sources Dominance	.815	.814	17

5.2.2 Sound Source Effect Scale

Table 5.7 shows mean and standard deviation of the sound source effect scale and its factors. The sound source effect scale has shown a mean score of 1.8208 in a scale between 0 to 6, with a standard deviation of .59872.

Table 5.7. Descriptive Statistics of Sound Source Effect Scale

Scale and factors	N	Mean	Std. Deviation
Sound Source Effect	300	1.8208	.59872
Talking	300	1.71	1.024
Shouting	300	1.23	.735
Walking	300	1.88	.998
Computer fan	300	2.00	.992
Coffee/tea machine	300	1.37	1.306
Florescent lamb	300	1.39	1.455
Refrigerator	300	.39	.963
Telephone	300	2.60	.896
Doors slamming	300	2.21	.862
Cleaning trolley	300	1.46	1.058
Music	300	3.07	1.650
Birds	300	2.53	2.081
Tree leaves	300	2.45	2.173
Rain	300	2.92	2.313
Lawn mower	300	1.41	1.203
Traffic	300	1.44	.998
Construction	300	.90	1.142
Valid N (list wise)	300		

A principal components factor analysis was conducted on the 17 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .697.five factors in combination explained 58.089% of the variance.

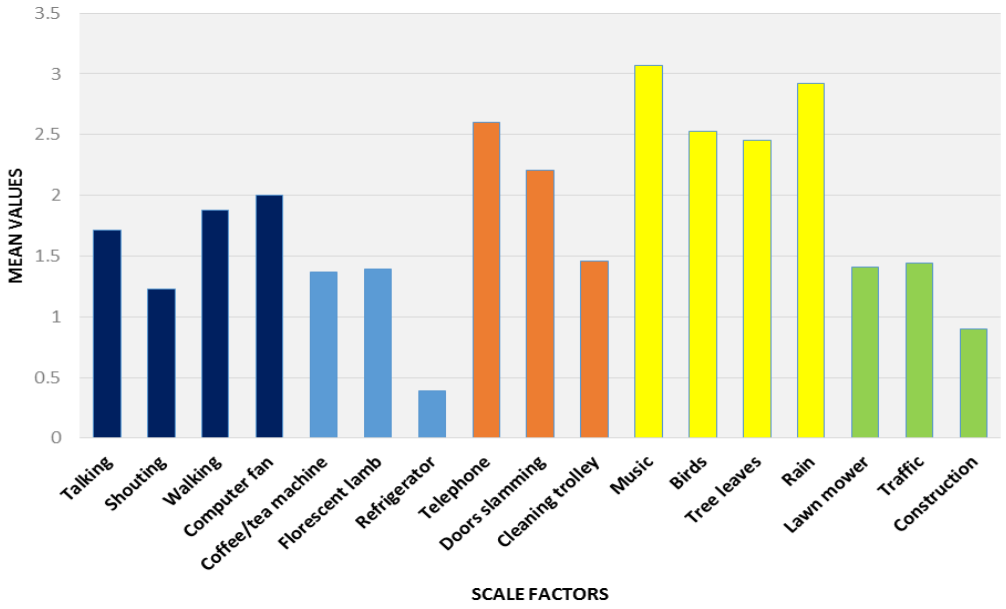


Figure 5.13. Sound source effect scale factors.

Table 5.8. Factor Analysis for Sound Sources Effects

Factor(s)	Number of Items	Factor Loadings	Explained Variance (%)
Sound Sources Effects	17	.409-.862	58.089
Component one	4	.627-.793	20.498
Component two	4	.482-.862	14.021
Component three	3	.649-.784	8.522
Component four	3	.584-.794	7.670
Component five	3	.409-.791	7.378

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: **.697**

Barlett Test of Sphericity: **Approx. Chi-Square= 1249.930; df = 136; p=.000**

Table 5.8 shows the minimum and maximum factor loadings after rotation. The items that cluster on the same factor suggest that sound sources effects scale is best represented by five components.

This part of analysis shows other classifications of sound source components according to its effect on the perception of soundscape, it represented in 5 components Table 5.9 as following:

1- The first component conducted on 4 items (Talking, walking, shouting, computer fan) which are very closed to the user of the space and produced by human activities.

2- Second component conducted on 4 items (Tree leaves, birds, rain, music), most of these items are natural sound sources which produced by nature, and support the classifications of sound sources in previous studies.

3- The third component has 3 items which are mechanical sound sources (Lawn mower, Construction, Traffic).

4- The fourth component conducted for 3 items (Florescent lamb, Refrigerator, Coffee/tea machine). These cluster of items are electric and the produced sounds with similar frequency inside the space.

5- The fifth component conducted on 3 items (Doors slamming, Telephone, Cleaning trolley). These items were grouped according to their sound type and the distance to the user of the space. Moreover, according to the location of sound source (outside or inside the building).

This classification of sound sources defining 5 components that can be represent the effect of sound sources on the perception of soundscape, these clusters considered the sound type, sound level, and sound source location, to classify the sounds that affect the soundscape perception.

Table 5.9. sound sources effects on the perception of soundscape

Pattern Matrix [a]

	Component				
	1	2	3	4	5
Talking	.793				
Walking	.658				
Shouting	.645				
Computer fan	.627				
Tree leaves		.862			
Birds		.845			
Rain		.816			
Music		.482			
Lawn mower			.784		
Construction			.651		
Traffic			.649		
Florescent lamb				.794	
Refrigerator				.747	
Coffee/tea machine				.584	
Doors slamming					.791
Telephone					.575
Cleaning trolley					.409

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.[a]

a. Rotation converged in 11 iterations.

Table 5.10. Reliability Analysis for Sound Sources Effects

Scale	**Reliability Statistics**		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Sound Sources Effects	.736	.750	17

Table 5.10 shows reliability analysis for sound sources effects. The scale had a good reliability score for Cronbach's α with a valu of 0.736.

5.2.3 Activity Scale

Table 5.11 shows mean and standard deviation of the activity scale and its factors. The activity scale has shown a mean score of 3.1640 in a scale between 0 to 6, with a standard deviation of .66318.

Table 5.11. Descriptive Statistics of Activity Scale

Scale and factors	N	Mean	Std. Deviation
Activity	298	3.1640	.66318
Reading	300	3.79	1.205
Writing	300	3.62	1.110
Meeting	299	1.91	1.693
Using computer	300	4.26	.737
Studying	299	2.44	1.789
Working	299	3.79	1.308
Socializing and chatting	299	2.59	1.034
Eating and drinking	300	2.93	.992
Valid N (list wise)	298		

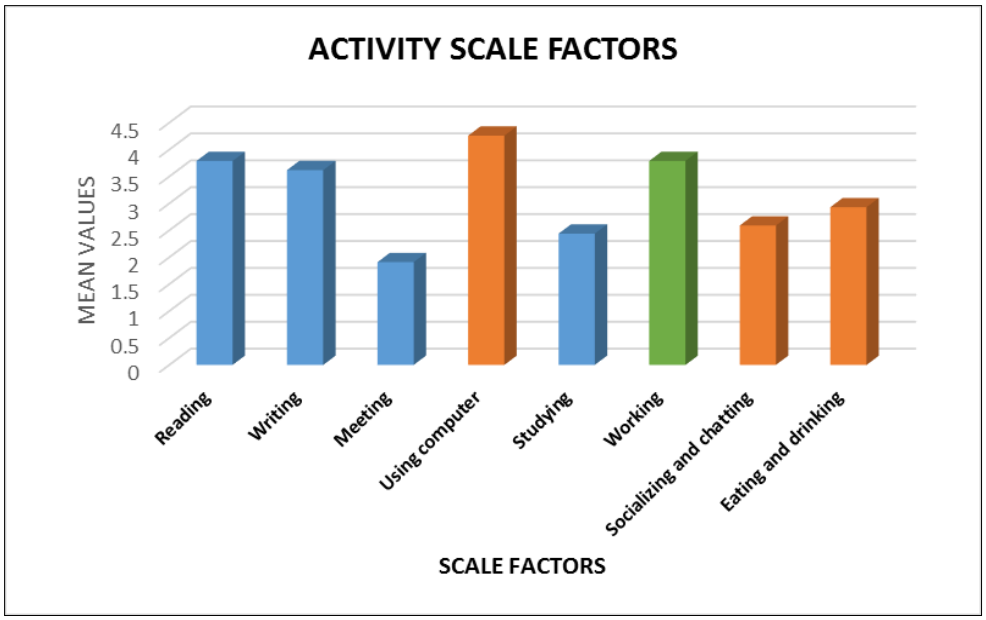


Figure 5.14. Activity scale factor

Table 5.12. Factor Analysis for Activity

Factor(s)	Number of Items	Factor Loadings	Explained Variance (%)
ACTIVITY	8	.568-.908	72.437
Component one	4	.568-.908	32.533
Component two	3	.675-.808	22.747
Component three	1	.876	17.157

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: **.614**
Barlett Test of Sphericity: **Approx. Chi-Square= 828.545; df = 28; p=.000**

A principal components factor analysis was conducted on the 8 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .614. Three factors in combination explained 72.437% of the variance. Table 5.11 shows the minimum and maximum factor loadings after rotation. The items that cluster on the same factor suggest that Activity Scale is best represented by three components.

These three components were defined according to the user behaviors in the work space, and which activities are more closed to each other, or could be done together as shown in Table 5.13.

Table 5.13. components of activity factor

Pattern Matrix [a]

	Component		
	1	2	3
Meeting	.908		
Studying	.884		
Reading	.616		
Writing	.568		
Socializing and chatting		.808	
Eating and drinking		.775	
Using computer		.675	
Working			.876

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.[a]

a. Rotation converged in 26 iterations.

Table 5.14. Reliability Analysis for Activity

Scale	Reliability Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Activity	.612	.580	8

Table 5.14 shows Reliability Analysis for Activity. The scale had a reliability, Cronbach's α = .612. which is good reliability.

5.2.4 Space Experience Scale

Table 5.15 shows mean and standard deviation of the Space Experience Scale and its factors. The Space Experience Scale has shown a mean score of (4.6904) in a scale of zero to six, with a standard deviation of 0.48102.

Table 5.15. Descriptive Statistics of Space Experience Scale

Scale and factors	N	Mean	Std. Deviation
Space experience	300	4.6904	.48102
Acoustics	300	5.35	.790
Lighting	300	5.30	.840
Colors	300	4.63	.991
Temperature	300	5.00	.913
Indoor air quality	300	5.24	.952
Humidity	300	4.50	.973
Odors	300	4.53	1.128
Building style	300	4.66	.980
Room area	300	3.74	1.141
Room height	300	3.72	1.175
Room height, width, depth proportion	300	4.59	.839
Finishing materials	300	4.67	.803
Furniture	300	4.74	.883
Furniture layout	300	4.94	.927
Indoor vegetation	300	4.33	1.205
Privacy level	300	5.03	.957
Spaciousness	300	4.75	.828
Valid N (list wise)	300		

A principal components factor analysis was conducted on the 17 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .763. four factors in combination explained 59.013% of the variance.

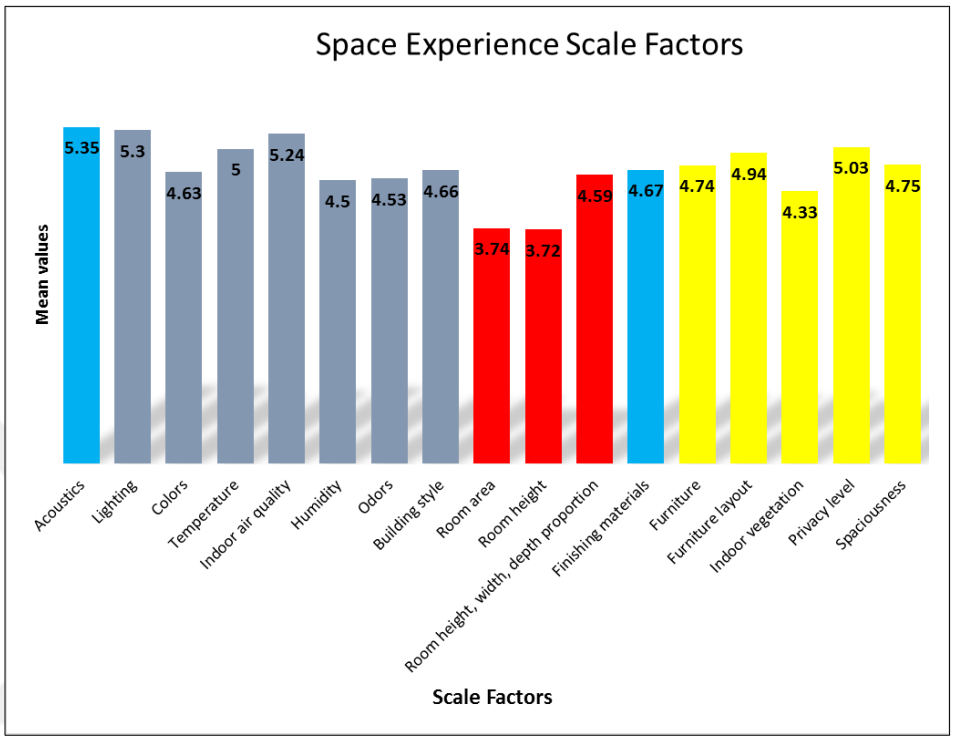


Figure 5.15. Space experience scale factors

Table 5.16. Factor Analysis for Space Experience

Factor(s)	Number of Items	Factor Loadings	Explained Variance (%)
Space Experience	17	.386-.893	59.013
Component one	7	.386-.803	26.453
***Component* two**	3	.642-.893	16.548
***Component* three**	5	. 482-.786	8.628
***Component* four**	2	.506-.691	7.384

***Kaiser-Meyer-Olkin Measure of Sampling Adequacy:* .763**

***Barlett Test of Sphericity:* Approx. Chi-Square= 1969.104; df = 136; p=.000**

Table 5.16 shows the minimum and maximum factor loadings after rotation. The items that cluster on the same factor suggest that Space Experience Scale is best represented by four components.

This part of analysis shows the classifications of space components according to its effect on the experience of space, it represented in 4 groups (Table 5.17) as following: The first component contains 7 items which can perceived by senses and considering the comfort as criterion, whereas the second component conducted on 3 items that related to the proportion of space. On the other hand, the third component includes 5 items regarding aesthetic of space. Finally, the fourth component conducted on 2 items that related to aural-visual effect.

Table 5.17. Components of space experience factors

Pattern Matrix [a]

	Component			
	1	2	3	4
Humidity	.803			
Odors	.791			
Indoor air quality	.756			
Temperature	.670			
Colors	.621			
Lighting	.556			
Building style	.386			
Room height		.893		
Room area		.869		
Room Height, width, depth proportion		.642		
Furniture layout			-.786	
Furniture			-.775	
Privacy level			-.712	
Indoor vegetation			-.515	
Spaciousness			-.482	
Acoustics				.691
Finishing materials				.506

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.[a]

a. Rotation converged in 9 iterations.

Table 5.18. Reliability Analysis for Space Experience

Scale	Reliability Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Space Experience	.809	.815	17

Table 5.18 shows the Reliability Analysis for Space Experience. The scale has a good reliability score, which is Cronbach's α = .809.

5.3. Correlations between Variables

Pearson Correlation is used to test the relationships between variables in the study. Table 5.19 shows that sound Source Dominance and Activity variables have significant positive relationships with **Space experience** variable with 0.181, $p < .01$ and 0.126, $p < .05$ values respectively. Soundscape expectation, Space quality expectation and Sound Source Effect variables have significant positive relationships with **Sound Source Dominance** variable, 0.290, .313, $p < .01$ and 0.140, $p < .05$ respectively. Soundscape expectation, Space quality expectation and Sound Sources Dominance variables have significant negative relationships with **Activity** variable with -0.309, -0.347 and -0.324, $p < .01$ values respectively. Sound Source Effect variable is related positively with **Activity** variable with 0.263, $p < .01$ value.

Table 5.19. Correlations between variables

			1	2	3	4	5	6
1	Soundscape expectation	Pearson Correlation	**1**					
2	Space quality expectation	Pearson Correlation	**.741****	**1**				
3	Sound Sources Dominance	Pearson Correlation	**.290****	**.313****	**1**			
4	Sound Sources Effect	Pearson Correlation	**-.037**	**-.123***	**.140***	**1**		
5	Activity	Pearson Correlation	**-.309****	**-.347****	**-.324****	**.263****	**1**	
6	Space experience	Pearson Correlation	**-.049**	**.035**	**.181****	**-.040**	**.126***	**1**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.3.1. Regression Analysis

Regression analysis is carried out, using SPSS software, to test leaner relationships of Soundscape expectation, Space quality expectation, Activity and Sound Source Dominance as predictors of Space experience. Test of Sound Source Dominance mediation effect on Space experience is also performed. Results of the analysis are addressed below.

Hierarchical multiple regression was used to assess the ability of one control measures (Sound Source Dominance) to predict levels of Space experience, after controlling for the influence of Soundscape expectation, Space quality expectation and Activity as shown in Table 5.20.

Table 5.20. Effect of Soundscape expectation, Space quality expectation, Activity and Sound Source Dominance on Space experience

Dependent Variable: Space experience

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Soundscape expectation	.002	.702	-.049	-.838	.403
Model Two	Soundscape expectation	.014	2.037	-.166	-1.924	.055
	Space quality expectation			.158	1.835	.068
Model Three	Soundscape expectation	.033	3.314*	-.149	-1.734	.084
	Space quality expectation			.197	2.262	.024*
	Activity			.148	2.409	.017*
Model Four	Soundscape expectation	.085	6.811***	-.174	-2.073	.039*
	Space quality expectation			.158	1.852	.065
	Activity			.207	3.370	.001**
	Sound Sources Dominance			.249	4.095	.000***

*****. Model / Coefficients are significant at the 0.001 level**

***. Model / Coefficients are significant at the 0.05 level**

Preliminary analyses were conducted to ensure no violation of the assumptions of linearity, multi-Collinearity and homoscedasticity. Soundscape expectation was entered at Step 1, explaining .2% of the variance in Space experience. After entry of the Space quality expectation at Step 2, the total variance explained by the model as a

whole was 1.4%. Activity was entered at step 3 which made the total variance explained by the model as a whole 3.3%, F (3, 294) = 3.314, p < .05. In model four Sound Source Dominance was entered which made the total variance explained by the model as a whole 8.5%, F (4, 293) = 6.811, p < .001.The control measure explained an additional 8.3% of the variance in Space experience, after controlling for Soundscape expectation, Space quality expectation and Activity, R^2 change = .083, F change (1, 296) = 6.109, p < .001. In the fourth model, three measures were statistically significant, with Sound Sources Dominance recording the highest beta value (beta = .249, p < .001) followed by Activity (beta = .207, p = .001) and then Soundscape expectation (beta = -.174, p < .05). Results lead support to H.

5.4. Testing for Mediation

Since Activity was a statistically significant predictor of Space experience in both model three and model four, testing for mediation is required to see if Sound Source Dominance mediated the relationship between Activity and Space experience. Activity must be a significant predictor of both Sound Source Dominance and Space experience for a valid mediated relationship. Table 5.21 shows regression results to test for mediation.

Table 5.21. Regression results to test for mediation

Model No.	Dependent Variables	Independent Variable	R^2	F	β	t	p
Model one	Sound Sources Dominance	Activity	.105	34.794	-.324	-5.899	.000***
Model two	Space experience	Activity	.016	4.741	.126	2.177	.030*

*****. Model / Coefficients are significant at the 0.001 level**

***. Model / Coefficients are significant at the 0.05 level**

Two simple regressions were used to assess the ability of Activity to predict levels of Sound Source Dominance and Space experience. In model one Activity explained 10.5% of the variance in Sound Source Dominance, F (1, 296) = 34.794, p < .001. In model two Activity explained 1.6% of the variance in Space experience, F (1, 296) = 4.741, p < .05. Results indicate partial mediation effect of Sound Source Dominance on the relationship between Activity and Space experience.

5.5. Testing for Moderation

Testing for moderation is carried out to see if the relationship between Personal Activity Level and Sound Source Dominance is moderated by Space and usage characteristics. Table 5.18. shows regression results to test for moderation.

5.5.1 Space Type as a Moderator

Table 5.22. Shows regression results for Space type as a moderator (Single Office V. Shared Office). No significant moderation effect of space type on the relationship between Personal Activity Level and Sound Source Dominance was found (F (3, 294) = 11.667, p = .686).

Table 5.22. Space type as a moderator (Single Office V. Shared Office)

Dependent Variable: Sound Sources Dominance

Model No.	Independent Variables	**R^2**	**F**	**β**	**t**	**p**
Model one	Activity	.106	17.468***	-.325	-5.900	.000***
	Space Type Dummy			-.027	-.483	.629
Model two	Activity	.106	11.667***	-.351	-4.129	.000***
	Space Type Dummy			-.132	-.495	.621
	Space Type * Activity			.110	.404	.686

*****. Model / Coefficients are significant at the 0.001 level**

5.5.2 Location as a Moderator

Table 5.23 shows regression results for Location as a moderator (Lower floor V. Upper floors). No significant moderation effect of Location on the relationship between Personal Activity Level and Sound Sources Dominance was found (F (3, 294) = 12.012, p = .271).

Table 5.23. Location as a moderator (Lower floors V. Upper floors)
Dependent Variable: Sound Sources Dominance

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Activity	.105	17.396**	-.327	-5.882	.000***
	Location Dummy		*	.018	.322	.748
Model two	Activity	.109	12.012**	-.235	-2.346	.020*
	Location Dummy		*	.325	1.146	.253
	Location * Activity			-.337	-1.104	.271

*****. Model / Coefficients are significant at the 0.001 level**
***. Model / Coefficients are significant at the 0.05level**

5.5.3 Time Spent as a Moderator

Table 5.24 shows regression results for Time spent as a moderator (Less than 6 hours V. More than 6 hours). No significant moderation effect of Time spent on the relationship between Personal Activity Level and Sound Source Dominance was found (F (3, 294) = 14.127, p = .196).

Table 5.24. Time spent as a moderator (Less than 6 hours V. More than 6 hours)
Dependent Variable: Sound Sources Dominance

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Activity	.121	20.304*	-.281	-4.859	.000***
	Time spent Dummy		**	.133	2.304	.022
Model Three	Activity	.126	14.127*	-.396	-3.736	.000***
	Time spent Dummy		**	-.169	-.704	.482
	Time spent * Activity			.295	1.295	.196

*****. Model / Coefficients are significant at the 0.001 level**

5.5.4 Time Preference as a Moderator

Table 5.25 shows regression results for Time preference as a moderator (Morning V. Afternoon). No significant moderation effect of Time preference on the relationship between Personal Activity Level and Sound Source Dominance was found (F (3, 294) = 15.410, p = .345).

Table 5.25. Time preference as a moderator (Morning V. Afternoon)

Dependent Variable: Sound Source Dominance

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Activity	.133	22.676***	-.281	-5.827	.000***
	Time preference Dummy			.133	3.091	.002**
Model Three	Activity	.136	15.410***	-.396	-3.676	.000***
	Time preference Dummy			-.169	1.557	.121
	Time preference * Activity			.295	-.946	.345

*****. Model / Coefficients are significant at the 0.001 level**

****. Model / Coefficients are significant at the 0.01 level**

5.5.5 Weekly Usage as a Moderator

Table 5.26 shows regression results for Weekly usage as a moderator (Less than 5 days V. 5 days and above). No significant moderation effect of Weekly usage on the relationship between Personal Activity Level and Sound Sources Dominance was found (F (3, 294) = 12.846, p = .879).

Table 5.26. Weekly usage as a moderator (Less than 5 days V. 5 days and above)

Dependent Variable: Sound Source Dominance

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Activity	.116	19.321***	-.308	-5.549	.000***
	Weekly usage Dummy			.104	1.884	.061
Model Three	Activity	.116	12.846***	-.289	-2.167	.000***
	Weekly usage Dummy			-.142	.564	.573
	Weekly usage * Activity			-.040	-.152	.879

*****. Model / Coefficients are significant at the 0.001 level**

5.5.6 Interruption as a moderator

Table 5.27 shows regression results for Interruption as a moderator (With interruptions V. Without interruptions). Results indicate a significant moderation effect of Interruption on the relationship between Personal Activity Level and Sound Source Dominance (F (3, 294) = 16.359, p < .001). This means that One SSD in Interruption brings about -1.137 standardized change in perception of Sound Source Dominance.

Table 5.27. Interruption as a moderator (With interruptions V. Without interruptions)

Dependent Variable: Sound Sources Dominance

Model No.	Independent Variables	R^2	F	β	t	p
Model one	Activity	.105	17.374***	-.330	-5.566	.000***
	Interruption Dummy			.015	.252	.801
Model Two	Activity	.143	16.359***	.021	.188	.851
	Interruption Dummy			.957	3.566	.000***
	Interruption * Activity			-1.137	-3.595	.000***

*****. Model / Coefficients are significant at the 0.001 level**

5.5.6.1 Moderation Equation

Based on coefficients Table 5.28 we can work out the following Moderation equation;

Explanation:

If (A) = ACTIVITY

(SSD) = SOUND SOURCES DOMINANCE

SSD = α + (β (A) + ɣ (I)) + ɵ (A * I)

SSD = 2.195 + (.021 A) + (1.390 I) + (- .468 A*I)

When I = 1, there is Interruption:

SSD = 2.195 + (.021 A) + (1.390 I) + (- .468 A*I)

SSD = 2.195 + (.021 A) + (1.390 * 1) + (- .468 A*1)

SSD = 2.195 + .021 A + 1.39 - .468 A

SSD = 3.585 - .447 A

When I = 0, there is no Interruption:

SSD = 2.195 + (.021 A) + (1.390 I) + (- .468 A*I)

SSD = 2.195 + (.021 A) + (1.390 * 0) + (- .468 A*0)

SSD = 2.195 + .021 A

That means:

When exposed to Interruption the coefficient of Activity changes (The total effect decreased) consequently Interruption moderates the relationship between Activity and Sound Source Dominance. Note that exposure to Interruption has decreased Sound Sources Dominance.

Table 5.28. Coefficients of correlations between activities and interruption with sound source dominance

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	3.159	.175		18.005	.000					
	Activity	-.325	.058	-.330	-5.566	.000	-.324	-.308	-.307	.864	1.158
	Interruption Dummy	.022	.086	.015	.252	.801	-.107	.015	.014	.864	1.158
2	(Constant)	2.195	.319		6.891	.000					
	Activity	.021	.112	.021	.188	.851	-.324	.011	.010	.226	4.430
	Interruption Dummy	1.390	.390	.957	3.566	.000	-.107	.204	.193	.040	24.707
	Interruption Dummy Activity	-.468	.130	-1.137	-3.595	.000	-.222	-.205	-.194	.029	34.305

a. Dependent Variable: Sound Sources Dominance

5.6 Testing of Groups Differences

5.6.1 Independent Samples T Test

An independent-samples t-test was conducted to compare the Space Experience scores for Gender, Space type and Interruption groups. As shown in Table 5.29, there was significant difference in scores for males (M = 4.61, SD = .493) and females (M = 4.74, SD = .467; t (298) = 2.285, p = .023, two-tailed). The magnitude of the differences in the means (mean difference = .13, 95% CI: .01781to .23878) was very small (eta squared = .017). There was no significant difference in scores for Single office (M = 4.69, SD = .428) and Shared office (M = 4.70, SD = .555; t (205.068) = -.179, p = .858, two-tailed). There was no significant difference in scores for 'Without interruptions' (M = 4.73, SD = .520) and 'With interruptions' (M = 4.68, SD = .465; t (298) = .866, p = .387, two-tailed).

Table 5.29. Group Statistics and Independent Samples Test

Dependent Variable	Independent Variables	Groups	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Space Experience	Gender	Female	178	4.74	.467	.03502	2.28	298	.023
		Male	122	4.61	.492	.04460			
	Space Type	Single office	182	4.68	.428	.03174	-.179	205.068	.858
		Shared office	118	4.69	.554	.05106			
	Interruption	Without interruptions	84	4.72	.520	.05675	.866	298	.387
		With interruptions	216	4.67	.465	.03166			

5.6.2 Tests of Between Subjects Effects

Multiple ANOVAs are used to test differences in Space Experience which are attributed to usage of space variables (Space Location, Time spent, Time preference and Time weekly) and demographic variables (Age, Occupation and Education). Results of these tests showed that there are not significant findings affecting this study (see Appendix F).

CHAPTER VI

RESULTS AND DISCUSSION

6.1 Results

Different statistical tests were applied to evaluate the results of the questionnaire in order to reveal the relationship between soundscape perception and space experience regarding other important related variables that were explained previously in the study.

6.1.1 The Relationship between Variables

The Pearson's Correlation test is carried out in order to test the relationship between the variables (sound sources dominance, sound source effect on perception, expectation of space quality and soundscape, and activity factors) as independent variables (see Table 6.1), and space experience as dependent variable. the sound source dominance and activity factor have a significant relationship with the space experience regarding expectation factor. As a result, in the suggested model (see Figure 6.1) soundscape perception will be represented by sound source dominance according to the most significant correlation between them, which supported the previous study by Jennings & Cain 2013, and Chen & Kang 2017, that the dominance of sound sources is considered to determine the relationship between soundscape and other variables in the space.

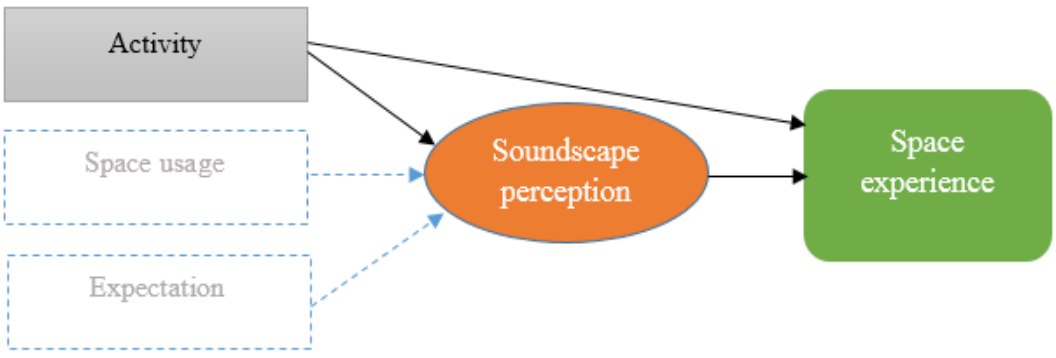


Figure 6.1. Testing the soundscape perception as a mediator between the activity and space experience.

6.1.1.1 The Model of the Relationship between Space Experience and Soundscape Perception Components

Four models were constructed to test the effect of variables on space experience (see Table 6.1). The most important model is the fourth model which presents the effect of sound source dominance (soundscape perception) and activity on space experience regarding the expectation of soundscape.

Table 6.1. Four models of space experience

Dependent Variable: Space experience

Model No.	Independent Variables
Model one	Soundscape expectation
Model Two	Soundscape expectation
	Space quality expectation
Model Three	Soundscape expectation
	Space quality expectation
	Activity
Model Four	Soundscape expectation
	Space quality expectation
	Activity
	Sound Sources Dominance

6.1.2 The Mediator between Activity and Space Experience

By applying simple regression test (see Table 5.21) reported in Chapter 5, the results showed that *the soundscape perception is working as a partial mediator between activity and space experience*, because there is a significant direct relationship between activity and space experience as explained in Figure 6.1. The activity factor has a direct effect on space experience and affect the perception of soundscape. For that reason, the soundscape perception working as partial mediator between the activities and space experience. Whereas The statistical tests did not show any significant relationship between space usage and expectation factors with space experience.

6.1.3 The Moderator between the Significant Relationships

Six factors of space and space usage that affect the soundscape perception were tested as moderators between soundscape perception and activity variable as presented in chapter 5. Figure 6.2 shows the significant moderator is the interruption factor ($F (3, 294) = 16.359$, $p < .001$) Table 5.27, which make changes (negative or positive) on the relationship between the activity and soundscape perception. The analysis resulted that the exposure to the interruption in the space affected negatively the perception of soundscape consecutively.

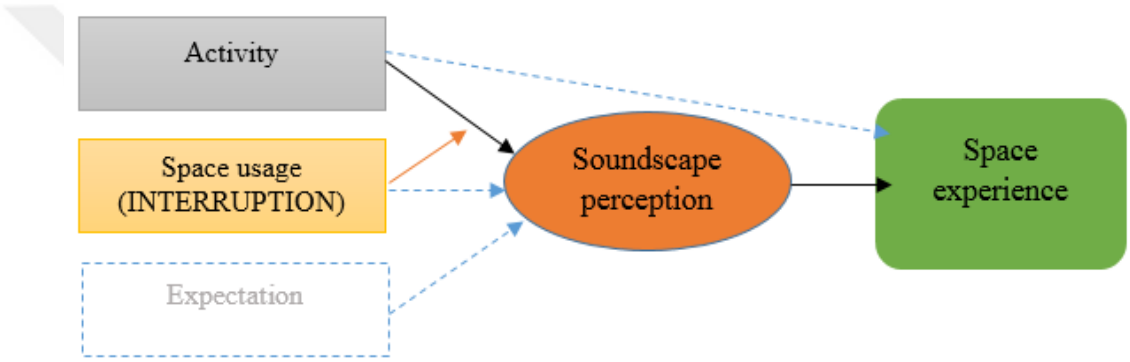


Figure 6.2. The moderator of the relationship between soundscape and activities

6.1.4 The Effect of Demographic Factor and Usage Factor on Space Experience

An independent-samples t-test was conducted to compare the most affecting factor within gender, space type, and interruption on space experience. The results showed that only the gender has a significant effect on space experience (males: $M = 4.61$, $SD = .493$) (females: $M = 4.74$, $SD = .467$). On the other hand, the Multiple ANOVAs is conducted in order to reveal the relationship between space usage factors and demographics that affect the experience of space. Only the time preference and time spent with space location have a significant effect on space experience, $F (2, 216) = 3.113$, $p = .046$). Furthermore, Post-hoc comparisons using the Tukey HSD test is conducted to get more accurate details about the significance results of Multiple

ANOVAs. It shows only the second floor and fourth floor have a significance score of comparison effect (Mean Difference = .3759, p =.025).

6.1.5 The Developed Model of Relationships between the Variables

As a result of the previous analysis, the conceptual model of relations between space experience and soundscape perception is developed. The activity has a direct effect on space experience and has another direct effect on soundscape perception. These two ways of affection make the soundscape perception play the role of partial mediator between the activity and space experience. Whereas, the interruption of usage in the space moderates the effect of activity on soundscape perception that could affect the experience of space successively.

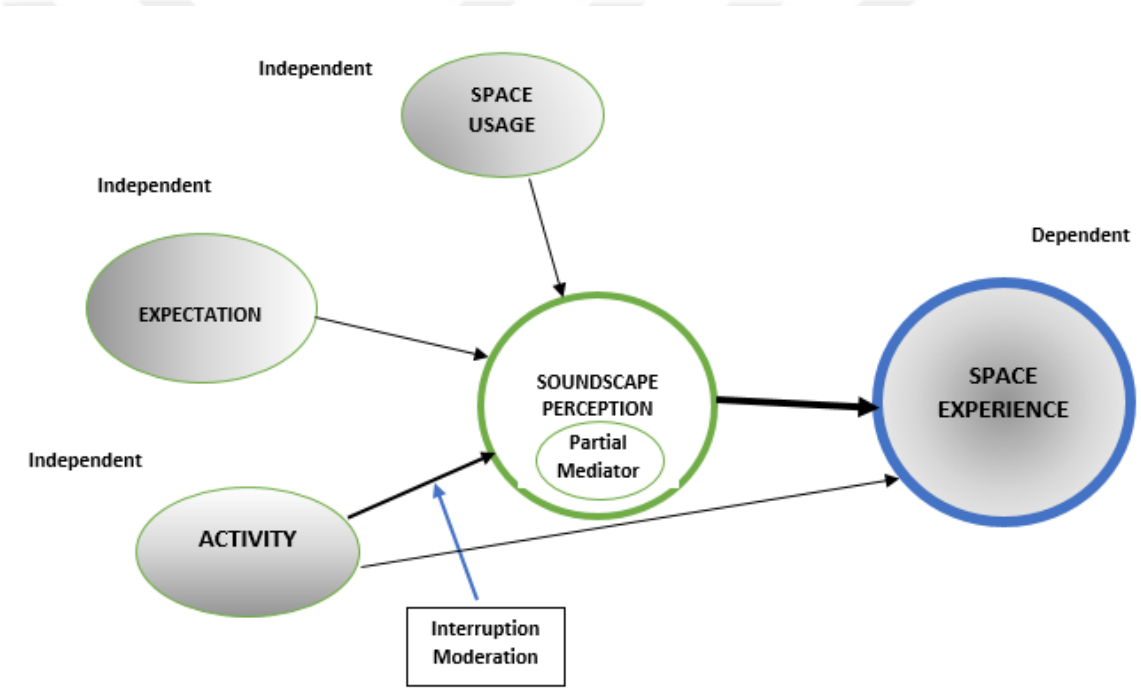


Figure 6.3. The developed model of relations with space experience

This result presents the importance of activities that the user is doing in the space. Moreover, presents the importance of space usage, especially the interruption of usage, which means that these factors should be considered in the design of spaces.

6.2 Discussion

In this study, an investigation on what the relationship between the perception of soundscape and experience of space could be, from a variety of perspectives and related variables are studied and tested. This section covers a brief overview of the philosophical perspective that has emerged, and summarizes and revisits the thesis' aims and hypothesis. Furthermore, it outlines the uses and practical applications of the findings of the study, and identifies future work and limitations.

The term soundscape consists of different sound sources, the important side of the sound source components is the dominance of sound sources that affect the perception of soundscape, and evaluated in the context according to the activity and personal situation (Jennings & Cain, 2013). In the results of this study, as shown in Table 5.19 the dominance of sound sources and activity have a significant direct relationship with space experience, which stated two meanings; first, the perception of soundscape could be represented with the perception of sound source dominance, this fact was emphasized by Jennings. Moreover, The dominance of sound source working in conjunction with other factors to affect the experience of space as shown in table 5.20, which explained the most significant model of factors that affect the experience of space . Second, the judgment whether the soundscape is positive or negative depends on the "pleasantness" or "unpleasantness" of the user in the context. This fact was illustrated in the correlations between soundscape perception and other factors such as activity, expectations of soundscape and space quality, and preferred time. Furthermore, the perception of soundscape measured by its components and affected by other different factors in the context.

Although, Davies (2013) concluded his study to describe the sound sources individually such as; rattle, whirring and delicate sounds, the soundscape deals with the total image of the heard sound and is described under four categories as, cacophony, hubbub, constant and temporal. As a result of this study, the sound sources can be defined in groups of components (Table 5.5) according to the responses of participants to four groups. Whereas these groups of sounds might be classified under Davies's description of sounds and soundscape. Moreover, the distance between the sound source and the user of the case space is presented in this study as an important factor to classify the sound sources.

The international standard (Iso, 2014) defines the context as "Interrelationship between person and activity and place", which supported the results in this study. The most important factors that affect the perception of soundscape and experience of space were considered in the questionnaire, and the results showed the importance of activity factor and usage factor, which play important role in the relationship between soundscape perception and space experience.

As hypothesized in this research;

1- *The soundscape perception is affected by sound sources regarding: sound sources dominance, expectation of soundscape, and activity in the space*. This hypothesis is accepted and explained in section 5. Table 5.20 presented that the expectation of soundscape and space quality working in conjunction with activity and sound source dominance to affect the experience of space. On the other hand, as shown in Table 5.21 the soundscape perception is a mediator between activity and space experience, which means that any change in activity will affect the perception of soundscape that successively make changes on the experience of space.

2- *The experience of space is affected by space components regarding: expectation of space quality, the usage of space, and demographical characteristics.*

As a result, in this study;

- The relationship between expectation of space quality and experience of space was tested as shown in Section 5.3.1 and Table 5.20 that there is a significant relationship between space quality expectation and space experience with activity factor. Moreover, Dokmeci Yorukoglu and Kang (2016) were presented the expectation as an important factor under psychological category, which affect the experience of context. Whereas, Dokmeci (2013) considered the expectation as the first step of psychological process (Figure 2.3). The results of this study shows that the expectation is more affective with the type of activity done by the users of the space.
- The usage of space was defined in the previous studies as a factor that affect the experience of space. This study investigated the effect of usage of space, and it was found that except the usage interruption, there is an important effect

of time spent and preference time on space experience, which reflect the usage factor of space.

- Furthermore, the results of this study presented that the space experience is affected only by gender when compared to the other demographical factors that were considered in the study such as; age, gender, and education.

3- The third hypothesis is that *the usage of space moderates the relationship between soundscape perception and spatial experience*. The results proved that the interruption use of space moderates the relationship between the activities and soundscape perception, which emphasized that there is indirect relationship between the usage interruption and experience of space Figure 6.3.

6.2.1 The evaluation and feedback

Based on the methodology and results of this study, evaluating the relationship between soundscape perception and spatial experience depends on activity (what the user of space doing), type of sound source (what the dominance of sound source), the knowledge about the space and acoustic environment (the expectation of space quality and soundscape), and the interruption of usage in the space. The results emphasized that:

- Most of the factors that affect the soundscape perception or space experience work in conjunction together.
- For that reason, evaluating the relationship between soundscape perception and spatial experience cannot be defined without understanding the effect of every factor regarding the other variables.

The results of this study could feedback the similar projects in the design phase to improve the space quality and acoustic environment. The recommendations that built upon the results of POE could help the decision makers and stakeholders to make manufacture perfect ideas of different space for different activities. Applying acoustic POE recommendations on building process will guide to improve the quality of soundscape, which lead to positive impact on the experience of space.

CHAPTER VII

CONCLUSION AND RECOMENDATIONS

7.1 Conclusion

There is an urgent demand to find a universal tool to identify the factors that influence the perception of soundscapes and space experience. It has been reviewed that previous studies on soundscapes and space experience have developed varied classifications and have used different criteria. This study presented the differences in the semantic and linguistic usage in these previous studies. Related studies on soundscape perception have been reviewed, and merged factors are created. For soundscape perception analysis, six merged factors are presented as:

1. Sonic
2. Spatial
3. Temporal
4. Psychological
5. Behavioral
6. Personal

In addition, studies on space experience are also reviewed and five merged factors are presented as:

1. User
2. Usage
3. Architectural design
4. Social context
5. Physical environment

The specific highlighted conclusion of this study is the integration of POE with a soundscape approach. Therefore, the POE stages are re-developed through applicable data collection methods and specific soundscape methods within each phase, including observations, measurements, interviews, architectural surveying, and questionnaires. In addition, collected data types and evaluated factors are specified for each proposed method and structured under the proposed acoustical POE phases. The proposed study design is a specifically structured framework that aims to contribute to the indoor soundscape and space experience research fields.

The adapted POE methodology would be beneficial especially for indoor soundscape researchers who would aim to use the proposed study design in case evaluation studies.

In addition, architects, interior architects, and space designers would benefit from this approach by integrating acoustical POE to traditional POE evaluations that could feed the planning, programming and designing phases of future projects.

The conceptual framework model and proposed study methodology are presented in three levels; Indicative, Investigative, and diagnostic. Seven categories were indicated in the first level; sound sources, orientation, lighting, furniture, finishing materials, space shape, and privacy. These characteristics of space and sound sources fed the followed level of investigative to build the interview questions. More details about soundscape perception factors and space experience factors were defined and their categorizations were finalized. Many of the outcomes were presented from the last level (diagnostic) by applying questionnaire to 300 participants. The results showed that there are important factors that influenced the relationship between soundscape perception and spatial experience embodied in;

1. Activity 2. Expectation 3. Usage Interruption

These factors were tested and the correlations between each factor were presented. Based on the fact that the factors must be evaluated together because of the interrelationship in between the variables, The best correlation model of soundscape expectations, space quality expectations, activities, and soundscape perception. Consequently, the expectation and activities with the usage interruption in space influence the perception of soundscape, which directly affects the experience of space.

7.2 Recommendations

The study has been utilized the POE methodology in order to provide a foundation for decision-making. Moreover, bridging the gap between the research and its application to design towards taking design out of intuitiveness. According to the results of this study, the benefits of POE outcomes is to develop the spaces acoustically, also the effective factors that influence the experience of spaces should be considered as below;

7.2.1 General Recommendations

- The type of activity in space should fit into acoustic environment, which means improving the quality of soundscape is necessary to improve an experience of space.

- The expectation of space quality and soundscape should meet with the reality, which would be suitable to the activity.
- In order to improve the quality of space experience, the interruption of space usage should be reduced, whereas the experience of space has inverse relationship with interruption.
- Visual attributes of space should be considered in the design stage that reflect a diversity of space characteristics.
- Individual differences affect the perception of soundscape especially the gender factor, which should be considered in the design of spaces and its characteristics.

7.2.2 Recommendations for Architects

- Architects should consider, acoustical and environmental factors during the design phases.
- The architects should consider the visual attributes that affect the perception of soundscape and experience of space.
- Audio-visual design should be considered in design of offices and spaces.
- Architects should adopt the principles of acoustic design in order to achieve the user's satisfaction.
- Designers, especially the architects, should learn and care the soundscape as one of the important components of context.
- The two attributes of space quality that are physical and visual comfort will enhance the pleasantness of space in particular office spaces, if well designed.

In the specific case study, exercising POE feeds the designer in future projects that will lead to save money in the case of usage related problems, or prevents errors from happening in advance. The purpose of POE and its analysis is crucial to determine the role of POE in improving the quality of space, overall environment and spatial characteristics and its consequences for design considerations.

7.3 Limitations of the Study

The thesis and presented study has been achieved its purposes and illustrate a distinctive systematic search for establishing an integrated framework for soundscape perception and space experience towards evaluating their relationship by presenting

in-depth adaption of evaluation tool. However, there are some obstacles that presented as the limitations of the study. With the carelessness of some people to participate in the survey or keep the participation form for a long time and does not fill it seriously. This situation consumed long time and a search for other participants in other spaces were required. Moreover, the diversity of culture is important in the study, all of the responses were from Turkish citizens that may have limit the representation of results. However, the sample size was proved by statistician as adequate in order to adopt and achieve the theoretical approach of POE and its application as the third phase to understand the relationship between soundscape perception and space experience.

REFERENCES

Adams, M., Davies, W., & Bruce, N. (2009). Soundscapes: an urban planning process map.

Aletta, F., Kang, J., & Axelsson, Ö. (2016). Soundscape descriptors and a conceptual framework for developing predictive soundscape models. *Landscape and Urban Planning, 149*, 65-74.

Aspuru, I., Fernandez, M., García, I., & Herranz-Pascual, M. (2013). Soundscape within the strategy of Bilbao city to improve Quality of Public Spaces. *Proceedings of the NAG-DAGA, Merano, Italy*, 18-21.

Bauer, J. (2016). The new ISO-standard on "Soundscape"-Maximizing the benefit for the Architectural design process. *Internoise 2016 (Proceedings)*.

Berglund, B., Eriksen, C., & Nilsson, M. (2001). *Perceptual characterization of soundscapes in residential areas.* Paper presented at the Proceedings of the 17th International Congress on Acoustics (ICA).

Bernat, S. (2016). Analysis of Social Conflicts in Poland's Soundscape as a Challenge to Socio-Acoustics. *Archives of Acoustics, 41*(3), 415-426.

Bild, E., Coler, M., Pfeffer, K., & Bertolini, L. (2016). Considering sound in planning and designing public spaces: A review of theory and applications and a proposed framework for integrating research and practice. *Journal of Planning Literature, 31*(4), 419-434.

Bogusz, E., Skrodzka, E., Hojan, E., Jakubowski, M., Talukder, A., & Hojan-Jezierska, D. (2011). Sounds and Vibrations Necessary for library of vibroacoustic events addressed to visually impaired persons–Questionnaire Results. *Polish Journal of Environmental Studies, 20*(6), 1395-1401.

Brown, J. D. (2011). Likert items and scales of measurement. *Shiken: JALT Testing & Evaluation SIG Newsletter, 15*(1), 10-14.

Brown, L., Kang, J., & Gjestland, T. (2009). Towards some standardization in assessing soundscape preference.

Bruce, N. S., & Davies, W. J. (2014). The effects of expectation on the perception of soundscapes. *Applied Acoustics, 85*, 1-11.

Chen, X., & Kang, J. (2017). Acoustic comfort in large dining spaces. *Applied Acoustics, 115*, 166-172.

Comite'Europe'en de Normalisation, C. (2007). Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics. *EN 15251*.

Craig, A., Moore, D., & Knox, D. (2017). Experience sampling: Assessing urban soundscapes using in-situ participatory methods. *Applied Acoustics, 117*, 227-235.

Davies, W. J. (2013). Special issue: Applied soundscapes. *Applied Acoustics, 2*(74), 223.

Davies, W. J., Adams, M. D., Bruce, N. S., Cain, R., Carlyle, A., Cusack, P., . . . Jennings, P. (2013). Perception of soundscapes: An interdisciplinary approach. *Applied Acoustics, 74*(2), 224-231.

Dökmeci, P., & Yılmazer, S. (2012). Relationships Between Measured Levels and Subjective Ratings: A Case Study of the Food-Court Area in CEPA Shopping Center, Ankara. *Building Acoustics, 19*(1), 57-74.

Dokmeci, P. N. (2013). *New framework on indoor soundscaping through built entity, sound environment, and contextual experience.* University of Sheffield.

Dokmeci Yorukoglu, P. N., & Kang, J. (2016). Analysing Sound Environment and Architectural Characteristics of Libraries through Indoor Soundscape Framework. *Archives of Acoustics, 41*(2), 203-212.

Dumyahn, S. L., & Pijanowski, B. C. (2011). Soundscape conservation. *Landscape Ecology, 26*(9), 1327.

Francis, D. C., & Ching, K. (1996). Architecture: form, space, & order: New York, New York: Van Nostrand Reinhold.

Giuliani, M., Scopelliti, M., & Capirci, O. (2001). *Deaf people and the cognition of environmental sounds.* Paper presented at the Proc. of 17th ICA.

Gozalo, G. R., Carmona, J. T., Morillas, J. B., Vílchez-Gómez, R., & Escobar, V. G. (2015). Relationship between objective acoustic indices and subjective assessments for the quality of soundscapes. *Applied Acoustics, 97*, 1-10.

Harvey, D. (1996). *Justice, nature and the geography of difference*.

Hassanain, M. A. (2007). Post-occupancy indoor environmental quality evaluation of student housing facilities. *Architectural Engineering and Design Management, 3*(4), 249-256.

Herranz-Pascual, K., Aspuru, I., & García, I. (2010). Proposed conceptual model of environmental experience as framework to study the soundscape. *Inter Noise 2010: Noise and Sustainability, Lisbon, Portugal, 13*, 2904-2912.

Herranz-Pascual, K., García, I., Aspuru, I., Díez, I., & Santander, Á. (2016). Progress in the understanding of soundscape: Objective variables and objectifiable criteria that predict acoustic comfort in urban places. *Noise Mapping, 3*(1).

Hidayetoglu, M. L., Yildirim, K., & Cagatay, K. (2010). The effects of training and spatial experience on the perception of the interior of buildings with a high level of complexity. *Scientific Research and Essays, 5*(5), 428-439.

Hojan, E., Jakubowski, M., Talukder, A., Wereda, H., Furmann, A., Ewertowski, R., . . . Bogusz, E. (2012). A new method of teaching spatial orientation to the blind. *Acta Physica Polonica A, 121*(1A), A5-A8.

Hume, K., & Ahtamad, M. (2013). Physiological responses to and subjective estimates of soundscape elements. *Applied Acoustics, 74*(2), 275-281.

Ismail, M. R. (2014). Sound preferences of the dense urban environment: Soundscape of Cairo. *Frontiers of Architectural Research, 3*(1), 55-68.

Iso, T. (2014). 43/SC 1/WG 54, 12913-1 Acoustics–Soundscape–Part 1:" Definition and conceptual framework". *International Organization for Standardization, 1*, 1559-1564.

Jennings, P., & Cain, R. (2013). A framework for improving urban soundscapes. *Applied Acoustics, 74*(2), 293-299.

Jensen, K., & Arens, E. (2005). Acoustical quality in office workstations, as assessed by occupant surveys.

Kang, J. (2010). From understanding to designing soundscapes. *Frontiers of Architecture and Civil Engineering in China, 4*(4), 403-417.

Kang, J., Aletta, F., Gjestland, T. T., Brown, L. A., Botteldooren, D., Schulte-Fortkamp, B., . . . Fiebig, A. (2016). Ten questions on the soundscapes of the built environment. *Building and environment, 108*, 284-294.

Kang, J., Chung, A., & Ip, G. (2006). *Acoustic comfort, quality and atmosphere in'non-acoustic'spaces: case studies in railway stations and open plan offices.* Paper presented at the Proceedings of 13th International Congress on Sound and Vibration.

Kang, J., & Schulte-Fortkamp, B. (2016). *Soundscape and the Built Environment*: CRC press.

Kinayoglu, G. (2009). *The Role of Sound in Making of a Sense of Place in Real, Virtual and Augmented Environments.* University of California, Berkeley.

Laugwitz, B., Held, T., & Schrepp, M. (2008). *Construction and evaluation of a user experience questionnaire.* Paper presented at the Symposium of the Austrian HCI and Usability Engineering Group.

Laugwitz, B., Schrepp, M., & Held, T. (2006). *Konstruktion eines Fragebogens zur Messung der User Experience von Softwareprodukten.* Paper presented at the Mensch & Computer.

Laugwitz, B., Schubert, U., Ilmberger, W., Tamm, N., Held, T., & Schrepp, M. (2009). Subjektive Benutzerzufriedenheit quantitativ erfassen: Erfahrungen mit dem User Experience Questionnaire UEQ. *Usability Professionals, 2009*, 220-225.

Li, J., Song, Y., Lv, S., & Wang, Q. (2015). Impact evaluation of the indoor environmental performance of animate spaces in buildings. *Building and environment, 94*, 353-370.

Lindborg, P. (2013). *Physiological measures regress onto acoustic and perceptual features of soundscapes.* Paper presented at the The 3rd International Conference on Music & Emotion, Jyväskylä, Finland, June 11-15, 2013.

Lindborg, P. (2015). Psychoacoustic, physical, and perceptual features of restaurants: A field survey in Singapore. *Applied Acoustics, 92*, 47-60.

Lindborg, P. (2016). A taxonomy of sound sources in restaurants. *Applied Acoustics, 110*, 297-310.

Marry, S., & Defrance, J. (2013). Analysis of the perception and representation of sonic public spaces through on site survey, acoustic indicators and in-depth interviews. *Applied Acoustics, 74*(2), 282-292.

McGregor, I., Leplâtre, G., Crerar, A., & Benyon, D. (2006). Sound and soundscape classification: establishing key auditory dimensions and their relative importance.

McGurk, H., & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature, 264*, 746-748.

Turkish Ministery. (2013). Regulation on evaluating and managing environmental noise *Official Gazette of TR 27601*.

Nemoto, T., & Beglar, D. (2014). Likert-Scale Questionnaires: JALT.

Niessen, M., Cance, C., & Dubois, D. (2010). *Categories for soundscape: toward a hybrid classification.* Paper presented at the Inter-Noise and Noise-Con Congress and Conference Proceedings.

Offenhuber, D., & Auinger, S. Urban Configuration and the Soundscape: Stadmusik.

Preiser, W. F. (1995). Post-occupancy evaluation: how to make buildings work better. *Facilities, 13*(11), 19-28.

Preiser, W. F., Rabinowitz, H. Z., & White, E. T. (1988). *Post-occupancy evaluation*: Van Nostrand Reinhold company.

Raimbault, M., Bérengier, M., & Dubois, D. (2001). *Common factors in the identification of urban soundscapes: Pilot studies in two French cities: Lyon and Nantes.* Paper presented at the Proceedings of the 17th International Conference on Acoustics (ICA). Rome.

Raimbault, M., & Dubois, D. (2005). Urban soundscapes: Experiences and knowledge. *Cities, 22*(5), 339-350.

Raimbault, M., Lavandier, C., & Bérengier, M. (2003). Ambient sound assessment of urban environments: field studies in two French cities. *Applied Acoustics, 64*(12), 1241-1256.

Ribeiro, Kortchmar, & Slama. (2001). Case Study of Building Diagnostics: Acoustic Post-occupancy Evaluation of Buildings in Tropical Climates. *Building Acoustics, 8*(3), 212-221.

S, U. (2009). *Analysing architecture*.

Schrepp, M., Hinderks, A., & Thomaschewski, J. (2014). *Applying the User Experience Questionnaire (UEQ) in different evaluation scenarios.* Paper presented at the International Conference of Design, User Experience, and Usability.

Schulte-Fortkamp, B. (2001). *The quality of acoustic environments and the meaning of soundscapes.* Paper presented at the Proc. of the 17th international conference on acoustics.

Schwenkler, J. L. (2009). *Space and Self-Awareness.* University of California, Berkeley.

Solomon, J. (2012). Building the Soundscape in the Age of Visual Distraction.

Tookaloo, A., & Smith, R. (2015). Post Occupancy Evaluation in Higher Education. *Procedia Engineering, 118*, 515-521.

Torija, A. J., Ruiz, D. P., & Ramos-Ridao, Á. F. (2014). A tool for urban soundscape evaluation applying support vector machines for developing a soundscape classification model. *Science of the Total Environment, 482*, 440-451.

Truax, B. (1996). Soundscape, acoustic communication and environmental sound composition. *Contemporary Music Review, 15*(1-2), 49-65.

Tuan, Y.-F. (1977). *Space and place: The perspective of experience*: U of Minnesota Press.

Turner, P., McGregor, I., Turner, S., & Carroll, F. (2003). Evaluating soundscapes as a means of creating a sense of place.

Uebersax, J. (2001). Statistical methods for rater agreement. *Website http://ourworld. compuserve. com/homepages/jsuebersax/agree. htm*.

Westerkamp, H. (1999). Soundscape composition: Linking inner and outer worlds. *Soundscape Newsletter, Amsterdam, Holland*.

Yang, W., & Kang, J. (2005a). Acoustic comfort evaluation in urban open public spaces. *Applied acoustics, 66*(2), 211-229.

Yang, W., & Kang, J. (2005b). Soundscape and sound preferences in urban squares: a case study in Sheffield. *Journal of Urban Design, 10*(1), 61-80.

Zhang, M., & Kang, J. (2007). Towards the evaluation, description, and creation of soundscapes in urban open spaces. *Environment and Planning B: Planning and Design, 34*(1), 68-86.

APPENDIXES

APPENDIX: A

Space observation Sheet

<table>
<tr><td colspan="2">Building</td><td colspan="3" rowspan="2">Department</td></tr>
<tr><td>Date:</td><td>Time:</td></tr>
<tr><td>Room/space No</td><td colspan="4"></td></tr>
<tr><td>Purpose of space</td><td colspan="4"></td></tr>
<tr><td>Number of users</td><td colspan="4"></td></tr>
<tr><td>Activity in room/space</td><td colspan="4"></td></tr>
<tr><td colspan="5">The design of room/space</td></tr>
<tr><td colspan="5">Size of room/space (is it appropriate) Yes □ No □</td></tr>
<tr><td colspan="5">Room/Space finishes</td></tr>
<tr><td>Floor</td><td colspan="4"></td></tr>
<tr><td>Walls</td><td colspan="4"></td></tr>
<tr><td>Ceiling</td><td colspan="4"></td></tr>
<tr><td>Doors</td><td colspan="4"></td></tr>
<tr><td>Windows</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Space characteristics</td><td>Colour □</td><td>Furniture layout □</td><td>Furniture crowed □</td><td>Space shape□</td></tr>
<tr><td>luminance □</td><td>Space size □</td><td>Space shape □</td><td>……..□</td></tr>
</table>

Acoustic environment	
Sound sources	
Dominant sound	
noise	Background: Foreground:
Comment	

Environment quality	
Temperature Hot/cold	
Noise	
Light type	Artificial □ natural □
Comment	

Furniture	
Furniture layout	
Furniture crowed	
colour	
Materials	
Comment	

APPENDIX: B


Measurements' sheet
Location data
Address
Building NO
Department
Floor
Time
Space No
Description of measurements' environment
Distance from space to main corridor
Weather
Sunny
Windy
Cloudy
Rainy
Snowy
Fogy
sound sources
Taking
Walking
Cleaning
cars
phone ringing
lawn mower
computer fan
Birds
Door slamming
Closed spaces
Measurements
Temperature
C°
Humidity
% RH
Lighting
Lux
Sound level
Lo A

APPENDIX: C

Çankaya University - Department of Interior Architecture

Interview

Dear participant,

This survey is a part of Ayad Aburawis's PhD research on *Evaluating the Relationship between soundscape perception and overall spatial experience*, and you are kindly invited to participate in this survey. Please share your opinion about your workspace environment and how do you perceive this environment. Your responses will be analysed to understand the relationship between the perception of a sonic environment and your experience of the space.

Your answers to the survey will only be used for the purpose of this research and not be shared to any third party.

The survey will take 10 minutes. Please answer to all questions as detailed as possible.

Thank you very much for your time.

Survey Consent Form

I understand the content described above and agree to participate in this study.

☐ Yes ☐ No

<table>
<tr><td colspan="2">Date: ……</td><td>Time: …… ……</td><td colspan="2">Room/space No: ……</td></tr>
<tr><td colspan="3">Building block name: ……</td><td colspan="2">Department: …… ……</td></tr>
<tr><td>Weather:
□ Sunny
□ Rainy
□ Cloudy
□ Fogy
□ Snowy
□ Windy</td><td>Floor:
□ Ground floor
□ 1st floor
□ 2nd floor
□ 3rd floor</td><td>Facade orientation:
□ North □ South
□ West □ East
□ North-West
□ South-West
□ North- East
□ South-East</td><td>Overlooking to:
□ Inner atrium
□ Car park
□ Main entrance
□ Other……..</td></tr>
</table>

Openings: □ Allows enough natural light □ Does not allow enough natural light	
Participant Mood at the moment:	Happy Sad Angry Poring Excited Kind ☐ ☐ ☐ ☐ ☐ ☐

Questions:

1- **During the daytime, which time period do you prefer to do your office works? Why?**

……

……

……

……

……

2- **What kind of sounds you can hear while you are being in this space, please list them? Which one is the most dominate?**

……

…..

.....

.....

.....

3- **Do you have past usage experience similar to this space? Please explain similarities/differences regarding (**space characteristics, acoustic environment, space usage time and spatial design**).**

……

……

……

……

……

……

……

……

Which space do you prefer (the past or the exist space)? Why?

……

……

……

……

……

……

□ Colours	□ Lighting	□ type of Finishes materials	□Furniture layout
□space proportion	□materials quality	□…… ……	□…… ……..
□…… ……..	□…… …….	□…… …….	□…… …….

4- Please choose which space characteristics in the table below affect your perception of this space acoustic environment. (add more characteristics)

5- **What are the activities you often do in this space? Please list all of them?**

……

……

……

……

……

……

……

6- **What are the environment factors that affect your experience of space?**

……

……

……

……

……

……

Other comments

……

……

……

……

……

……

……

Thank you very much

APPENDIX: D

ÇANKAYA ÜNİVERSİTESİ

DEPARTMENT OF INTERIOR ARCHITECTURE

Questionnaire on Indoor Soundscapes

Dear participant,

In this study, evaluation of the soundscape and spatial factors of the space is conducted to assess how well it performs acoustically for those who occupy it, this information will be used to understand areas that need improvement, provide feedback for similar buildings and future projects. This study is done as a part of *PhD research and will be included in the dissertation.* By completing this questionnaire, you are indicating your consent to participate in this research.

This survey should take approximately 10 minutes to fill out. Any information provided from participators will be confidential and used only for academic purposes. Thank you for your time and consideration.

I understand the content described above and agree to participate in this study.

☐ Yes ☐ No

All the below questions are related to your work environment. *Please tick the appropriate choice* for each item.

University name:…… …… Department:……..

Room no:……

Personal characteristics				
1- *Gender*	☐ Female	☐ Male		
2- *Age*	. . . . .			
3- *Nationality*	☐ Turkish	☐ Other……..		
4- *Occupation type*	☐ Academic staff	☐ Administrative staff	☐ Student	☐ Other……..
5- *Education level*	☐ Primary school	☐ High school	☐ Bachelor's	☐ Master's ☐ PhD

Space and usage characteristics

6. Space type: ☐ Single Office ☐ Shared Office

7. Location: ☐ Basement ☐Ground floor ☐1st floor ☐2nd floor ☐3rd floor ☐4th floor ☐5th floor ☐>5th floor

8. In an average day, how much time do you spend in your office?

☐ < 1 hour	☐ 1-2 hours	☐ 2-4 hours	☐ 4-6 hours	☐ 6-8 hours	☐ >8 hours

9. Which time during the day do you prefer to do your office works?

☐ 8:00 – 12:00	☐ 12:00 – 16:00	☐ 16:00 – 20:00	☐ after 20:00

10. I can use my office for my office work:

☐ Once a week	☐ 2 days a week	☐ 3 days a week	☐ 4 days a week	☐ 5 days a week	☐ more than 5 days a week

11. In general, during the office hours, I can use my office to do my office works:

☐ Along the day without interruptions.	☐ Along the day with interruptions by activities such as lectures and meetings.

12. Please RANK each sound source that you hear in your office according to its DOMINANCE in your office acoustic environment.

SOUND SOURCES	1-Least dominant	←				6- Most dominant →	SOUND DOES NOT EXIST
	1	2	3	4	5	6	
a) Talking	☐	☐	☐	☐	☐	☐	☐
b) Shouting	☐	☐	☐	☐	☐	☐	☐
c) Walking	☐	☐	☐	☐	☐	☐	☐
d) Computer	☐	☐	☐	☐	☐	☐	☐
e) Coffee/tea machine	☐	☐	☐	☐	☐	☐	☐
f) Florescent lamb	☐	☐	☐	☐	☐	☐	☐
g) Refrigerator	☐	☐	☐	☐	☐	☐	☐
h) Telephone	☐	☐	☐	☐	☐	☐	☐

i) Doors	☐	☐	☐	☐	☐	☐	☐
j) Cleaning trolley	☐	☐	☐	☐	☐	☐	☐
k) Music	☐	☐	☐	☐	☐	☐	☐
l) Birds	☐	☐	☐	☐	☐	☐	☐
m) Tree leaves	☐	☐	☐	☐	☐	☐	☐
n) Rain	☐	☐	☐	☐	☐	☐	☐
o) Lawn mower	☐	☐	☐	☐	☐	☐	☐
p) Traffic	☐	☐	☐	☐	☐	☐	☐
q) Construction	☐	☐	☐	☐	☐	☐	☐
r) Other……..	☐	☐	☐	☐	☐	☐	☐
s) Other……..	☐	☐	☐	☐	☐	☐	☐

13. Based on your previous experience (knowledge) on your past office environments, please rate your EXPECTATION of your office <u>soundscape</u> and <u>space quality</u>:

	Very negative	**Negative**	**Slightly negative**	**Slightly positive**	**Positive**	**Very positive**
	1	**2**	**3**	**4**	**5**	**6**
a) Soundscape	☐	☐	☐	☐	☐	☐
b) Space quality	☐	☐	☐	☐	☐	☐

14. Please rate the EFFECT of the following sound sources on your <u>office acoustic environment</u>:

SOUND SOURCES	**Very negative**	**Negative**	**Slightly negative**	**Slightly positive**	**Positive**	**Very positive**	**SOUND DOES NOT EXIST**
	1	**2**	**3**	**4**	**5**	**6**	
a) Talking	☐	☐	☐	☐	☐	☐	☐
b) Shouting	☐	☐	☐	☐	☐	☐	☐
c) Walking	☐	☐	☐	☐	☐	☐	☐
d) Computer	☐	☐	☐	☐	☐	☐	☐
e) Coffee/tea machine	☐	☐	☐	☐	☐	☐	☐
f) Florescent lamb	☐	☐	☐	☐	☐	☐	☐
g) Refrigerator	☐	☐	☐	☐	☐	☐	☐

h) Telephone	☐	☐	☐	☐	☐	☐	☐
i) Doors	☐	☐	☐	☐	☐	☐	☐
j) Cleaning trolley	☐	☐	☐	☐	☐	☐	☐
k) Music	☐	☐	☐	☐	☐	☐	☐
l) Birds	☐	☐	☐	☐	☐	☐	☐
m) Tree leaves	☐	☐	☐	☐	☐	☐	☐
n) Rain	☐	☐	☐	☐	☐	☐	☐
o) Lawn mower	☐	☐	☐	☐	☐	☐	☐
p) Traffic	☐	☐	☐	☐	☐	☐	☐
q) Construction	☐	☐	☐	☐	☐	☐	☐
r) Other……..	☐	☐	☐	☐	☐	☐	☐
s) Other……..	☐	☐	☐	☐	☐	☐	☐

15. Please rate your activity level for each office activity:

OFFICE ACTIVITIES	**Never**	**Very rarely**	**Rarely**	**Sometimes**	**Very often**	**Always**
	0	**1**	**2**	**3**	**4**	**5**
a) Reading	☐	☐	☐	☐	☐	☐
b) Writing	☐	☐	☐	☐	☐	☐
c) Meeting	☐	☐	☐	☐	☐	☐
d) Using computer	☐	☐	☐	☐	☐	☐
e) Studying	☐	☐	☐	☐	☐	☐
f) Working	☐	☐	☐	☐	☐	☐
g) Socializing, chatting	☐	☐	☐	☐	☐	☐
h) Eating, drinking	☐	☐	☐	☐	☐	☐
i) Other……	☐	☐	☐	☐	☐	☐
j) Other……..	☐	☐	☐	☐	☐	☐

16. Please rate the EFFECT of the following spatial characteristics in your office on your <u>space experience</u>.						
SPATIAL CHARACTERISTICS	**Very non-related**	**Non-related**	**Slightly non-related**	**Slightly related**	**Related**	**Very related**
	1	**2**	**3**	**4**	**5**	**6**
a) Acoustics	☐	☐	☐	☐	☐	☐
b) Lighting	☐	☐	☐	☐	☐	☐
c) Colour	☐	☐	☐	☐	☐	☐
d) Temperature	☐	☐	☐	☐	☐	☐
e) Indoor air quality	☐	☐	☐	☐	☐	☐
f) Humidity	☐	☐	☐	☐	☐	☐
g) Odours	☐	☐	☐	☐	☐	☐
h) Building style	☐	☐	☐	☐	☐	☐
i) Room area	☐	☐	☐	☐	☐	☐
j) Room height	☐	☐	☐	☐	☐	☐
k) Room height, width, depth proportion	☐	☐	☐	☐	☐	☐
l) Finishing materials	☐	☐	☐	☐	☐	☐
m) Furniture	☐	☐	☐	☐	☐	☐
n) Furniture layout	☐	☐	☐	☐	☐	☐
o) Indoor vegetation	☐	☐	☐	☐	☐	☐
p) Privacy level	☐	☐	☐	☐	☐	☐
q) Spaciousness	☐	☐	☐	☐	☐	☐
r) Other……	☐	☐	☐	☐	☐	☐
s) Other……	☐	☐	☐	☐	☐	☐

THANK YOU FOR TAKING PART IN THIS QUESTIONNAIRE

APPENDIX: E

REPORT OF THE ETHICS COMMITTEE REGARDING THE ADOPTION OF THE QUESTIONNAIRE QUESTIONS

ÇANKAYA ÜNİVERSİTESİ
REKTÖRLÜK

Sayı : 80281877-050.07- 04249
Konu : Etik Kurul Raporu

09. Kasım 2017

FEN BİLİMLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜNE,

İlgi: 20.10.2017 tarih ve 050.03-02180 sayılı yazınız.

Enstitünüz İç Mimarlık Anabilim Dalı doktora çalışması kapsamında seçilen ofis mekanları kullanıcılarına yönelik uygulanacak 20 (yirmi) öğeyi içeren, İç Mekan Akustik ve Mekansal Deneyim Faktörlerin Anlaşılabilmesi için yapılacak olan anketin incelenmesi ve Proje Onay Formu talebiniz, Üniversitemiz Bilimsel Araştırma ve Yayın Etiği Kurulu tarafından değerlendirilmiş ve uygun görülmüştür.

Bilgilerinizi ve ilgiliye bilgi verilmesini rica ederim.

Prof. Dr. Hamdi MOLLAMAHMUTOĞLU
Rektör

Ek : 20.10.2017 tarih ve 90 sayılı Araştırma ve Yayın Etiği Kurulu Proje Onay Formu

APPENDIX: F

Differences attributed to usage of space variables

Between-groups analysis of variance was conducted to explore the impact of usage of space variables (Space Location, Time spent, Time preference and Time weekly) on levels of Space Experience. As shown in the tables below there was a statistically significant main effect for Space Location, F (4, 216) = 4.562, p = .001, the effect size was moderate (partial eta squared =.078). In addition, there was a statistically significant main effect for Time Preference, F (2, 216) = 3.113, p = .046, however, the effect size was small (partial eta squared =.028). There was a statistically significant cross effect for Space Location * Time Spent, F (10, 216) = 1.955, p = .040, the effect size was moderate (partial eta squared =.083). There was no statistically significant main effect for Time Spent, F (5, 216) = Time Spent, p = .366, nor for Time Weekly, F (4, 216) = .565, p = .688. Multiple Comparisons for the significant variable (Space Location). Post-hoc comparisons using the Tukey HSD test indicated that only mean difference score between the second floor group and fourth floor group (Mean Difference = .3759) was significant, p =.025.

Multiple Comparisons for the significant variable (Time preference). Post-hoc comparisons using the Tukey HSD test indicated that mean difference scores between time preference groups do not reach a significant level at p =.05

Differences Attributed to Demographic Variables

Between-groups analysis of variance was conducted to explore the impact of demographic variables (Age, Occupation and Education) on levels of Space Experience. In Table 5.29 There was a statistically significant main effect for Age, F (3, 268) = 2.707, p = .046, however, the effect size was small (partial eta squared =.029. There was a statistically significant cross effect for Age * Occupation, F (3, 268) = 2.707, p = .049, however, the effect size was small (partial eta squared =.029). There was no statistically significant main effect for Occupation, F (2, 268) = 2.408, p = .092, nor for Education, F (3, 268) = 2.200, p = .088.

Multiple Comparisons for the significant variable (Age). Post-hoc comparisons using the Tukey HSD test indicated that mean difference scores between Age groups do not reach a significant level at p =.05.

Dependent Variable: Space Experience

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	24.505[a]	83	.295	1.427	.022	.354
Intercept	1022.313	1	1022.313	4942.326	.000	.958
Space Location	3.775	4	.944	4.562	**.001**	.078
Time Spent	1.129	5	.226	1.091	.366	.025
Time Preference	1.288	2	.644	3.113	**.046**	.028
Time Weekly	.468	4	.117	.565	.688	.010
Space Location * Time Spent	4.044	10	.404	1.955	**.040**	.083
Space Location * Time Preference	2.445	8	.306	1.478	.167	.052
Space Location * Time Weekly	1.935	7	.276	1.337	.234	.042
Time Spent * Time Preference	1.842	6	.307	1.484	.185	.040
Time Spent * Time Weekly	.514	3	.171	.828	.480	.011
Time Preference * Time weekly	1.131	4	.283	1.367	.246	.025
Space Location * Time Spent * Time Preference	.232	4	.058	.280	.891	.005
Space Location * Time Spent * Time Weekly	.099	2	.050	.240	.787	.002
Space Location * Time Preference * Time Weekly	.998	5	.200	.965	.440	.022
Time Spent * Time Preference * Time Weekly	.000	0	.	.	.	.000
Space Location * Time Spent * Time Preference * Time Weekly	.000	0	.	.	.	.000
Error	44.679	216	.207			
Total	6669.118	300				
Corrected Total	69.184	299				

Dependent Variable: Space Experience

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7.257[a]	21	.346	1.536	.065	.107
Intercept	811.514	1	811.514	3607.719	.000	.931
Age	1.827	3	.609	2.707	.046	.029
Occupation	1.083	2	.542	2.408	.092	.018
Education	1.484	3	.495	2.200	.088	.024
Age * Occupation	1.788	3	.596	2.649	.049	.029
Age * Education	1.784	5	.357	1.586	.164	.029
Occupation * Education	1.230	3	.410	1.823	.143	.020
Age * Occupation * Education	.000	0	.	.	.	.000
Error	60.283	268	.225			
Total	6448.782	290				
Corrected Total	67.540	289				

a. R Squared = .107 (Adjusted R Squared = .038)

Dependent Variable: Space experience

Tukey HSD

(I) Space location	(J) Space location	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ground floor	First floor	-.1481	.09389	.514	-.4063	.1102
	Second floor	-.2046	.09184	.173	-.4572	.0481
	Third floor	-.1806	.09956	.368	-.4545	.0932
	Fourth floor	.1713	.14232	.749	-.2202	.5628
First floor	Ground floor	.1481	.09389	.514	-.1102	.4063
	Second floor	-.0565	.06573	.911	-.2373	.1243
	Third floor	-.0326	.07614	.993	-.2420	.1769
	Fourth floor	.3194	.12705	.091	-.0301	.6689
Second floor	Ground floor	.2046	.09184	.173	-.0481	.4572
	First floor	.0565	.06573	.911	-.1243	.2373
	Third floor	.0239	.07360	.998	-.1785	.2264
	Fourth floor	.3759*	.12554	.025	.0306	.7213
Third floor	Ground floor	.1806	.09956	.368	-.0932	.4545
	First floor	.0326	.07614	.993	-.1769	.2420
	Second floor	-.0239	.07360	.998	-.2264	.1785
	Fourth floor	.3520	.13129	.060	-.0092	.7131
Fourth floor	Ground floor	-.1713	.14232	.749	-.5628	.2202
	First floor	-.3194	.12705	.091	-.6689	.0301
	Second floor	-.3759*	.12554	.025	-.7213	-.0306
	Third floor	-.3520	.13129	.060	-.7131	.0092

Based on observed means.

The error term is Mean Square (Error) = .207.

*. The mean difference is significant at the .05 level.

Dependent Variable: Space experience

Tukey HSD

(I) Time preference	(J) Time preference	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
8:00 - 12:00	12:00 - 16:00	.0374	.05688	.788	-.0968	.1716
	16:00 - 20:00	.1100	.08051	.360	-.0800	.3000
12:00 - 16:00	8:00 - 12:00	-.0374	.05688	.788	-.1716	.0968
	16:00 - 20:00	.0726	.08273	.655	-.1226	.2678
16:00 - 20:00	8:00 - 12:00	-.1100	.08051	.360	-.3000	.0800
	12:00 - 16:00	-.0726	.08273	.655	-.2678	.1226

Based on observed means.

The error term is Mean Square (Error) = .207.

Dependent Variable: Space Experience

Tukey HSD

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
21 - 30	31 - 40	-.0816	.09941	.845	-.3386	.1754
	41 - 50	-.0571	.10368	.946	-.3252	.2109
	51 - 60	.1017	.13164	.867	-.2386	.4420
31 - 40	21 - 30	.0816	.09941	.845	-.1754	.3386
	41 - 50	.0244	.06301	.980	-.1384	.1873
	51 - 60	.1833	.10271	.283	-.0822	.4488
41 - 50	21 - 30	.0571	.10368	.946	-.2109	.3252
	31 - 40	-.0244	.06301	.980	-.1873	.1384
	51 - 60	.1588	.10685	.447	-.1174	.4351
51 - 60	21 - 30	-.1017	.13164	.867	-.4420	.2386
	31 - 40	-.1833	.10271	.283	-.4488	.0822
	41 - 50	-.1588	.10685	.447	-.4351	.1174

Based on observed means.

The error term is Mean Square (Error) = .225.

APPENDIX: G

4IN1 Multi-Function Environment Meter
INSTRUCTION MANUAL

1. INTRODUCTION

The 4 in 1 digital multi- Multi-Function Environment Meter has been designed to combine the functions of Sound Level Meter, Light Meter, Humidity Meter, and Temperature Meter. It is an ideal Multi-Function Environment Meter Instrument with scores of practical applications for professional and home use. The Sound Level function can be used to measure noise in factories, schools, offices, airports, home, etc., checking acoustics of studios, auditoriums and hi-fi installations.

The Light function is used to measure illuminance in the field. It is fully cosine corrected for the angular incidence of light. The light sensitive component used in the meter is a very Stable, long life silicon diode.

The Humidity/Temperature is for use a humidity/semiconductor sensor and K type thermocouple. This operations manual contains general information and specification.

2. FEATURES

4 functions measure Sound level, Light, Humidity and Temperature

3 1/2 large LCD display with units of Lux, ℃℃℃RH and C & dB, A & dB indication.

Easy to use

Light measuring levers ranging from 0.01 lux to 20,000 lux.

Sound level range:

A LO (low) – Weighting: 35-100 dB

A HI (High)- Weighting: 65-130 dB

C LO (low) – Weighting: 35-100 dB

C HI (High)- Weighting: 65-130 dB

Resolution: 0.1 dB

Humidity measurement from 25℃RH to 95℃RH with 0.1℃RH resolution and fast time response.

Temperature measuring levers ranging from – 20.0℃℃℃750℃/-4 ℃℃℃1400℃

3. SPECIFICATIONS

Display: Large 1999 counts LCD display with function of Lux , x10 Lux, ℃, ℃, %RH and dB, A & dB ,C & dB, Lo & dB, Hi & dB, MAX HOLD, DATA HOLD indication.

Polarity: Automatic, (-) negative polarity indication.

Over-range: "OL" mark indication.

Low battery indication: The "BAT" is displayed when the battery voltage drops below the operating level.

Measurement rate: 1.5 times per second, nominal.

Storage temperature: -10℃ to 60℃(14℃ to 140℃) at℃ 80℃ relative humidity

Auto Power Off: Meter automatically shuts down after approx.10 minutes of inactivity.

Power: One standard 9V, NEDA1604 or 6F22 battery.

Dimensions/Wt.: 251.0 (H) x 63.8 (W) x 40 (D) mm/250g Photo Detector

Dimensions: 115 X 60 X 27 mm.

APPENDIX: H

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Ayad ABURAWIS

Date and Place of Birth: 28 November 1970, Mesallata

Marital Status: Married

Phone: +90 5373543996, +218 913289620

Email: c1388650@student.cankaya.edu.tr , aburwaisayad@gmail.com

EDUCATION

Degree	Institution	Year of Graduation
M.Sc.	Libyan Academy., School of Applied Science, Architecture department	2008
B.Sc.	Tripoli Univ., Faculty of Engineering, Tripoli	1995
High School	Othman Al Gezani school, Mesallata	1988

WORK EXPERIENCE

Year	Place	Enrollment
2013- Present	Çankaya University. The Graduate School of Natural and Applied Science, Interior Architecture Department	Ph.D. student
2011-2013	Executive office of the Municipality of Mesallata city	Head of the office

2009-2011	Architecture department, Faculty of Technical Engineering	Head of department
2007-2009	Authority for Facilities and Infrastructure Development	Head of department
2001-2007	Construction Department, High Institute of Engineering, Mesallata	Head of department
1996-2001	Gadames Office for Architecture and Planning, Tripoli	Architect

LANGUAGE SKILLS

- Arabic-Mother Language.
- English (reading and writing).

COMPUTER SKILLS

- Microsoft Office Programs, (Word, Exile, and PowerPoint).
- Drawing Programs, (AutoCad and SketchUp).
- SPSS Program

PUBLICATIONS

- Aburawis, A.A.M. and P.N. Dokmeci Yorukoglu, *An integrated framework on soundscape perception and spatial experience by adapting post-occupancy evaluation methodology.* Building Acoustics, 2018. **25**(1): p. 3-16.
- ABURAWIS, A.A.M. and P.N.D. YORUKOGLU, *Occupant experience of indoor soundscapes in university office spaces.* 2018.

HOBBIES

Reading, Travel, playing tennis ball.