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Soundscape Evaluation on Mississippi State University Campus

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Soundscape evaluation on Mississippi State University campus

By

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Soundscape evaluation on Mississippi State University campus

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The term soundscape, used for the first time at the end of 1970s, refers to the sum of the sounds that can be heard and perceived by people in a specific environment. The concept of soundscape has recently received attention in planning and design disciplines. Recent studies on soundscape have shown that the acoustic environment plays an important role for the comfort of site users. Hence, this research investigates how objective measurement of soundscape might be different from subjective perceptions of users in the Mississippi State University Campus as a public open space due to demographic and climatic variations. The public open spaces studied in the Mississippi State University Campus include four locations: the Mitchell Memorial Library, the Colvard Student Union, the Bell Island, and the Sanderson Center. These locations were evaluated through objective measurement, and subjective evaluation.

DEDICATION

I would like to dedicate this study to my dear family: my lovely wife Gunseli Ayca Yildirim, and my dear parents Musa Yildirim and Gulseren Yildirim who encouraged and stood behind me during this research period. In addition, I want to expand this dedication to my sisters Gulcin Yildirim and Irem Yildirim for their motivation.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variances
dB	Decibel
dBA	Decibel with A weight
dbB	Decibel with B weight
dBC	Decibel with C weight
fps	Feet per second
kU	Ku band of the waveform
log	Logarithm
MP3	MPEG Layer 3
MPH	Mile per hour
MSU	Mississippi State University
SPL	Sound Pressure Level
SPSS	Statistical Package for the Social Sciences
WAV	Windows Wave Audio Format
WHO	World Health Organization
WMA	Windows Media Audio

CHAPTER I

INTRODUCTION

1.1 Background

The term soundscape, used for the first time at the end of 1970s, refers to the entire range of sounds which can be heard by a human in a particular environment. However, the term “sound” has mostly been used as a synonym for the word “noise” and investigated as a negative concept by planning and design disciplines (Zhang and Kang, 2007). However, the notion of soundscape illustrates sound as a term that describes the place. So the term soundscape was proposed as a field to reconsider the interpretation of noise and its implications. The difficulty was to analyze the limits of sound measurements and to relate for their social and cultural aspects as suggested by Schafer. So, it is difficult to make a connection about sounds between sound levels and human life. Soundscape proposes to assess sound in its multiple aspects and to examine its perception and interpretation as a holistic approach (Schulte-Fortkamp, 2010).

Psychoacoustic factors measure and evaluate the surrounding sound accurately by using equipment. On the other hand, the research is primarily based on evaluation of subjective investigation and variables in order to develop the soundscape notion. Hence, subjective evaluation was enriched by the sound level pressure measurements. Even though soundscape studies integrated with qualitative and quantitative types of approaches, in order to evaluation them, the study relied more on subjective evaluation rather than objective measurements.

To conduct a qualitative method means for Hollstein, “we are referring to a heterogeneous ‘field of research’ and among them are different forms of observation, interviewing techniques with low level of standardization and the collection of documents or archival data" (Hollstein, 2010). At the same time, a host of methods are used, which rest on various theoretical and assumptions and methodologies. Yet, in spite of their differences, those approaches all share common ground, as advocates of the ‘interpretive paradigm’ agree on certain ideas about the nature of social reality, which is shaped by social meaning. Social reality is always a ‘meaningful’ reality, and by representing meaning, refers to a context of action in which actors organize action (Hollstein, 2010). According to Hollstein, “social reality always depends on a certain point of view or perspective and is therefore tied to social location. And last, since social reality is negotiated, it is always dynamic: social realty is a process” (Hollstein, 2010).

Soundscape can be described as any sound in the territory that is perceived and understood by the person or group of people (Truax, 1984). There is a strong relationship between sound, human, and environment, and the sound is in the middle of this relationship. Since the mediator point is soundscape, the listener is the receptor, and the entire environment defines the preference for individual experience. So, the concept of soundscape is improved by these integrated components and their relations with these three elements in the study.

Figure 1.1 was created as an example of an acoustic communication by Truax (Truax, 1984). Sound can be transferred both ways since the sound is the central point in his theory. Hence, both the environment and humans as receptors have impact on acoustic communication.

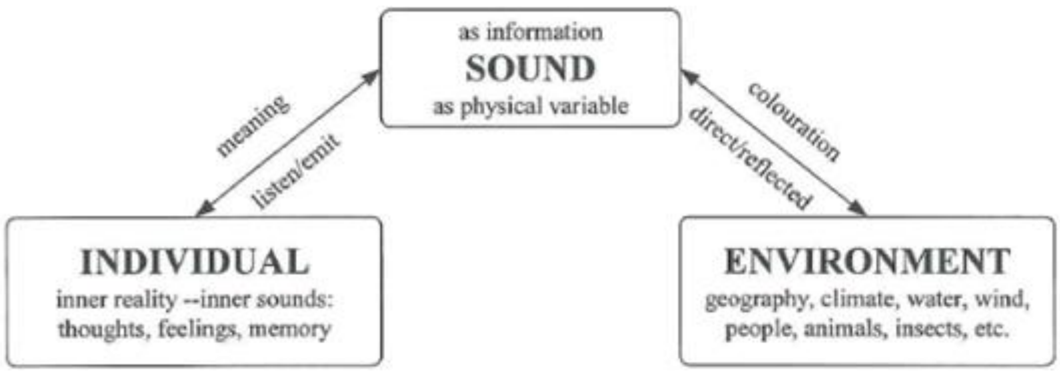


Figure 1.1 Scheme of acoustic communication

Quietness was the required assessment for the acoustic quality; however, it is not correct for the environment since people do not want quiet, particularly outside (Brown, 2006). So, different sound types and levels might be a more desirable sound environment for the individuals. According to Brown (2006), the existing wanted and unwanted sounds determine the person's choice of the site. So, preferred sounds in the urban content may mask the unwanted sounds. Brown (2006) extends his idea with a matrix as it can be seen in Figure 1.2.

Figure 1.2 Matrix of acoustic quality evaluation

(Brown, 2006)

Landscape and sound have common features since both of them have human based interaction and physical features with psychological perception in any context. Soundscape is a concept that is based on human experience rather than solely objective measurement. So, to have a better understanding about the sound is complicated, and it is necessary to demonstrate some basic definitions about the soundscape.

The first study emerged to analyze sound and noise in the middle of the last century (Turner et al., 2003). This concept lasted until the 1970s since Southworth attempted to survey participants about how they feel about sounds in Boston (Southworth, 1969). The term soundscape did not have any proper meaning at that time. Then, Schafer (1977) and Truax (1984) shaped the definition of soundscape. According to Schafer, "soundscape is the totality of sounds in any environment. Central to the definition of soundscape is the emphasis on the way how the acoustic environment is perceived and understood by individuals or a society" (Schafer, 1977).

Soundscape presents in an environment with visual and sound features. Sound exists in any characteristics such as different sound sources, sound levels, waves, and spectrum. Human interacts with the environment through sounds and its particular content.

1.2 Problem statement

This research aims to examine the effects of sounds on the campus users as a planning and design element. Some of previous studies have focused on national parks and urban parks. However, the goal of this research is to investigate the soundscape on the campus as an open space. Moreover, the study also examines the campus users' response in regard to the sound and sound characteristics. Sound recordings, sound pressure level measurements and questionnaires have been used for measurement and evaluation at the four selected sites of Mississippi State University Campus (Mitchell Memorial Library, Colvard Student Union, Bell Tower, and Sanderson Center). The results have been presented as statistical tables, sound illustrations, and in graphics.

1.3 Goals and objectives

The goal of this study is to examine the soundscape of Mississippi State University Campus as an urban open space. The objectives of this study including:

1. To define the sound levels at the four campus sites and determine the sound types;
2. To characterize the acoustic quality of soundscape in the campus area;
3. To demonstrate the campus users' perception and preferences for sounds;

4. To figure out whether demographic factors have any impact on the perception of soundscape.

To do this, there are several steps;

1. Scrutinizing the literature and general information to have a better understanding about soundscape studies.
2. Measuring the existing sound pressure level with sound pressure level meters in order to examine the objective measurement.
3. Developing a survey for campus users in order to look at the subjective perspectives.
4. Comparing and contrasting the measured sound and preferred sound, and discussing the soundscape in design and planning process.

Mississippi State University is located in the city of Starkville in Mississippi. The overall population was 24,360 in 2012 (U.S Census Bureau). The population of the city has increased roughly 10% since 2000. Mississippi State University has 20,424 students (MSU Student Enrollment Profile 1).The campus has several sound sources such as traffic that causes noise problems. In addition, there are construction-related noises and natural sounds. There is a critical need to have a better understanding about how people react to different sounds in campus as an urban open space. In addition, it is essential to figure out the preservation, enhancement, and alteration of soundscape in the campus. The researcher selected four main locations in the Mississippi State University Campus as study sites. The selection criteria relied on meeting purpose, different sound types, and locations. The researcher examined all locations in terms of sound preferences.

1.4 The significance of the study

Despite the fact that many studies investigated soundscapes of natural parks and urban parks, this study examines the soundscapes in a campus as a public open space. The settings in the urban or rural area define the soundscape and the sources of sound. The location of urban spaces consists of traffic circulations and roads, and resonance sources. The economic and social conditions lead the shape of city and create the geometric shape and locations in the city. So, transportation and accommodation requirements are provided by the city features and urban context.

According to the researchers, public open space contributes therapeutic and revitalizing practices. These practices have direct and indirect positive implications on site users' physiological and psychological health. Apart from the campus, there are few public open spaces in the city of Starkville. Inhabitants barely have access to these few public open spaces even though public open spaces increase the livability of urban life. So, introducing soundscapes plays a major role in order to improve the quality of the limited public open spaces.

For several years, the aim of the designers and planners is masking or eliminating the sound from the buildings or public space. So, sound was assumed to be minimized in the site. However, it should be used for designating to create a pleasant ambiance for the public. Therefore, this study intends to examine the urban soundscape in the urban open spaces. The expected findings will provide soundscape information background and effects on the planning and design of sound in order to increase the quality of life.

The objective measurement of sound provides a vital documentation of existing soundscapes and an inventory for the sound objects and sources that create the components of the campus and its identity. As a result of this, a sound archive was produced. Many studies have been conducted by several disciplines except Landscape Architecture. So, another aim is to introduce this concept into the literature of Landscape Architecture. Visual language will be enriched by audio language concepts with this study. Since design process is mostly based on visual criteria, sound sources are ignored. So, the sound sources should be evaluated as design sources.

Another important aspect of this study is to create a new model for the design and planning process. The soundscape inquiry was evaluated within the scope of general frame of the campus and site-related sound quality. A comprehensive profile of human-related sound preferences was drawn during examination of the sound and human interaction. Furthermore, the sound objects and sources ,that compose the soundscape in the area, were classified in order to define the functions of sounds for the human experience.

1.5 The overview of the methodology

Even though the concept of soundscape is quite broad, the aim of this research was narrowed to sound and campus and their relation to each other. The first section is about defining the sound, noise, soundscape, and campus as an open space. The next section is focusing on soundscape concept as an acoustic environment component. Then, the locations of soundscape measurements and surveys are introduced. In this section, survey questionnaires were conducted as a subjective evaluation of sound while sounds were measured as an objective measurement. The survey consisted of two main parts. While the fist part was asking personal information and behavior in the campus, the other part was seeking to figure out the sound evaluation in the campus surrounding. In the last section, the collected objective and subjective evaluations were investigated and analyzed by comparing and contrasting the situations (see Appendix D).

1.6 Thesis organization

The thesis consists of following sections: Literature Review, Methodology, Results, Discussion, and Conclusions. While the Literature Review Section introduces the origins of soundscape and its components, The Methodology Section defined the survey design that consists of participants and measurements of sites that was found by equipment. Then, the Results Section states the survey responses and site measurements. In the Discussion and Conclusions Section, the relationship between survey results and site measurements was discussed by the researcher with literature findings.

1.7 Limitations

Since the participation by campus users of the survey part was not in a large sample, the study might not reflect the general opinion of the sounds in the campus. Other campus users also might have affected the ones who took part in this research by commenting or discussing for the questionnaire part. In addition, the effects of climate conditions could not be observed year round since the measurements and questionnaires were conducted during summer and fall seasons. Another limitation was that there were not as many as participants for the summer because of summer holiday.

CHAPTER II

LITERATURE REVIEW

2.1 Sound

Sound is defined by Kennedy and Timerson (1996) "as a type of energy which mediates throughout solid, liquid or gas medium in the form of vibrations." In the media, all vibrating particles move merely tiny distances to both of their regular position. So, sound is conveyed in the platform of a perpendicular wave." The time for finishing a whole course by a moving particle is called "period," *T*. Moreover, the adjustment of the wave from a reference point is called a phase (Kennedy and Timerson, 1996). The resonances are reproduced and the rate that is per second is described as "frequency," *f*. The unit of frequency is hertz (Hz). The distance between next sections that same conditions of particle movement happening is called the wavelength, λ (Kennedy and Timerson, 1996). So, the distance a sound wave is conveyed is one cycle of vibration.

2.1.1 Transmission of sound

A source produces the sound that the human ear perceives, and the sound is conveyed by a medium. Then, it is perceived by the human brain through the ear. So, there should be three components in order to perceive any sound; sound source, receiver (ear and brain), and a transmitter. If any one of these components is missing, there is not any sound.

The sound speed does not affect the frequency; the sound has the same speed each frequency. The temperature of the context changes the sound velocity. In the cold weather, the sound velocity declines, while it increases in the hot weather. In addition, the direction of a sound is altered when temperature changes, particularly from hot air to cold air (Avsar, 1998). Sound waves go up in the atmosphere in the daytime when the ground warms, whereas they head to ground in the night time since the ground gets warm. Since the water surface has a reflective function, the sound can travel further distance.

The sound velocity also depends on the substances. Sound velocity differs in different materials in 68°F; CO_2: 908 fps, air: 1128 fps, alcohol: 3980 fps, water: 4800 fps, gold: 5718 fps, copper: 11680 fps, and iron: 16830 fps. So, the gas that has less density is not a good sound conveyor (Avsar, 1998).Temperature also has effects on sound velocity. It is known that as long as the temperature increases, the particles in the substance tend to move. Therefore, sound velocity goes up while temperature rises.

2.1.2 Sound levels

The unit of sound pressure level is decibel, which was originated from electrical engineering. It shows a proportion or relative value. The human ear does not take action progressively to sound strength or pressure while perceived changes in intensity or pressure tend to be proportional to the ratios between pressures. Hence, this situation makes it more convenient to apply the decibel (dB) as a logarithmic unit in order to examine the intensity and pressure of the sound (Avsar, 1998). The term can be defined as a proportion of two magnitudes in the logarithm version. So, decibel emerged as a unit that proportions are used 10 times bigger or smaller than the others (Avsar, 1998). To illustrate that, 20 decibel is 10 times bigger than 10 decibel. 30 decibel is 100 times bigger than 10 decibel (Avsar, 1998). Table 2.1 shows that some decibel examples.

Table 2.1 Sound types and dB values, 03 October 2014

dB Values	Sound Types
0 dB	The minimum sound level that can be heard by human ear
30 dB	Whisper, quiet speaking level
50 dB	Rain drop sound, ventilation or refrigerator sound
60 dB	Normal speaking sound
70 dB	Busy traffic
80 dB	Alarm clock, subway, factory or plant
90 dB	Truck, lawn mower, shouting
100 dB	Refuse collection vehicle, stereo system
110 dB	Rock concert, chain saw
120 dB	Pub or night club
130 dB	Symphony
140 dB	Shotgun, 4 propeller aircraft
160 dB	Boeing 707 airplane
167 dB	4 jet engine airplane
180 dB	Rocket ship

2.1.3 Sound levels

Sound pressure level is a parameter that mentions the relation between the strength of sound source and the distance of the source. So, it refers the intensity, strength, and extension. The sound pressure is between 2×10^{-5} N/m^2 and 20 N/m^2

Sound pressure level (SPL) can be showed as SPL= 20 log (P/Po) P; sound pressure, Po; a standard reference pressure (minimum sound pressure that can be perceived by human ear 2×10^{-5} N/m^2).

20 microPascals was chosen as reference value since a mature person can hear 1000 Hz as a frequency, which means that person needs 20×10^{-6} Pa as a sound pressure level. So, the reference comes from the frequency that is 1000 Hz in this case (Ozguven, 1995).

If more than one sound source makes a contribution to any space they also add to the sound pressure levels. If the two sources have the same intensity and distance from the source the sound pressure level is two times bigger than the former level. Sound intensity has a direct correlation with the square of sound pressure level. So, a twice bigger sound intensity means that the add root 2 ($\sqrt{2}$) that is 3 dB. Thus, as it can be understood from this explanation, total sound pressure level is not equal to the addition of the sound intensity by sound sources. The reason is that the sounds sources from more than one source integrate as a sound energy (Proplan, 2006).

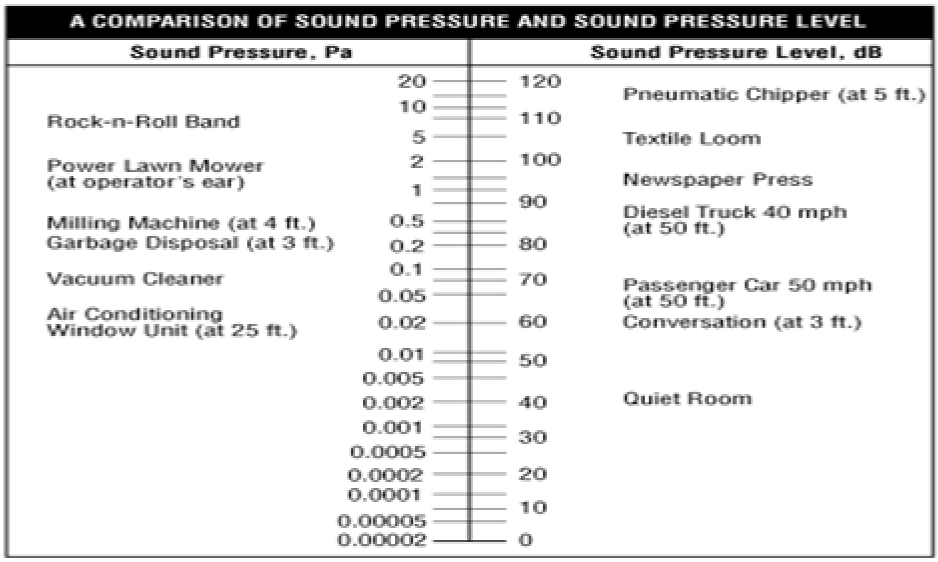


Figure 2.1 Relation of sound pressure and sound pressure level, 04 May 2014

Notes: http://www.ccohs.ca/oshanswers/phys_agents/noise_basic.html

2.1.4 The sound power

The sound power of a source is watts (W) that is the term of rating the sound amount from its source. Sound might be perceived by the measurement of material amount that comes from stability value (Noise Control, 1991). Sound power examples are illustrated in Figure 2.2).

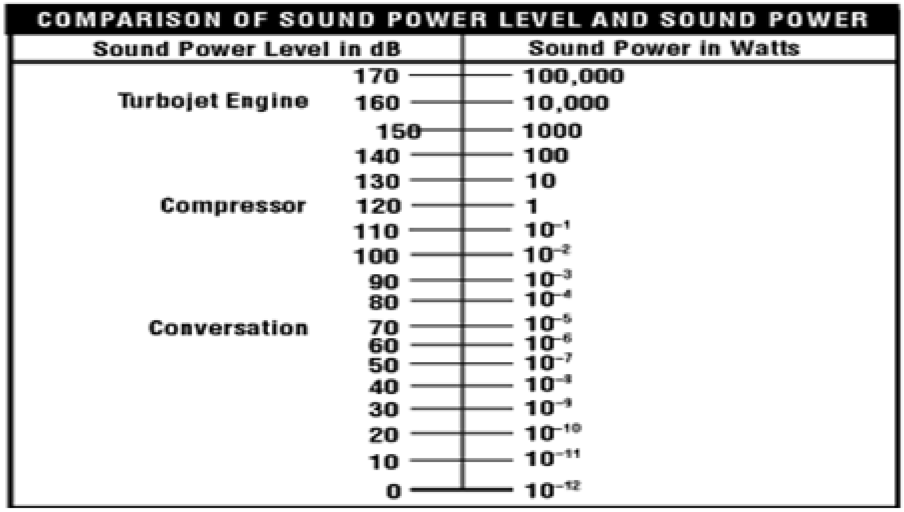


Figure 2.2 Relation of sound power level and sound power, 04 May 2014

Notes: http://www.ccohs.ca/oshanswers/phys_agents/noise_basic.html

2.1.5 The sound power

There are many parameters for defining the sound types. A particular rate is usually preferred while measuring sound. In this context, sound weights are taken into account for a human ear and its attraction to sound (Figure 2.3). Typical sound weight networks comprise A, B, C, and D values that are called dBA, dBB, dBC, and dBD (Proplan, 2006).

dB(A): This is the value that is generally used for noise measurement. In addition, this value is designated for the most appropriate sound levels for the human ear (Proplan, 2006). Apart from this value, dBC weight is used for high frequency such as wind turbine while dBD is applied for higher frequency (1-10 kHz) like airport and airplane noise.

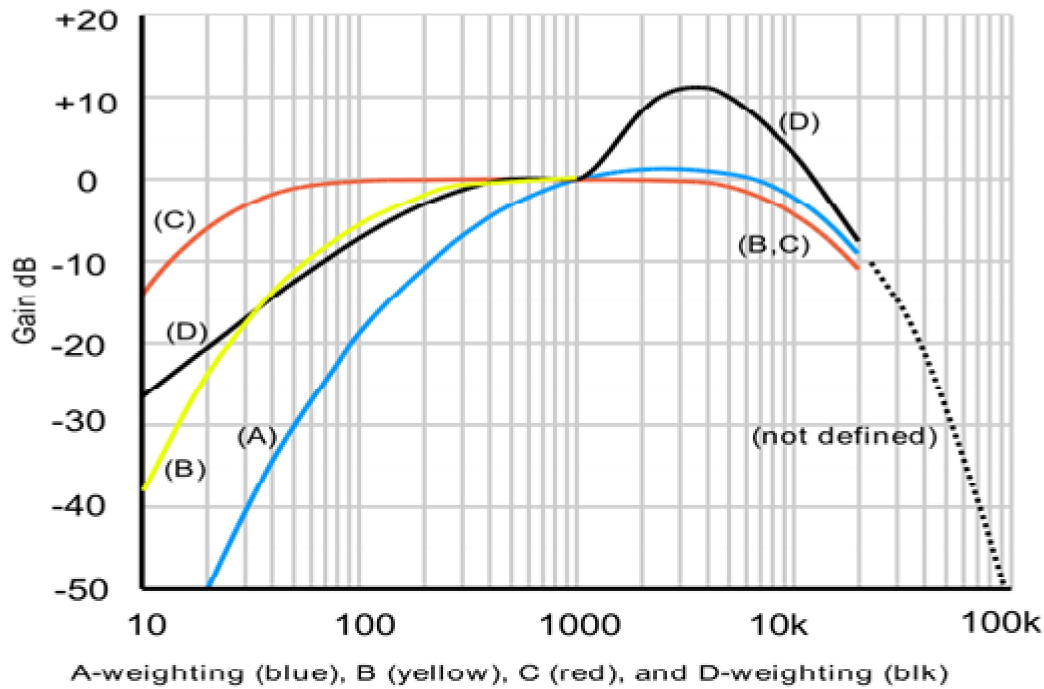


Figure 2.3 Different sound weights with frequency, 06 May 2014

Notes: http://www.sengpielaudio.com/Calculations03.html

There are also other terms that are required mentioning in this study.

Equivalent Continuous Sound Level (Leq): This is a parameter that is the desired technique to define sound levels that change through a period of time. So, it leads a particular sound pressure level value that allows entire sound energy during the time of concerned (Noise Control, 1991).

The Minimum Sound Pressure Level (Lmin): The minimum sound pressure level in the concerned time period (Noise Control, 1991).

The Maximum Sound Pressure Level (Lmax): The maximum sound pressure level in the interested time period (Noise Control, 1991).

2.1.6 Sound spreading

As it is mentioned in a previous section, sound travels as a vibration in the atmosphere with a sound wave. There are many factors such as temperature, climate conditions, distance, existing structures, topography, and so on that affect the sound spreading. Therefore, sound has different velocity and intensity in various conditions (Maekawa, 1994).

The direction of wind plays a major role for the sound spreading. If the wind direction is the same direction of the sound source, sound waves tend to go down on the ground and the sound pressure level increases (Maekawa, 1994). On the other hand, if the wind is in the opposite direction to sound sources, sound waves incline to go up and the sound pressure level decreases (Maekawa, 1994).

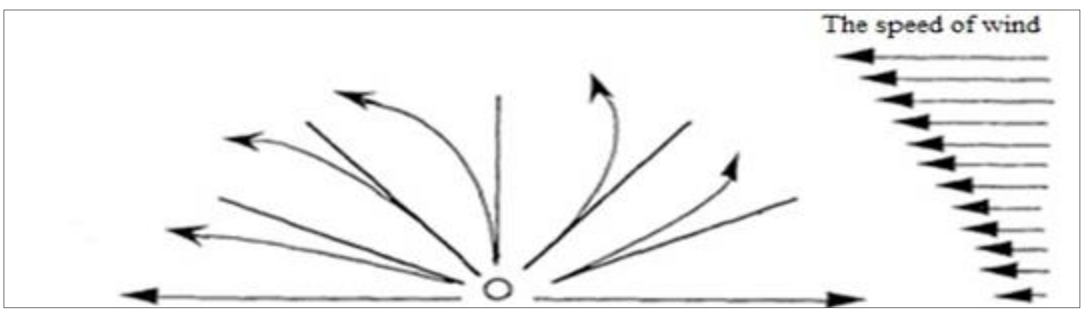


Figure 2.4 Sound pressure level and wind
(Maekawa, 1994, 12)

There is also a direct correlation between the velocity of sound and temperature. The sound goes up into the low temperature while it comes to ground in high temperature (Maekawa, 1994).

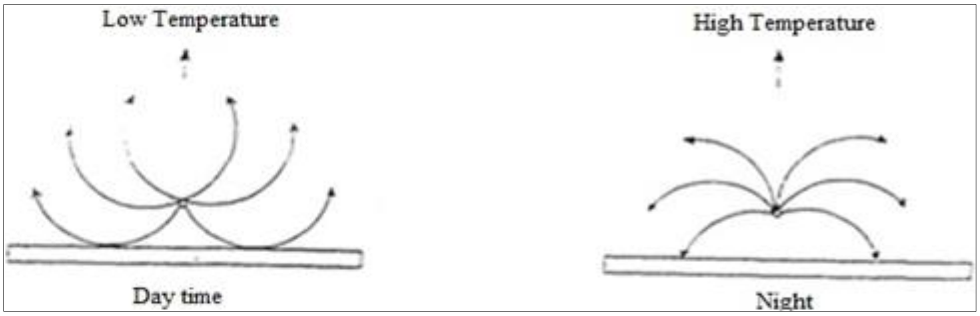


Figure 2.5 Sound pressure level and temperature

(Maekawa, 1994, 16)

The sound source is affected by the quality of ground and vegetation. When the sound source is not high enough from the ground, the sound wave has crucial importance. If the ground is a reflective and hard surface, the direction of sound can change. For instance, the concrete surface is reflective and it never absorbs the sound source, whereas the vegetation cover has less reflective function and more absorbance (Parkins and Humphreys, 1968). Vegetation also plays a crucial role for sound spreading (Maekawa, 1994). If the location of vegetation is between sound sources and the receiver, sound level is decreased by vegetation.

Table 2.2 The effects of vegetation on sound spreading

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz
Vegetation cover	0.5	-	-	3	-
Vegetation cover	0.57	-	-	12	-
Coniferous trees	7	11	14	17	19
Deciduous trees	2	4	6	9	12

(Maekawa, 1994, 340)

The topography has also some effects on sound. The topography has different functions for sound spreading either to decrease or to increase the actual sound level from its source (Maekawa, 1994). For instance, hills might decrease the sound levels.

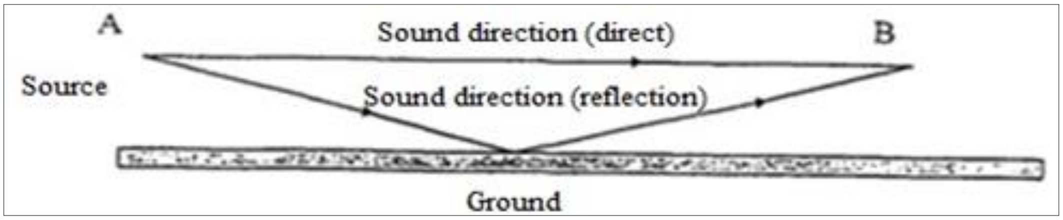


Figure 2.6 Sound pressure level and topography
(Maekawa, 1994, 114)

2.2 Noise

Since technological and social developments have been increasing for decades, the sources of noise also increase. According to the noise control standard (1991), in the modern society, noise pollution has emerged as a threat for not only human health, but also for fauna and flora, and environment in addition to soil, air, and water pollution. According to a research conducted by Joo (et al. 2011), noise challenges animals to adapt to disturbed landscapes for efficient communication. Many scientists claim that noise is the main stress source that has adverse effects on animal communication and breeding. Several studies have also claimed that many birds and amphibians have altered their vocalizations or calling behaviours due to noise (Joo et al., 2011). People are exposed to noise problems in any case. However, the psychological and physical problems that are caused by noise are still ignored. Noise can be defined as a negative sound type that has adverse effects on human hearing systems and perception, work performance, and it changes the beauty and comfort of any environment. It has a haphazard structure or sound spectrum that makes this sound type an unwanted sound. In other words, negative sounds can be explained as noise (Figure 2.7).

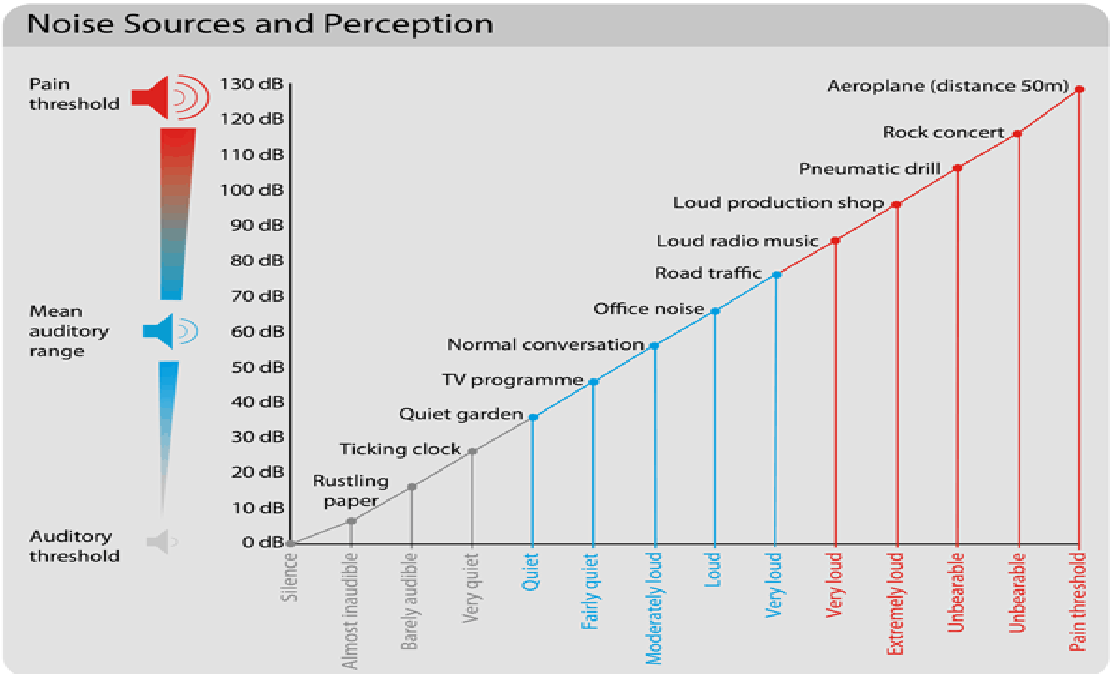


Figure 2.7 Noise sources and sound level, 08 May 2014

Notes: http://q-windows.com.my/developer/sound-insulation.html

Sample text after figure. Noise pollution is not similar to other pollutions. Even though it exists, it cannot be seen or smelled. Noise also does not have any solid waste. It does not pollute the soil, air, or water. So, it is difficult to compare and contrast with the other polluters. Its effects are mostly subtle and slow. However, implications are permanent. It has many effects on people such as, communication problems, concentration and learning troubles, nervousness, sleeping problems, and other psychological problems (Guski,1999).

After realizing the negative implications of noise, the research of rural and urban areas has transformed recently, changing their focal point from adverse approach of sound to review of the entire acoustic environment and the positive effects of sound. For instance, the noise mapping studies and noise mitigation concepts transformed to interpretation of the sound sources recently (Kang, 2004).

On the other hand, the evaluation of noise as a sound level is difficult to create a direct connection between sound level and annoyance since human perception is determined by multi sense. It is suggested that there are several dimensions that vary for the urban acoustic, such as emotional assessment, activity, and clarity (Domingo and Isabel, 2007). From this point of view, physical features of sound and human can act differently from each other. A young person, for instance, can go to a concert and does not feel annoyed even though the sound level is at a noise level; however, an elderly person may find this sound annoying. Thus, individual, emotion, situations, and other environment conditions play a major role. These features and conditions attribute the soundscape as an acoustic preference.

The sound environment (acoustical environment) consists of wanted and unwanted sounds, emerging from different sources. These sounds have different functions and meanings for the inhabitants. The sounds, in a rural or urban area might be human, mechanical, or natural, and are the vital parts of the sound environment (Raimbault and Dubois, 2005). These sound sources may be directed or utilized to improve the quality of life. Natural sounds are generally significant features of the human experience. Even though natural sounds are not a novel concept, several studies questioned how these sounds are perceived by people. These natural sounds are vulnerable and threatened sources since societies take advantage of technological improvements. So, natural sounds are decreasing because of urbanization. They should be preserved and protected (Jensen and Thompson, 2004). Another research conducted by Hall et al. (2013) also indicates that natural sources such as human speech and animal sounds are mostly preferred over traffic and construction sounds. For instance, while the traffic and construction sounds were interpreted to be desirable, the acoustic comfort was rated better than the traffic and construction sounds were interpreted to be unpleasant (Hall et al, 2013). These findings illustrate the significant contribution to the quality of human perception of sounds.

There are many former sound studies conducted in places such as urban neighborhoods and national parks, urban acoustic, which examined urban land uses, noise mapping, and so on (Kang, 2004). The study about traffic sounds, for instance, illustrates that there is a strong relationship between annoyance and increasing sound levels (Roberts et al, 2003). Other studies point out that human reactions to environmental sounds can be mediated by the surrounding soundscapes (Job and Hatifield, 2001). Brown and Muhar (2004) also mentioned that positive and negative effects of urban sounds create opportunities for the planning and design disciplines for better environment. (Brown and Muhar, 2004).

Two-folded sound environments that are positive and negative effects provide some opportunities for the design, planning, and environmental studies to designate the best acoustical environment.

In recent studies, high quality soundscape has been emphasized (Brown, 2007). For the studies, analyzing and protecting the existing soundscape or mitigating the noise is highlighted by many researchers (Schulte-Fortkamp, 2002).

The improvement of soundscape was first studied through a concept of acoustic ecology (Truax, 1999). This term emphasizes that sound has a particular meaning for the different disciplines. Soundscape was studied by scientists and musicians who used the human senses to study the environment. The first studies on soundscape focused on aesthetic and archive purposes. It was carried out by R. Murray Schafer in the 1960s. In his sound approach, he was worried about the dominance of the visual aspect and the loss of sound culture at the same time in modern societies. This anxiety allows him to develop some hearing and listening experiences that were the goal of sound awareness (Truax,1999). His main aim was to investigate the sound. To do this, he looked for interactions between people and sound, and how people perceive their environment. His first field study is World Soundscape Project concerned sound measurement, recordings, and soundscape description. Nowadays, the approach of soundscape has been supported by numerous areas all over the world (Truax, 1999).

2.3 Soundscape

2.3.1 Definitions of soundscapes

Soundscape is explained in numerous fields such as acoustic environment, sonic environment, sound environment, auditory environment, sound variation, auditory scenery, aural space, natural acoustic environment, sound ambient environments, ambient conditions, city soundscape, total ambient soundscapes, total soundscape, acoustic soundscape, and environment sounds (Truax, 1999).

The interpretation of soundscape differs field to field. Schafer defines soundscape "as a sonic environment that includes any sound in the environment" (Schafer,1977). For Truax (1999), sound environment is the sound that is perceived and understood by the human or the group. Porteous and Mastin (1985) expanded Schafer's idea and stated that soundscape is all sounds in any place from a room to a region. In addition, they mentioned that acoustic environment exists with a series of components that have the listener in the center point of these components. Downing and Hobbs (2005) also agreed with Schafer's explanation and they said soundscape refers total ambient sound environment in an area. Turner highlights the term soundscape as auditory environment with interacting receivers (Turner et al.,2003).

Another term is "auditory scenery" which represents that soundscape creates an auditory scenery that can be understood by ear (Ge and Hokao, 2003). The next expression is the sound environment. Soundscape is grasped for the social and cultural case in the idea of people who are commuting in a society with their certain environmental sounds (Finegold and Hiramitsu, 2003). Soundscape has a relationship between the human ear, human beings, sound and environment, and society (Zhang and Yang, 2007). According to the sound variation concept, sound can be experienced in a space or a time with a particular topography and different sound sources (Raimbault and Dubois, 2005). As a wave concept, soundscape is the waveform that can transfer to audio platforms by the car or human caused sources (Pauline, 2005).

In addition to terminology and definitions of soundscape it is necessary to explain and categorize the main themes of soundscape: keynote sounds, sound signals, and sound marks. Schafer (1977) categorized the soundscape into three themes mentioned above.

Keynote sounds are used to explain the type of the musical composition. In the site, geography, climate, water, wind, tree groups, birds, insects, and some animals produce keynotes or background sounds (Truax, 1999). The common feature of keynote sounds is that people ignore these types of sound and not listen cautiously even though these sounds are identifiable (Schafer, 1977).

The next feature is sound signal, which is known as foreground sound. This sound type works opposite of background sound. So, this is more easily recognized than ambient sound and it is called sound signals (Truax, 1999). There is a similar correlation for sound signals and keynote with a visual perceive of background and figure. Acoustic environment can be evaluated with sound signals even though it is complex process.

The last theme is sound marks, which are similar to landmarks. Sound marks have unique and effective qualities. These sounds are identified and recognized by visitors or local people (Schafer,1977). Since these sound types are unique for urban acoustic life, they should be conserved and preserved.

Among these three features, sound signals are more striking elements for urban environments. On the other hand, sound marks are crucial for the urban or rural area since these sounds might be either foreground or background. Moreover, these sounds have short-term or long-term memory for the identity of any site during the history (Truax, 1999).

2.3.2 The concept of soundscape

Soundscape research is about relationships between the ear, human beings, sound environments, and society (Schafer,1977). Research in soundscape covers physical science, engineering, social science, humanity, medicine, architecture, and art. It has been mainly developed within the academic disciplines of anthropology, architecture, ecology, design, human geography, linguistics, medicine, noise control engineering, psychology, sociology, and more recently, computer simulation and artificial intelligence (Kang, 2007). As a global concept, it may also be fruitful to integrate insights from knowledge or values produced by every culture, therefore involving literature and musicology, and more generally, art, aesthetics, laws, and religious studies as well (Kang, 2007).

People cannot define the sound environments with verbal statements since each sound source has a different meaning for each person. Sound sources can create different sounds and events that relate to samples for the soundscape. Definitions of sound source are useful for investigating of the perception of sound. Figure 2.8 demonstrates the sound sources category (Brown, 2009).

Another approach is about acoustic effect that gives the physical shape to the area where it is important for the users. After mitigating the noise and unwanted sound with several meetings and solutions, researchers focus on improving some strategies and instruments for the acoustic quality and health relations such as sleep habits, introducing the sound, and planning healthy communities (Kihlman and Kropp, 2001). In addition, the relationship between mental health and acoustic ambiance has been studied for several years. On the other hand, it is claimed that traffic noise increases stress and mental problems, and this problem has been emphasized in several platforms. So, public health is affected by road traffic in some way by sound (Kihlman and Kropp, 2001).

Lubman and Sutherland (2002) conducted research about the implications of sound in a classroom and playing areas on child attitude and understanding. They claimed that high-level sound pressure has adverse effects on learning and hearing whereas low sounds are ideal for perception.

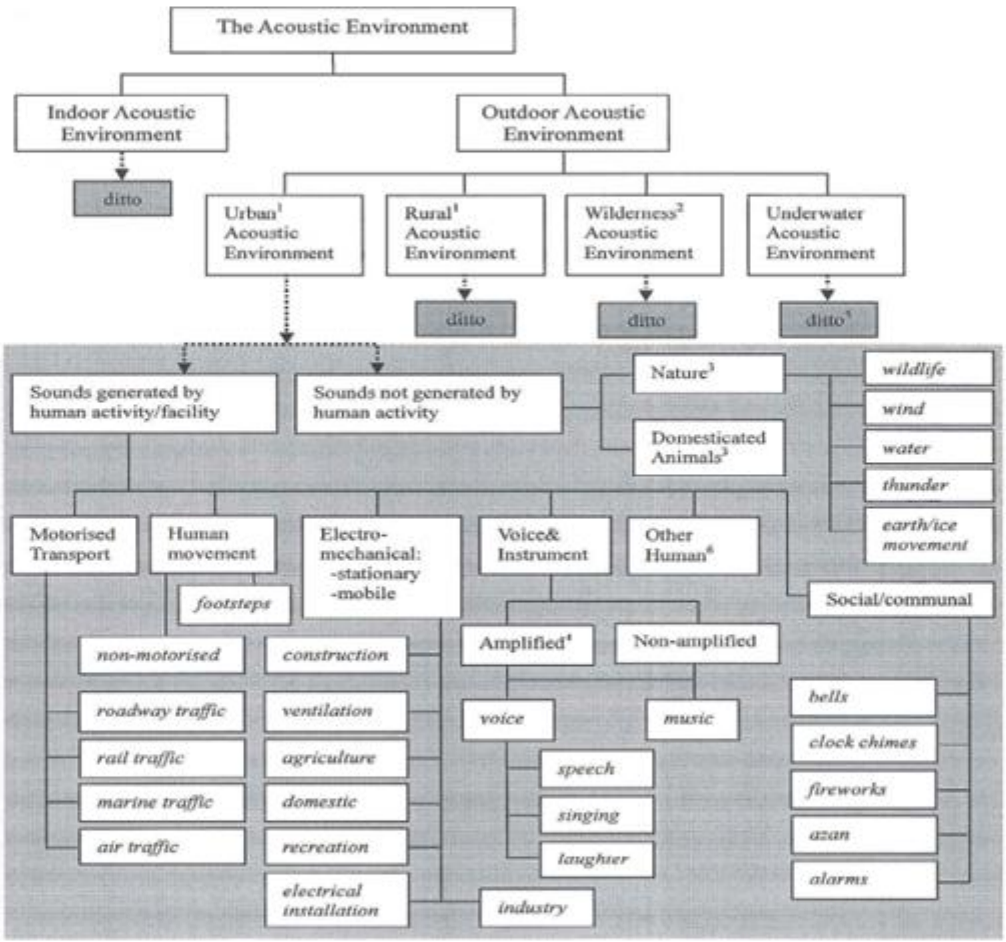


Figure 2.8 Sample sounds in an acoustic environment

(Brown, 2009, 390)

Next approach is perceptual context. Since Truax explained the soundscape as a way that acoustic atmosphere is perceived by a human or group, it is suggested that sound and soundscape occurs within human perception (Truax, 1999; Raimbault and Dubois, 2005; Yang and Kang, 2005). After examining sound, it was understood that acoustic quality has a positive effect and it needs to be improved in the areas. There were two folds in the previous studies about human perception of soundscape. One side investigated the hearing and psychological relations. The other side tried to find the implication of sound and interaction within visitors.

To examine the relationship between soundscape and perception, it is necessary to explain the listening and hearing process. Listening is a vital tool for the human, perception, and environment to interact with each other. Listening is one of the most active modes of receiving the outcome and it has psychological contributions. When a person visits an area, the sound that is perceived by each human is different (Treasure, 2011). Even though there are many listening types, the most well known is the listening-in-search that is based on the most important sound source in the area since humans look for the sign in the sound environment (Treasure, 2011). The signal is required for this sound type. Readiness-in-listening represents the sound that is everywhere and human can focus in any direction. The situation of the site may affect the type of listening that is used by a person.

Listening is different from hearing. Hearing is interception of the sounds as energy whereas listening is a process of using the brain and transforming it as a meaningful manner (Truax, 1999). While there is an activity, sound may stimulate the understanding. However, the other type of stimulation relies on abstract memory call unless the source of sound can be recognized. The regular process is to identify the sound sources. If a person cannot recognize the source, sound memory is triggered as an abstract memory for the physical environment (Dubois et al, 2006).

There are many studies about listening practices. Southworth (1969) conducted one of these field practices. He investigated several tests about human perception of sounds, particularly compare to visual perception in Boston. According to his findings, sound and soundscape is a two-fold concept. One fold is recognizing the sound that may be unique or monotonous for the specific site while the other one is quality of the sound that is based on person's preference. Sound source can be received or refused in terms of person or context in any environment. Since perception is an extremely subjective evaluation, some sounds and sources may be accepted in any site whilst they can be refused in another site (Southworth, 1969). Anthropogenic sounds such as construction and chatting are common sounds that require more attention while informative sounds are weak and can be easily masked. Therefore, people pay more attention to contrasting sounds (Southworth, 1969).

Another approach of the sound evaluation is to make a connection between physical measurement of the sources and people's perception. Most of them are about physical features of sound to received quality. The equal sound suggests a low basis for estimating the human response to sound (Fidell et al, 1996). The evaluations of subjective measurements are based on significant amount of respondents' comparison about sound quality. For the sounds studies, factors such as sound intensity and observation and evaluation of the site enhance the quality of the site conditions.

Next, the evaluation of acoustics plays a major role for the soundscape studies. Subjective evaluation of the sound quality is extremely complex comparing with objective evaluation of sounds. While evaluating the environmental acoustic quality, sound information also has a major role for the validness of the evaluation (Brown, 2007). It is suggested that human characteristics should be connected for the sound evaluations. To illustrate it, these characteristics might be age, education level, gender, nature and relations, daily activities as a recreation and sport, and so on.

Brown (2006) suggested an uncomplicated tool for the soundscape evaluation. A 2 by 2 matrix parameter was offered to describe the subjective evaluation of sound quality that is heard by humans (Brown, 2006). This tool highlights the importance of the site content and the suitability of acoustics in the particular environment (Brown, 2006). The difficulty with this tool is that it gets confused with the existing noise since assessment and evaluation of the noise is integrated with the sound and it is difficult to distinguish between desirable and undesirable sounds.

Soundscapes also include ecosystem sounds since organisms produce sounds in ecosystems. Soundscape ecology is "the study of systematic relationship between humans, organisms, and their sonic environment" (Schafer, 1994) or "the study of effects of soundscape on the physical responses or behavioral characteristics of living organisms in the system" (Truax, 1999). So, soundscapes can be affected not only by urban sounds but also by ecosystem.

2.3.3 Development of soundscape studies

The first soundscape study was conducted by Schafer in the 1960s at Simon Fraser University and he emphasized visual dominance in the society rather than sound. His first aim was to focus on the relationship between person, sound, and society. The name of the project was the World Soundscape Project (WSP) and it was conducted because of sudden and dramatic changes of soundscapes in Vancouver. So, the aim was to draw an attention to sound environment rather than noise. In 1975, a group of students and researchers conducted some investigations, as well as some seminars and workshops

(Schafer, 1977). After this efficient organization, many academic outcomes were published.

Schafer published his book ,*The Tuning of the World*, which is an expressive content about soundscape in 1977. The next year (1978) Barry Truax used that book as a reference in his publication ,*Handbook for Acoustic Ecology*, to address for the acoustic and sound concept. In the following years Truax facilitated further communications about acoustic in his book *Acoustic Communication* (Truax,1999).

An organization that is called the World Forum for Acoustic Ecology that was founded in 1993 consists of several organizations and persons from different fields (Ozcevik and Yuksel Can, 2013). This association provides many ideas about the relation of sound and ecology. The members participated in several interdisciplinary studies, such as social, cultural, and ecological approaches.

Apart from aforementioned organizations, there are many worldwide associations. 100 Finnish Soundscape is one of them. It was a research project that includes collecting, recording, and preserving of the existing soundscapes in Finland between 2003 and 2006 (Ozcevik and Yuksel Can, 2013). The main aim of the research was not only to collect the data, but also draw public attention about sounds. It was launched as a national competition for gathering different geographic information in Finland (Ozcevik and Yuksel Can, 2013).

Another organization is European Silence Project (SILENCE). This was a three-year research project that was supported by European Commission (Ozcevik and Yuksel Can, 2013). The main purpose of this project was to create a tool and method for the noise problem in the urban areas. Since this project conducted in several countries the results were slightly different. Concerning the acoustic aspect of the environment, the participants of the project gave a contradictory evaluation of its qualitative dimension (soundscape) and a negative evaluation of its quantitative dimension (noise level) (Ozcevik and Yuksel Can, 2013). The dominant sound source identified by the users was indeed related to the construction sites and was evaluated as unpleasant.

The Positive Soundscape Project (PSP) was a project conducted between 2006 - 2009. The project was a multidisciplinary project and the goal was to improve the positive sound and to distinguish the negative sound and positive sound (Ozcevik and Yuksel Can, 2013). So, the organization attempted to find an instrument for the use in urban planning. The Positive Soundscape Project has analyzed the methods and results from several different disciplines to provide a coherent characterization of listeners' response to an urban soundscape (Ozcevik and Yuksel Can, 2013). Results from soundwalks have been integrated to show that the two emotional responses seem to be calmness and vibrancy.

Soundscape of European Cities and Landscapes was a COST Action Project supported by the European Union for four years. The project was pioneered by Jian Kang who is an acoustic expert from England. There were many goals for the project. One of them was to create an artistic approach for the soundscapes by multi-disciplinary and international participants. Another aim was to improve the policies, applications, and laws about the sound and soundscapes (Ozcevik and Yuksel Can, 2013).

Since 2000, there are many attempts about soundscape studies in the world. Previously, the sound was categorized as a noise. So, there were many studies about noise mapping by software and mitigating the noise level in micro and macro scale.

However, the approach of sound was changed recently. There are many new contributions published through conferences, magazines, and seminars, such as WFAE (World Forum for Acoustic Ecology), Ecomusicology, and Inter-Noise.

The concept of soundscape has recently gained attention in the planning and design disciplines whose focus is generally on the visual, rather than the acoustic, aspect. Sound is an important element of a place that affects individual's perception and understanding of an environment. Urban acoustic environments are complex and involve a broad diversity of sound resources. Evaluation of urban soundscapes is crucial not only for noise mitigation but also to assess acoustic comfort, which is integral to the overall environmental quality. There are many significant activities in soundscape research at the global level; however, very little has been done in the field of landscape architecture. The above-mentioned activities have resulted in and may continue to result in some steps forward in the scientific fields, but have also hindered important break-through.

2.3.4 Soundscape and public open spaces

Open space was described as land or water in an urban area that is not invaded by cars or buildings (Gold, 1980). Tankel (1963) suggested that open space is not only the territory but also the place above the land. Cranz (1982) claimed that "open spaces are wide-open areas that can be fluid to the area that the city can flow into the park and the park can flow into the city" (Cranz, 1982). Public open space is described by Walzer (1986): "Public space is space where we share with strangers, people who aren't our relatives, friends or work associates. It is space for politics, religion, commerce, sport; space for peaceful coexistence and impersonal encounter. Its character expresses and also conditions our public life, civic culture, everyday discourse." According to Jan Gehl

(1987), open space is the field that provides several sorts of activities such as necessary (school, work, shopping, and transportation), optional (sitting, standing, and sunbathing), and social (children's play, conversations, and passive activities). Newman divided open spaces into four categories: public (parks and plazas), semi-public (school playground), semi-private (courtyards and communal gardens), and private open spaces (individual gardens).

The Project for Public Spaces (PPS) proposes four essential elements that make public open spaces successful. These components are accessibility, activities, comfort, and sociability (PPS, 2000). Accessibility contains functions such as linkages, walkability, pedestrian activities, and traffic. Activity components include festivals and retail sales. While comfort involves safety, sitting places, and cleanliness, sociability includes interactivity and diversity (PPS, 2000). A public open space offers an area that has fresh and open air with many recreational facilities for the advantages of the people. Especially for the high-density cities, open spaces help to reduce the negative effects of crowdedness and other social problems.

One of the fundamental functions of open spaces can be restorative for humans in terms of both physical and psychological health. According to Kaplan, a restorative environment reduces the mental problems (Kaplan and Kaplan, 1989). According to the Job Pressures Project, employees with nature views had less ailments and headaches (Kaplan and Kaplan, 1989). Restorative environments are the main components of having a great quality of life. Nature and natural ambiances add a good deal more restorative knowledge than construction settings. The engagement with the nature has improved the health advantages (Ulrich, 1984). Ulrich observed that post-surgical patients whose hospital windows overlooked trees recovered faster than those who did not have a view of nature. In addition, working in urban areas that have natural features such as trees and grass, is helpful for reducing stress. Researchers also emphasize that urban open spaces with plants and animals are more positively perceived by residents (Kuo et al, 1998).

Conway (2000) claims that urban open spaces improve mental health and decrease stress. There is a certain connection between frequency of the users of the open space and restorative effects (Payne, 2008). Fuller et al. (2007) conducted a research that revealed that biological quality of the open spaces improves the psychological benefits of the users. They also found that there is a strong relationship between psychological benefits of plants, butterflies, and birds (Fuller et al, 2007). Schroeder stated that natural elements and features improve the relaxing circumstances such as water, plants, and animals (Schroeder, 1991). So, his findings state that open spaces with nature and related features improve relaxing while decreasing the stress. People like alterations in their life such as daytime and night time, seasons, and years. To illustrate it, season alterations provide a magnificent experience to people in the urban open spaces. While fall seasons have various colors of leaves, trees, and winds from different directions, the summer is good for walking, sunbathing, and running. Winter is considered good for walking as well. Natural environments and seasonal effects provide an excellent experience for the users of open spaces with the senses such as smelling, hearing, and touching (Harrison, 1987). Hence, urban designers and planners need to balance and integrate the perceptions in order to create the ideal open spaces for humans.

People use restorative surroundings in public spaces for recreational experiences. Simonic (2006) conducted a project in Slovenia on visual perception. He claimed that sites include natural components and materials that provide active and passive recreation for restorative purposes. The project proposed that restorative surroundings are affected by the site features, organization, natural and artificial elements of the site (Simonic, 2006).

There are many ideas about what the design elements and concepts are for the open spaces in terms of landscape practices (Ulrich, 1984). For instance, design should address users' need, and users should be interacted in the design and planning. Open spaces should be designated with adaptability and sustainability approaches (Francis, 2003). In addition, these landscape practices provide people different visual and aural contributions and activities interacting with nature and urban settings (Payne, 2008). After providing opportunities such as walking, sitting, or community gardening, these areas provide a healthy and better quality of life.

The function of the open spaces is a sort of barrier zone between structures and communities. Open space is a green tool between dense population and high buildings. So, these areas offer a good amount of trees and green areas. Meanwhile, open spaces create room for people to get away from a monotonous and stressful daily life (Chiesura, 2004).

Another strong role of open spaces is the connection function for people. Open spaces offer a variety of outdoor activities such as walking, eating, meeting, chatting, sports, democratic speech, sunbathing, relaxing and so on (Burgess et al, 1988). These activities can be categorized as active or passive recreation for the users. While active space offers planned sport activities and recreational efforts such as tennis and soccer;

passive open space provides sitting on the bench, sunbathing, reading a book near the water fountain, or unplanned informal games (Chiesura, 2004).

Urban open space is a key point of any place since it provides social and cultural connections. Moreover, it serves for the all senses for the human experiences. So, while creating an open space, it is required to designate everything in a balance such as recreation areas, social platforms, vegetation, and animal areas (Chiesura, 2004). Therefore, open spaces should connect not only structures and places, but also it needs to create an integration between people and culture. Urban designers need to create these experiences to the public. It is known that the more successful or livable the area is, the more accessible and useful cities by people (Chiesura, 2004).

Next, since public open spaces improve the quality of the life, they also contribute for sustainability. Plants and natural elements help to maintain the climate effects such as wind and rain. In addition to the physical advantages, these plants also have psychological benefits, as people feel more secure and calm in these areas (Chiesura, 2004). Spiritual linking of the nature can be considered as a psychophysical concept. Therefore, aforementioned benefits improve the quality of life that also helps to create a sustainable environment (Chiesura, 2004).

Soundscape and acoustic comfort, which concentrates on the way people consciously perceive their environment, involves interdisciplinary efforts including physical, social, cultural, psychological and architectural studies. Particular attention is paid to urban open spaces (Kang, 2007). Such spaces are important components in a city. However, almost all cities have some open spaces that are popular whilst others are not. Besides social and visual issues, it is vital to consider the environmental conditions of such places and how they could attract people to use them (Kang, 2007). Recent studies on the soundscape of such spaces have shown that the acoustic environment plays an important role in the overall comfort. Although some soundscape studies are based on experimental research, most of them are based on field surveys in urban open public spaces considering acoustic comfort evaluations, sound preferences, as well as the effects of demographic factors, other physical conditions and cultural differences.

Open spaces have various roles in a city, and they have crucial importance, contributing significantly to the quality of life. Green urban area is, therefore, considered a special type of free space with a predominance of planted areas, and green urban areas should fulfill three main functions: aesthetic, ecological and leisure (Nucci, 2001). Thus, aside from the number of green areas in a city, the quality and distribution of these areas are also important. Indices of the amount of green space per inhabitant are not enough to ensure environmental quality in urban areas, even though these indices are normally employed to ensure this objective (Milano, 1984).

There are many studies examining the relationship between sounds, urban open space, and landscape architecture. It is a comparatively new concept for the landscape architecture field. "Within the field of landscape architecture, the pressing contemporary need to look beyond a reading of the landscape in purely aesthetic terms" (Cosgrove, 1998). Fowler (2012) launched some studio classes that were performed in regard to soundscape and landscape architecture. Each of the studios integrated soundscape with the design of urban open spaces in order to examine the role of the landscape architecture in the soundscapes (Fowler, 2012). The aim of this project was to address soundscapes in design pedagogy for the landscape architecture field.

Numerous studies integrate sound studies and visual aspects in urban open spaces. Carles et al. (1999), used sound samples and visual images from urban open spaces and found that natural sounds were rated positively. Several natural sound sources, such as water, improve both the images of natural surroundings and the meaning of the urban spaces. In a similar way, Bjork (1995) mentioned that sounds of water and birdsongs have relaxation effects on people, as examined from some parameters such as heart rate and electromyographic reactions (Carles et al., 1999). Moreover, the interpretation of both visual and aural samples from urban open spaces showed that natural soundscapes are susceptible to the existing artificial sounds (Carles et al., 1999). Both sound and sight help to understand and to interpret the environment. Yu and Kang compared the relations in sound level investigation among humans who have sight or do not have sight. The result was surprising since the sighting attitude is more related to the sound investigation (Yu and Kang, 2008). The aural and visual interaction was also examined in gardens, and it was illustrated that a positive evaluation of the landscape reduces sound annoyance whereas a negative evaluation of the landscape increases sound annoyance (Maffiolo et al., 1999). So, acoustic and visualization have a positive relationship and mutual support; therefore, they enhance each other.

In addition, the arguments about quality of urban surroundings, increasing sound levels and decreasing quality of urban open spaces, have increased for the last decade with growing concern on design and planning disciplines in terms of livable and sustainable environment (Williams, 2000).

Soundscapes of green urban open spaces have been studied less even though the literature is increasing about sound studies. In Curitiba, Brazil objective measurements were used to evaluate sound pressure levels in urban parks for defining sound types (Zannin et al., 2006). The research was conducted in six urban parks, and the highest sound level was 67 dBA in the Botanical Garden Park due to roads of heavy traffic. According to the research findings, the sound levels of all the measured sites were well above the limits established by local and international standardizations. The other research in a large urban park in Japan was conducted subjective measurement that examined the soundscapes at several locations such as a forest, a Japanese garden, and a baseball stadium (Ge and Hokao, 2004). The findings showed that sound evaluation is affected by demographic features such as age, education level, and residential status.

Open spaces are investigated in terms of sound environment recently. The main aim is to distinguish sound from noise. In the current design concept, particularly open space, the visual satisfaction is not adequate design criteria. So, sound as another design concept needs to be considered in order to create a better environment (Hedfords, 2003).

Soundscape and acoustic comfort concentrate on the way people consciously perceive their environment. Particular attention is paid to urban open spaces. Such spaces are important components in a city. Almost all cities have some open spaces which are popular whilst others do not. The soundscape is considered as an integral part of urban open spaces, contributing to the identity and specificity of the environment. The quality of soundscape is evaluated within the particular context for urban open space. The physical features of the sound environment need to be analyzed beyond the noise level (Raimbault, 2003).

Since sound studies are introduced recently, creating the imaginative conditions with sounds offer enthusiastic designs (Brown and Muhar, 2004). According to Pascal

Amphoux, imaginative characteristics identified in three categories that are protecting or masking (noise), offering new places as an offensive approach ,new sounds sources for the background as an opposition, and creative aspect for improving sound landscapes (Hellstrom, 2002).

Urban design and planning discipline focus on visual features and pay few attentions to the other senses. Humans apply all senses in order to experience the environment (Yu and Kang, 2008). Moreover, these senses have different effects on perception and all of these senses and perception may be changed. Hence, acoustic sound and its perception could be utilized in the same direction (Yu and Kang, 2008).

Examining the sound creates many opportunities to make a place a positive surrounding. Open spaces are the unique "showroom" of any city; thus, soundscape design reflects the importance of high quality structured public open space that has various sound sources. On the other hand, some public spaces do not have sound features and it creates misunderstanding since a triumphant soundscape design improves the existing features with other characteristics. Therefore, sound objects and interests need to be defined properly. Sound resource is the fundamental feature for the soundscape design.

While it is easy to mask any sound from its source or at any distance, it is not the ideal solution for the soundscape. Masking is the aim of noise mitigation. The method is creating opposite sounds that can easily gain attention (Broadbent, 1987). The contrasting background provides the attention to the foreground. Unrelated sounds from the concept are not as irritating as they can be easily distinguished and located as opposed to vague or unclear sound sources (Broadbent, 1987). There is a study about background and foreground sound which illustrates the similarity of intense perception of background and intense perception of sound profile (Hedfords and Berg, 2003b).

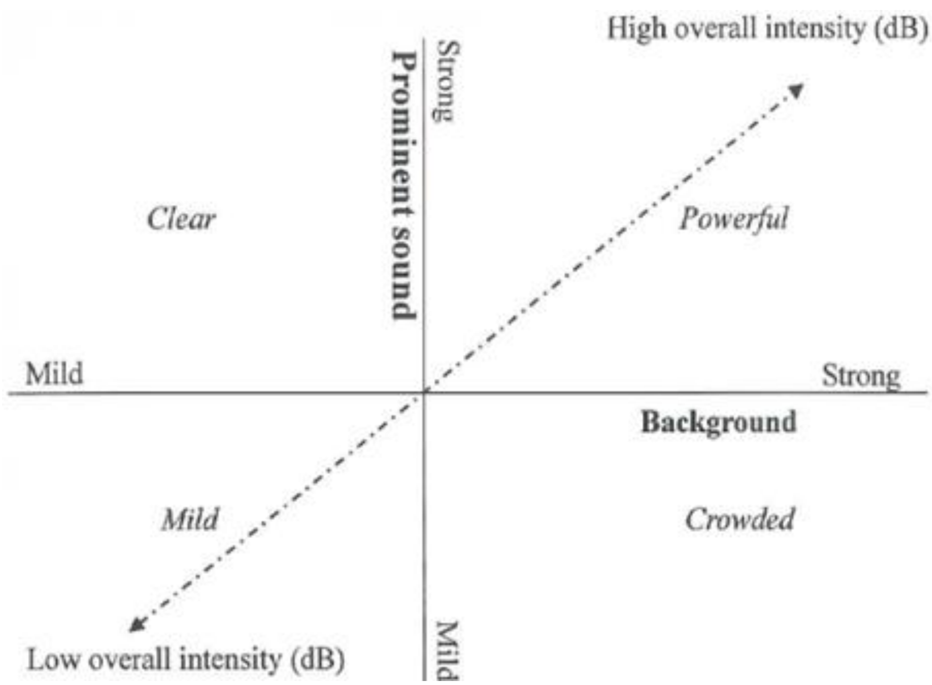


Figure 2.9 Dimensions of intensity in acoustic qualities
(Hedfords, 2003)

The concept of sonic identity helped to define the sound identity in a place since this identity belongs to users of this area and their sound choices (Hellstrom, 2002). Hellstrom has conducted two steps for his research. First, he applied a sound reminder map in order to choose the identical sound sources and locations that are symbolic for a certain type of acoustic images. The next stage is to use the technological methods and recurrence of it to examine the features of sound identity. It consists of the detailed interpretation by users and observations of how the users are active in the site (Paquette, 2004).

To create sound identity improves the hearing and sight relations that provide a series of activities for the users in a large area. Appropriate open space design refers to having a various activity opportunity with the different interests (Brown and Muhar, 2004). These activities enhance the pleasantness and quality of the surroundings with an integration of acoustic and visual values. No matter what type of open space there is, it is given many functions and purposes. Acoustic images are created in any open space and it is necessary to eliminate or mitigate the disturbing elements from the proposed design (Brown and Muhar, 2004). Therefore, prospering soundscape design serves for both purposes. First, it improves the quality of life and reduces the stress. Second, it also creates a perspective to a site in terms of paying attention about human interests and anticipations.

Acoustic structure is a complex element group that is based on subjective experience. The results can be altered site to site or even time to time in any area. Even though there are many suggestions or standard methods for the acoustic design, they rely on previous experience and information (Brown and Muhar, 2004). Hence, the design and planning process should emphasize the sound types that are related to site content.

The sound pressure level is a significant component for the subjective evaluation of a sound environment. The effects of several demographical features on sound examination have been studied by many researchers. There are different results in regard to age and gender effects (Yang and Kang 2005). The effects of different age groups on acoustic comfort were also studied. While younger people prefer mechanical sounds, older people prefer natural sounds (Yu and Kang, 2008). For gender, many studies showed that there were no significant difference between males and females, both in terms of the sound level evaluation and acoustic comfort (Yang and Kang, 2005). For the education level, many studies point out that there is no significant effect on sound evaluation while some studies illustrated that human who has a higher education level is less tolerant of sounds (Yu and Kang, 2008).

There are also many demographic characteristics such as income, general situation of health, marital status, family size, type of residence, occupancy, sound or noise experience, and sleeping habits that affect the subjective evaluation of sound (Yu and Kang, 2008). Marital status was indicated to affect sound annoyance (Fields and Walker, 1982). According to Bertoni et al. (1993), the house size and the family size do not have any significant influence on sound annoyance while results from Miedema and Vos (1999) suggest that people living alone are less annoyed compared to those living in a large family. Income and economic status do no have significant influence for sound annoyance (Maurin and Lambert, 1990; Bertoni et al., 1993; Fields, 1993) and so is the general state of health, measured by the frequency of visiting doctors (Bertoni et al., 1993). Since the aim of soundscape design is not always to create quiet areas in the urban open spaces, it is vital to consider the impacts of socio-demographic features for the sound studies. Kang (2006) provides a comprehensive review of this literature on the soundscape of these types of urban open spaces (Kang, 2006).

For the campus as a public open space, it has many facilities of buildings with places designed between them. The campus has circulation, study areas, relaxation, and aesthetic opportunities. In addition, "many campuses indicate that a great deal of the casual interchange, chance of meetings, entertainment, and study between classes takes place outdoors, when the weather permits" (Marcus and Francis, 1998). Concerning the literature, there are a few studies about campus design and planning even though there are numerous studies about campus constructions, educational policy, and fiscal concerns. For the campus design and planning, some literatures can be mentioned in "*Campus Planning: Redesign-Redevelopment-Rethinking"* (Myrick-Newman-Dahlberg & Partners, 1983) and in "*Campus Architecture; Building in the Groves of Academe"* (Dober, 1996). According to research that was conducted in 1981 on the University of California at Berkeley campus, almost all of the participants (92%) indicated that they felt that they were in their home while on the campus. So, authors proposed some design solutions, such as "entrance", "front porch", "front yard", and "backyard" of the "home" in regard to the findings of the research (Marcus and Francis, 1998).

Although there are numerous attractions for the campus areas, these areas also have some problems such as crime, wears and tears of the site furniture, and traffic. The major problem is the traffic-related sound problem after crime for the campus. Even though the university suggests users to use mopeds for the traffic moving solution, using mopeds increases the sound levels in the campus (Marcus and Francis, 1998).

European universities have been influenced the campus design in the United States in terms of architectural form, design elements, and historical guide (Chapman, 2006). Even though the first campus was built around the 1600s, the stronger and the more comprehensive concept of campus was created in 1813 by architect Joseph Ramee (Dober, 1996). The design ideas and strategies of Thomas Jefferson have a vital part in forming the campus design in the U.S. Indeed, it is still playing a major role for the modern campus design and planning (Chapman, 2006). The demands of campus design have been increasing because of growing population, particularly in the last century.

Existing topography and geometric shape of the topography were used to create the facilities and services.

Campus areas should offer many facilities, activities, and experiences like any other urban open space. The challenge for the campus design is to also design a learning area for students so that they can interact with this site. It is necessary to have a better understanding about the physical situation of the site in order to create an integrated campus facility. While creating a successful campus design, there are many difficulties for the urban designer such as social and cultural knowledge about the students and the environments. Dober explains the elements and facilities that are the main parts of the campus (Dober, 2000). Another important aspect is to remember that campus should last for a very long time. So, the designer should consider not only the short-term process of campus, but also long term triumphs, as well (Kriken, 2004).

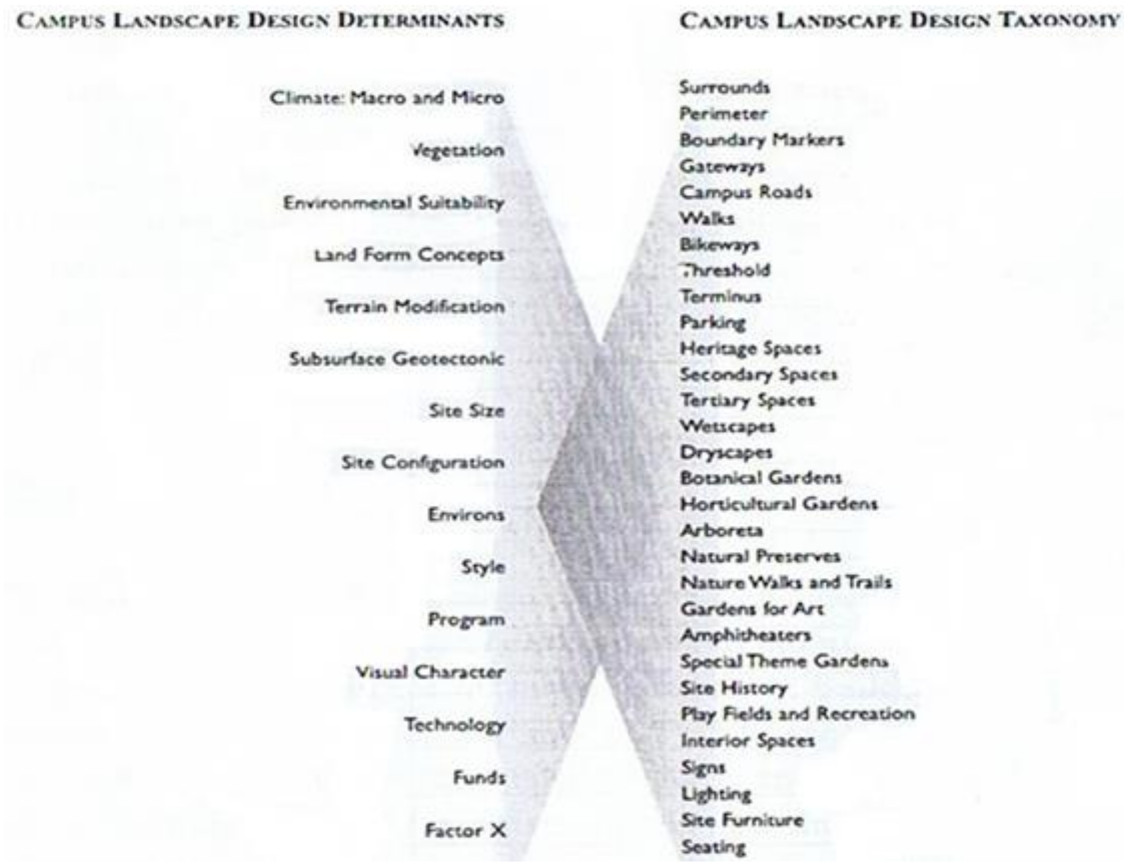


Figure 2.10 Impact Diagram / Design Determinants and Design Taxonomy Components (Dober, 2000, 21)

Acoustic environment in the urban spaces have not been paid attention until recent years. Since urban open spaces have unique features, they are valuable in term of acoustic environment (Kang, 2007). Public open space is the mediator between urbanized modern life and nature. It provides canopy trees, benches for sitting, and squares for meeting. These spaces also host birds and other animals. In addition, urban open spaces prevent the heavy traffic load and its noise from reaching the inhabitants. Soundscape and its perception differ in the urban open spaces since different places have various users that are vital for soundscape design and planning. Properly designated urban areas with soundscape contribute for creating livable and high-quality urban settings. The interaction between construction, traffic, and natural sounds provide a distinctive soundscape environment in Mississippi State University Campus. The campus is located in the eastern part of Mississippi, it is 125 miles of Jackson and it is served by Highways 82, 12 and 25. The size of the university is about 4,200 acres (http://www.msstate.edu/web/ gen_info.htm). Mississippi State University is located in the humid subtropical climate region, characterized by temperate winters; long, hot summers; and rainfall that is fairly evenly distributed through the year. The latitude of the campus is: 33.4493° while the longitude is: -88.79268° (http://www.findlatitudeandlongitude.com/?loc=mississippi+state+ university&id=74858). Location of the campus has diverse landscape features and biodiversity. So, there is a great variety of sound sources in the locations. The figure 2.11 shows the location of the campus in Mississippi State.

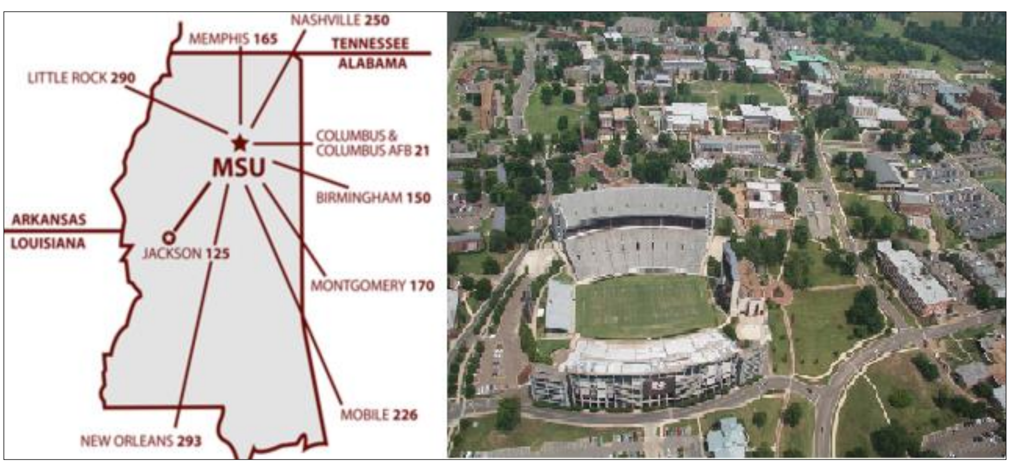


Figure 2.11 Location of the Mississippi State University campus

Notes: http://www.careermsstate.edu/employers/traveling/where.php

2.4 Summary

The idea of sound and acoustic design have recently gained attention. The studies and literatures about sound and their relationship with the open spaces provide importance of the acoustic environment. There are numerous focuses and study ideas in many disciplines. On the other hand, it brings confusion about the concept of sound as each discipline categorizes their subjects as either science, human studies, or social areas. It is necessary to integrate all disciplines in order to have a successful soundscape concept. After achieving this integration, the next projects or studies could be more inclusive.

The concept of the soundscape relies on not only a certain time period and area, but also cultural understanding and human needs. The notion of soundscape has been investigated by researchers. They examine the site acoustic as a sound ecology and the quality of sound sources that are related to social, cultural, and human values. Many of the sound related studies merely focus on noise instead of paying attention the fruitful sounds of the surroundings. It is required to examine and investigate the sound pressure among social and cultural evaluations.

Since open spaces have different functions and activities, such as recreation, soundscapes also have diverse features. In order to create a better understanding about acoustic design, sound design integrates the human needs and casual life. However, there is not generally accepted idea or analysis how a user perceives the sound. So, in this research several components that are based on human preference and subjective measurement are used in order to create sound preference. Apart from social science, the soundscape concept is also important for the implementation or practice part such as urban design. City planners, landscape architects, architects, and engineers are the pioneer disciplines in this content. In addition, there are many significant activities in soundscape research at the global level in many disciplines; however, very little has been done in the landscape architecture field.

Mississippi State University Campus as an open space, has a several opportunities for the sound features since it includes both natural and manmade sound sources. Since open spaces are the most valuable indicators for people's well being, it has more access for the users. The campus is the most appropriate site not only with its sound sources, but it also has several factors and elements that need to be investigated.

Given that the perception of an outdoor environment depends not only on the physical features, but also on the characteristics of the users, it is important to study their interactions. So, in this thesis, the research question is how objective measurements of soundscape can be compared with subjective perceptions of users in the Mississippi State University Campus. While trying to answer this research question, there will be some additional research questions that the researcher would like to answer in order to understand or explain the problem elaborately. These questions are: What is the semantic differential analysis in the Mississippi State University Campus? What are the relations between acoustic comfort and demographic factors such as age and gender? This research attempts to define soundscapes of different locations in Mississippi State University Campus and to understand how humans perceive and evaluate the soundscape qualities in these location.

CHAPTER III

METHODS

3.1 The general perspective

Sound as a term is the moderator between the listener and the environment. The human receives the sound and the user experiences the sound environment. As sound provides humans a sense of place , it creates a symbolic calling in the mind (Truax, 2001). The core notion of this thesis is to examine the sound, user as a listener, and surrounding.

There were four sites that were selected for sound measurement and observation. The selection criteria was based on the sound variety and density of campus users, The data to get from these sites including physical features of sound, sound recording and site observation. In addition, on-site interviews were conducted to understand how campus users evaluate the acoustic conditions. After these site studies, statistical analysis were conducted in order to depict the sound preferences and profiles. The framework of the thesis methodology is illustrated in the Figure 3.1.

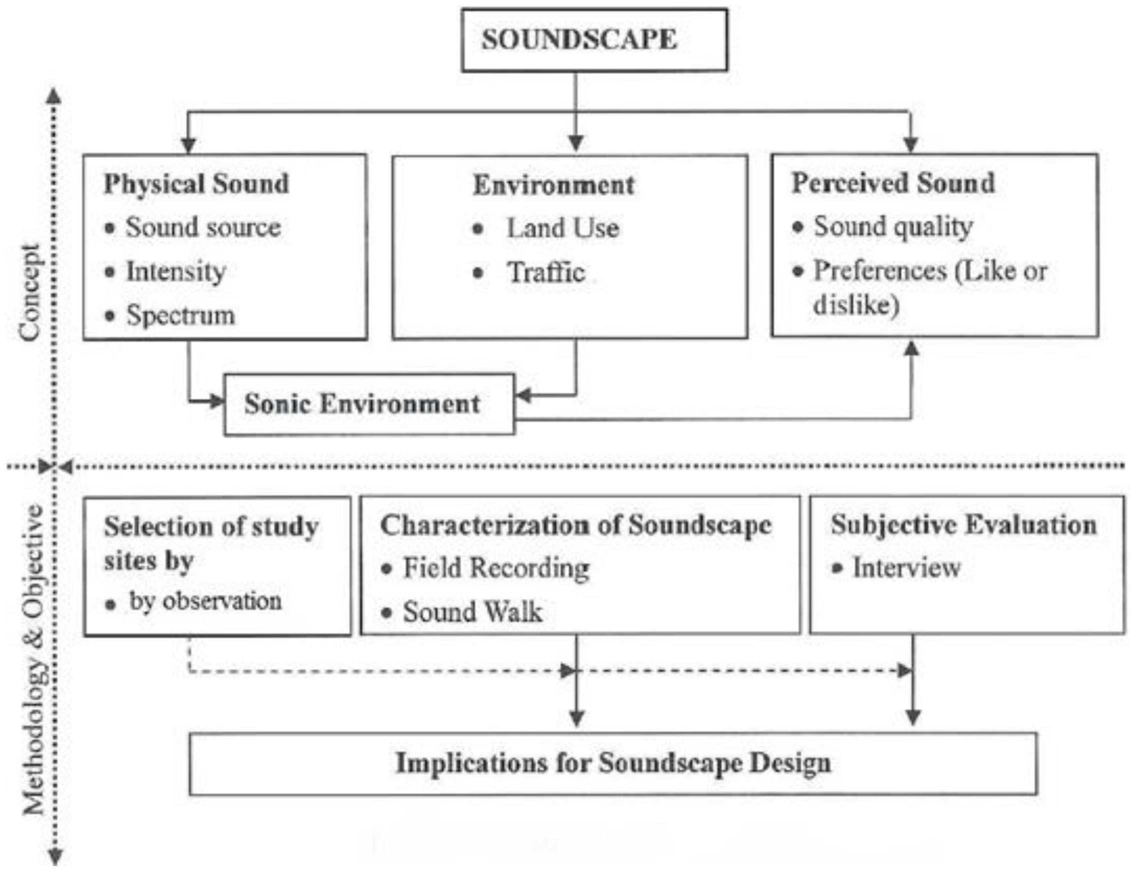


Figure 3.1 Framework of the methodology

3.2 The research content and participants

The research was conducted in four locations. The public open spaces as Mississippi State University Campus socially, culturally, and historically were assessed through an acoustic practice—soundwalks. As there are many sound sources in these areas: Mitchell Memorial Library, Colvard Student Union, Bell Island, and Sanderson Center have been selected and identified since research settings are some of the heavily used areas in the campus. Figure 3.2 represents the soundwalks route and locations.

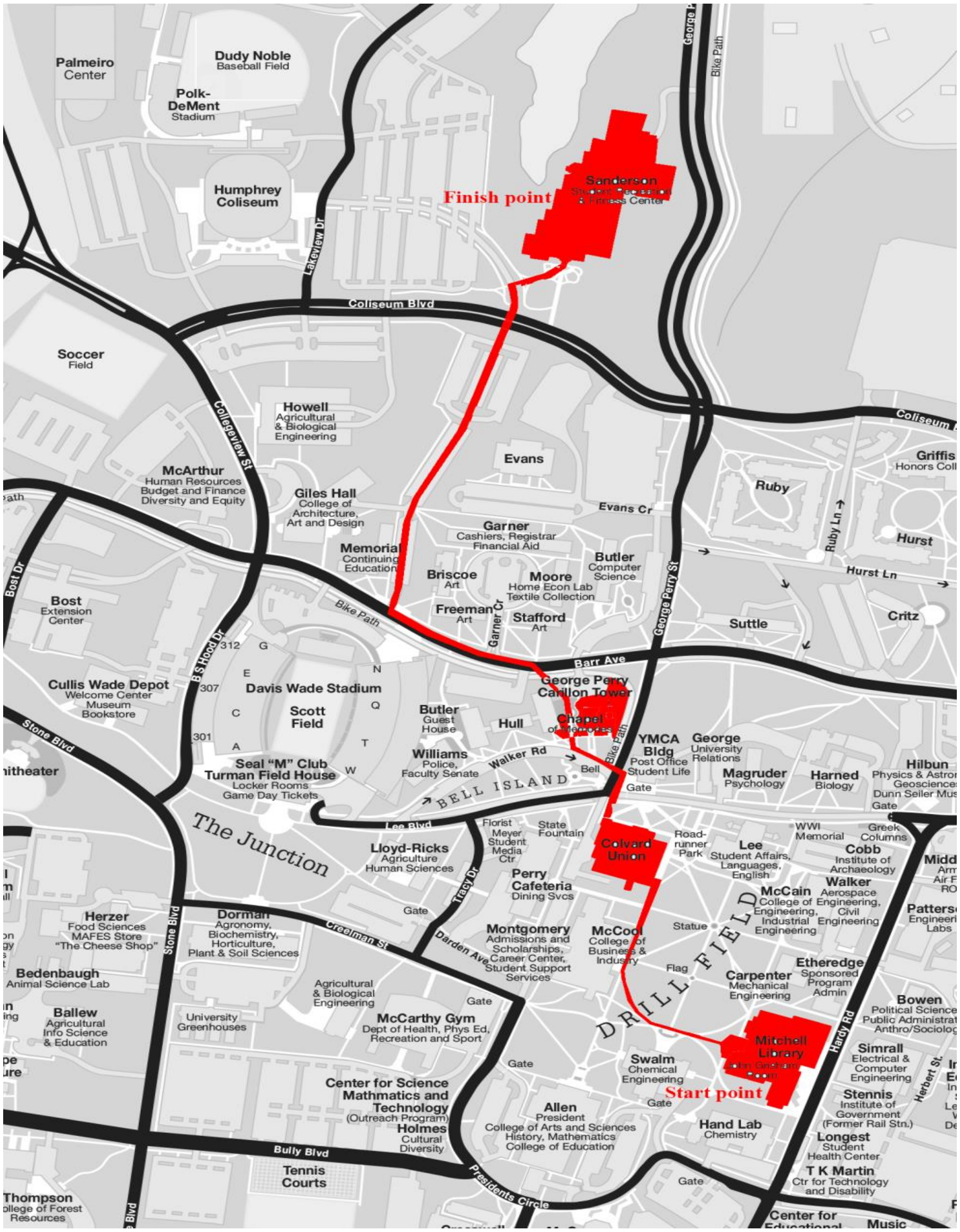


Figure 3.2 Soundwalks route and location (Not to scale), 19 May 2014.

Notes: http://www.msstate.edu/web/maps/

In the field of soundscape studies, the technique of soundwalking is an important primer for critical listening (Gopinath and Stanyek, 2014). Soundwalking involves a researcher following a pre-agreed route through an environment in silence. The walks are conducted every week and last around 20-30 minutes. As Westerkamp noted: "A soundwalk is any excursion whose main purpose is listening to the environment. It is exposing our ears to every sound around us no matter where people are. Sounds have been neglected by people for a long time and, as a result, people have done little to develop an acoustic environment of good quality" (Gopinath and Stanyek, 2014).

Participants were randomly selected in the designated locations. An advertising poster about the study in the buildings (Mitchell Memorial Library, Bagley College of Engineering, Bowen Hall, College of Business, Colvard Student Union, and Allen Hall) and verbal conversations were used to recruit the participants. Around 60 people refused to participate the study because of time management problems. In addition, several campus users who were wearing ear buds and ear phones did not want to take part for the study.

During summer and fall seasons in 2014, that is from July to September, the objective measurement on soundscapes was carried out in the four stations that were mentioned above for the field survey. Table 3.1 shows the site photograph, main functions, major sound sources, and the participants' number of interviews for each site. In terms of function, the sites include meeting, transition, social, commercial, relaxation, and office. In terms of sound types, the sites have traffic noise, surrounding speech, footsteps, water sounds, church bells and construction sounds. In terms of case study sites, there were slight variations in climatic conditions since the research was conducted in the summer and fall, and there was a wide difference for the urban morphology due to different sites. A comprehensive two-stage questionnaire was conducted to determine the profile of human-related sound perception. Stage one, as a pilot or a preliminary study, was a soundscape walk with a small number of participants in four selected sites. Stage two included more detailed interviews in these sites with a much larger sample size from the general public.

Table 3.1 Site features

Site	Main functions	Main sound sources	Participants
Mitchell Memorial Library 	Meeting, transition	Traffic, surrounding speech, footsteps, construction	15
Colvard Student Union 	Social, commercial	Traffic, surrounding speech, footsteps	13
Bell Tower 	Relaxation, transition, office	Traffic, church bell, water, construction, surrounding speech	11
Sanderson Center 	Relaxation, commercial	Traffic, footsteps, surrounding speech, construction	12

As preliminary study, stage one, soundscape walks were frequently used in environmental acoustics research. The general purpose was to encourage the participants to listen carefully and make judgments about the sonic environment and sounds they are experiencing. Since listening is one of the psychological functions through which people perceive the world, the evaluation of sound effects on people is primarily a subjective concern, rather than merely based on objective parameters.

The soundscape walk was carried out with a small group, 10 persons, which had the same number of male (five) and female (five) attendants who were all audiologically normal. The walk started from the Mitchell Memorial Library and it continued through the Colvard Student Union, the Bell Island, and finally ended at the Sanderson Center. During the soundscape walk, the participants were asked, for each site, to list the sounds they heard, evaluate the overall soundscape and give further comments. In the evaluation form that was showed in Table 3.2, there were approximately 15 indexes which were used with a 7-point bipolar rating scale (Zhang and Kang, 2010).

Table 3.2 7-point bipolar rating scale

	Very	Fairly	Little	Neutral	Little	Fairly	Very	
Agitating	+++	++	+	0	-	--	---	Calming
Comfort	+++	++	+	0	-	--	---	Discomfort
Directional	+++	++	+	0	-	--	---	Everywhere
Echoed	+++	++	+	0	-	--	---	Deadly
Far	+++	++	+	0	-	--	---	Close
Fast	+++	++	+	0	-	--	---	Slow
Gentle	+++	++	+	0	-	--	---	Harsh
Hard	+++	++	+	0	-	--	---	Soft
Interesting	+++	++	+	0	-	--	---	Boring
Like	+++	++	+	0	-	--	---	Dislike
Meaningful	+++	++	+	0	-	--	---	Meaningless
Natural	+++	++	+	0	-	--	---	Artificial
Pleasant	+++	++	+	0	-	--	---	Unpleasant
Quiet	+++	++	+	0	-	--	---	Noisy
Rough	+++	++	+	0	-	--	---	Smooth
Sharp	+++	++	+	0	-	--	---	Flat
Social	+++	++	+	0	-	--	---	Unsocial
Varied	+++	++	+	0	-	--	---	Simple
Beautiful	+++	++	+	0	-	--	---	Ugly
Bright	+++	++	+	0	-	--	---	Dark

(Kang and Zhang, 2010)

After conducting the walking with the small group, 5 indexes which were used with a 7-point bipolar rating scale were selected higher than the other. Table 3.3 illustrated that ranking.

Table 3.3 Most admired index from previous rating scale

	Very	Fairly	Little	Neutral	Little	Fairly	Very	
Far	+++	++	+	0	-	--	---	Close
Interesting	+++	++	+	0	-	--	---	Boring
Like	+++	++	+	0	-	--	---	Dislike
Natural	+++	++	+	0	-	--	---	Artificial
Quiet	+++	++	+	0	-	--	---	Noisy

Stage two was the more detailed on-site survey. The characteristics of sound sources are vital for soundscape evaluation. The four stations were representative of typical soundscapes in the campus as an open space, including continuous and intermittent sounds, man-made and natural sounds, meaningful and meaningless sounds, and pitched and varied sounds. In the selected sites, interviewees were selected randomly within different age groups. The interviewee was given a consent form with the cover letter. These documents defined the aim of the research, the location of the on-site survey, encouragement for the interviewee, communication information, and finally anticipated performance from the interviewee. To examine the possible time and seasonal effects, the survey was conducted over different seasonal periods and at different time intervals. Each interviewee was asked to fill in a questionnaire. The first part of the questionnaire included the location of the interviewees on the site and some additional information such as campus users' activities and their ideas about surrounding sounds were recorded by the researcher. The second part of the questionnaire was about demographic factors, evaluations of sound level and acoustic comfort, and preferences of various sound types by classifying a sound as favorite, or neither favorite nor annoying. The final part was an evaluation form for the semantic differential analysis. The soundscape questionnaire was introduced as a part of the overall survey of general environmental conditions including thermal, lighting, wind, humidity and visual environment, so to avoid any possibility of bias in the acoustic aspect. Promptly before or after an interview or when the interviewee was filling the questionnaire quietly, the sound pressure level was measured in terms of one-minute L_{eq}.

The total number of participant was 51. The interviewee numbers were limited as it was difficult to manage and to recruit the campus users in the daytime. It might be considered as a research limitation because of numbers or accuracy of the evaluation. On the other hand, it might be conceded sufficient participants since the main factor was subjective evaluation in this study and it was based on personal preferences. Thus, it differs person to person, site to site, and even time to time.

3.3 Data collection

Objective measurement of the study consists of several steps. One of them is sound walking in the selected sites. In order to figure out the sound features in the sites, sound walking was conducted with a group who walked with the researcher at the sites.

In addition, the sound was recorded to analyze the sound components while sound was measured by the sound pressure level meter at the same time. The sound recordings were conducted by using an Olympus ME-52W Noise Cancelling Microphone and an Olympus 142665 DM-620 SLV Voice Recorder (Figure 3.3). The reason for using this equipment is that the voice recorder has a three-channel technique. The recordings were gathered in the sites that have different features. Each recording took 60 minutes and the recordings were saved in 4 GB Built-in Memory as a Waveform Audio File (WAV) format since this format has a minor quality loss from original recordings compared to MP3 or WMA format, even though WAV format is extremely larger than the other formats. Furthermore, WAV format allows the researcher to edit for further stages in free software. The recordings were used to analyze and to edit the sounds. In addition, they were used for visualization purposes for the next steps.

Figure 3.3 Olympus 142665 DM-620 SLV voice recorder and noise cancelling microphone, 25 May 2014.

Notes: http://www.amazon.com/gp/product/B004S561V0/ref= oh_aui_detailpage _o03_s00?ie=UTF8&psc=1

In order to measure the sound pressure level, measurements were conducted every other day and four times (8:00 am - 12 noon - 4:00 pm - 8:00 pm) a day during July through September. Each time sound was measured for one hour in order to estimate L_{Aeq}. The table about measure time, date, and location is included in the Appendix. A type II sound pressure level meter that was Mastech MS6700 Autoranging Digital Sound

Level Meter Tester between 30dB -130dB was used (Figure 3.4). The sound was measured in dBA weight rather than dBB and dBC since the weight of dBA covers a larger frequency range than the others despite the fact that the sound pressure level meter also has dBA and dBC options. In addition, it has a light for the night measurements and it has max sound illustration to figure out the maximum sound level in the sites.

Figure 3.4 Sound pressure level meter, 25 May 2014.

Notes: http://www.amazon.com/gp/product/B00879E95I/ref= oh_aui_detailpage _o03_s00?ie=UTF8&psc=1

Apart from objective data collection, there is also subjective data collection. A questionnaire was conducted in the selected sites. At the beginning, the location of the interviewees on the site and some additional information were filled out by the interviewer. The first part of the questionnaire included personal information and behavior. The second part of the questionnaire was the acoustic environment evaluation. While the interviewee filled out the questionnaire, the sound pressure level was measured and the sounds were recorded by aforementioned methods. The questionnaire can be seen in the Appendix D.

3.4 Data analysis

Since this research consists of both qualitative and quantitative contents, it is required to examine the data with different methods. As an objective measurement, sound recordings were transferred to the computer via USB connection. Then, these recordings were analyzed in a software called Raven (Lite 1.0 edition). This software allows the control of sound contents and quality. Besides, the software contributes to edit and to cut the sound recordings and to create the visual outputs (Figure 3.5). After investigating the sound recordings as a WAV format, they are also saved as WMA format since the files of this format are smaller than WAV.

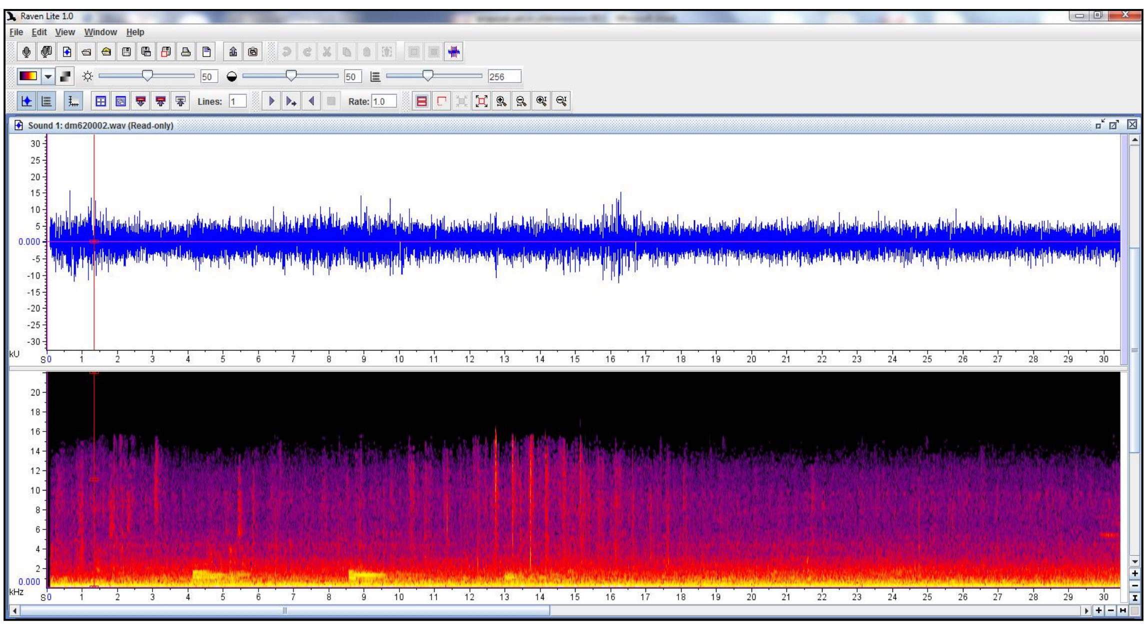


Figure 3.5 Sample view of the Raven Lite 1.0 Software

The questionnaire was established in SPSS software program for the survey analysis. The graphics and tables that obtained by numerical data in the standard configuration. Data were extracted SPSS format like Microsoft Excel for calculation and examinations. In this research, many persons participated and that provided adequate data. Sample and measurement information was provided by quantitative info such as descriptive numbers and graphic illustrations. Correlation is a common definition method in order to seek for relation between two variables.

In addition, general perceptions of the campus users were figured out from the data with utilizing inferential statistical methods. A greater number of these statistical data derive from a general statistical model that is known General Linear Model; for instance, Analysis of Variances (ANOVA), Regression Analysis, and T-test. Some of these techniques were utilized in this research. Preferences of campus users and their acoustic evaluation were examined and interpreted with Analysis of Variances (ANOVA). Furthermore, selected sites were compared with the same method. The relation between two categories of data was investigated by T-test.

CHAPTER IV

RESULTS

Results of the recordings, measurements, and survey are presented in this chapter. So, the chapter is divided into three parts that demonstrate the results of site recordings, measurements, and survey respectively.

4.1 Site recordings

Sounds were recorded in the sites in order to obtain the sound features. The sound recordings were analyzed and edited to create graph to demonstrate the site characteristics. The graphs showed that intensity, spectrum, and spectral features of each site as waveforms and spectrogram. Spectrograms are computer-generated images to illustrate the sounds of the sites. A spectrogram is read from left to right and higher pitched acoustics seem higher on the spectrograms. So, sounds in the spectrograms might have different pitch, duration, and loudness. Higher sounds seem higher on the spectrograms while louder tones appear in a brighter color. In the figures, the sounds increased through yellow, red, and purple, respectively. In addition, longer tones are shown as longer marks on the spectrograms (Charif and Krein, 2006). Figure 4.1 illustrates the features of a spectrogram.

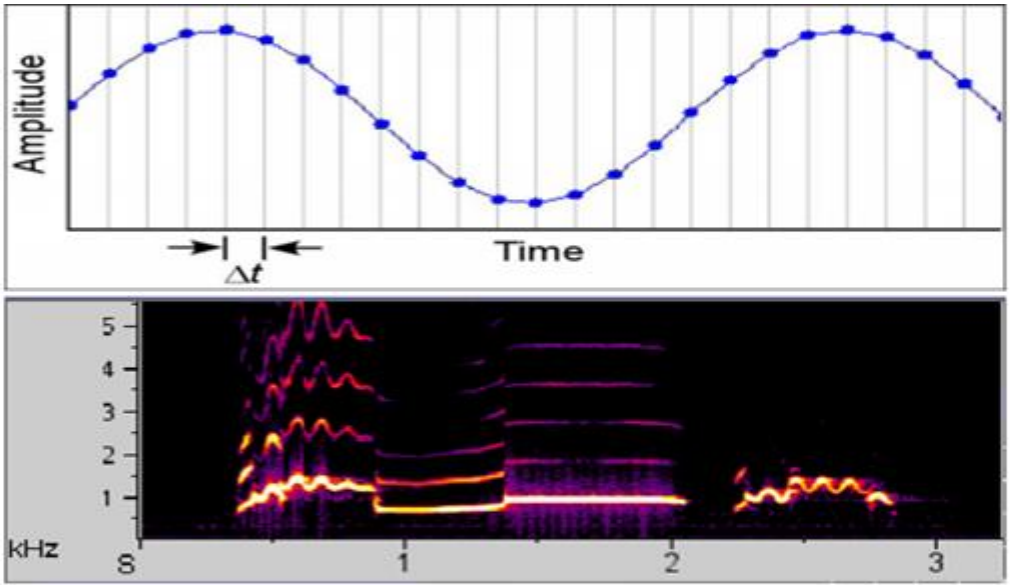


Figure 4.1 Sample features of the spectrogram
(Charif and Krein, 2006, 21)

Figure 4.2, Figure 4.3, Figure 4.4, and Figure 4.5 demonstrate the spectrograms and waveforms for each site and for the different time intervals (8am-12noon-4pm-8pm). These forms were provided to define and to compare the four research sites in terms of sound features.

As it can be understood from the figures, each site had different sound elements in different time intervals. In the Mitchell Memorial Library, sound was fluctuating, between +20 and -20 kU, in the first half of the morning recordings. Sound frequency was mostly around the high levels between 55 dBA and 70 dBA, and it was also fluctuating. For noon, the frequency bands were at the lower level than morning; however, waveforms were still fluctuating, particularly in the second half of the noon. Afternoon and night recordings had constant waveform. While sounds of afternoons were at higher levels, sounds at nights were at lower levels in terms of the frequency bands (Figure 4.2).

Sounds had different characteristics at the Colvard Student Union. The sound was fluctuating during each time interval; however, morning and particularly noon had larger range of waveforms (Figure 4.3). Besides, noon and night recordings occurred in lower frequency bands whereas morning and afternoon were in higher frequency bands.

The sound structure at the Bell Tower was fluctuating for all time intervals except afternoon (Figure 4.4). The waveforms were between + 30 kU and - 30 kU in the mornings and noon. However, sound was at the high level during afternoon, 65-75 dBA, and night recordings were between 60-65 dBA.

Finally, the sound profile of the Sanderson Center was steady. In terms of waveform, it was fluctuating but the sound profiles of the afternoon was relatively steady. Furthermore, sound levels were emerging at the lower frequency bands for the all time intervals (Figure 4.5).

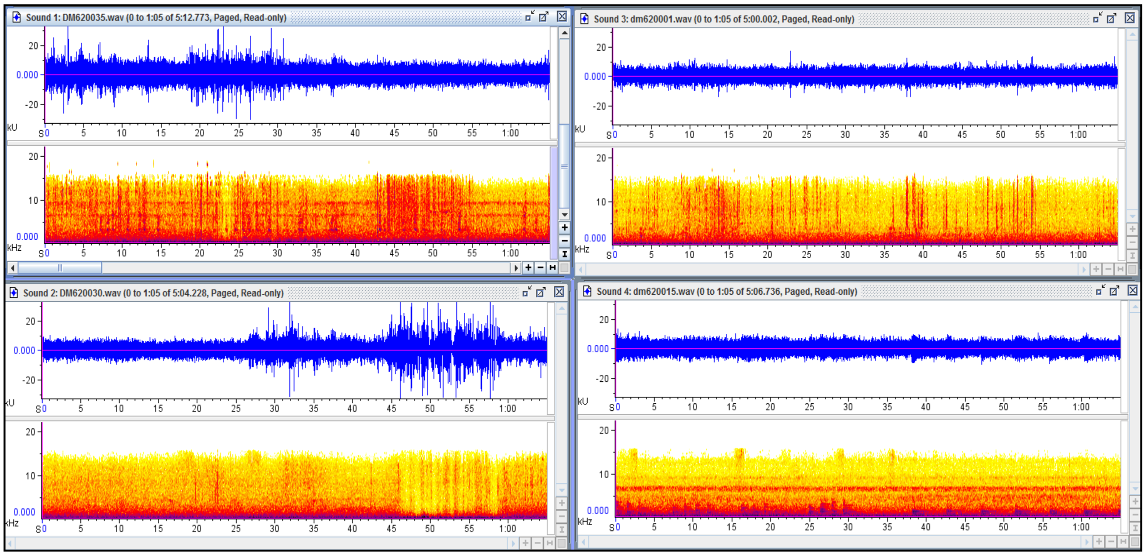


Figure 4.2 Spectrograms and waveforms of the Mitchell Memorial Library

(Counterclockwise: 8am-12noon-4pm-8pm)

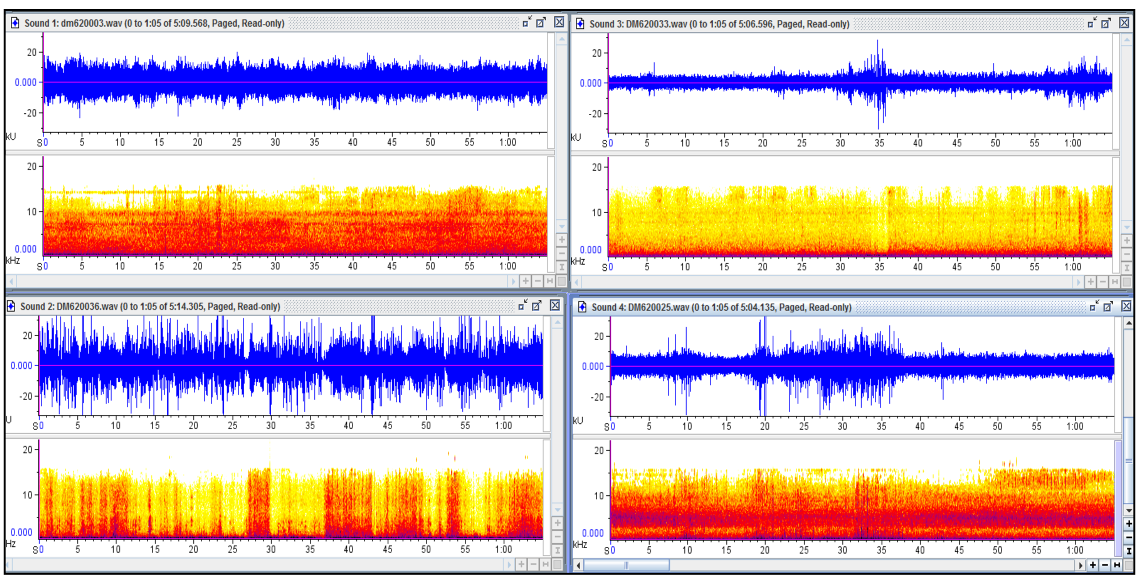


Figure 4.3 Spectrograms and waveforms of the Colvard Student Union

(Counterclockwise: 8am-12noon-4pm-8pm)

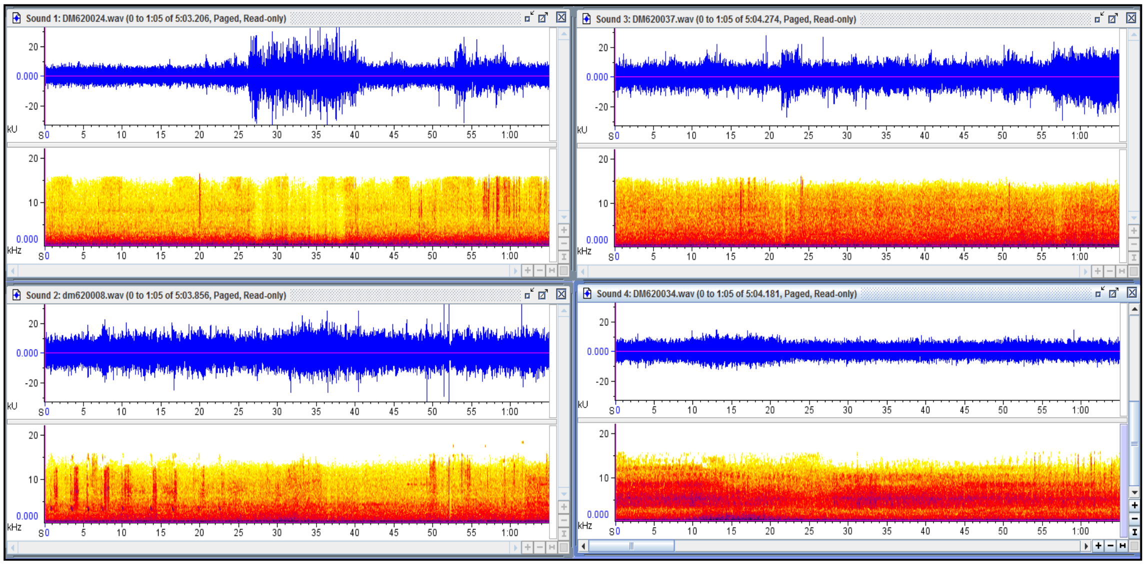


Figure 4.4 Spectrograms and waveforms of the Bell Tower

(Counterclockwise: 8am-12noon-4pm-8pm)

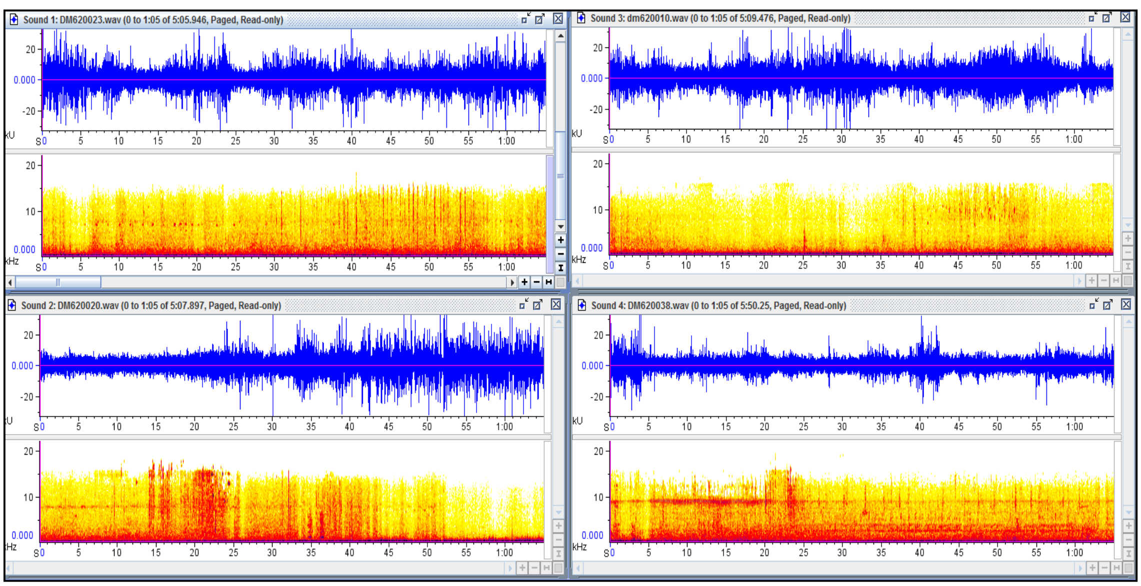


Figure 4.5 Spectrograms and waveforms of the Sanderson Center

(Counterclockwise: 8am-12noon-4pm-8pm)

4.2 Site recordings

Apart from site recordings, sound pressure levels were measured. Each site was measured four times a day (8am-noon-4pm-8pm) and different days (every other day) in the week between July and September 2014. A table was created and it was used for the sound measurements during summer and initial fall semester (See Appendix E). After measuring the sounds with the sound pressure level meter, they were saved and used for the further steps. The next step was the calculation of the L_{eq} dBA for one hour period, L_{1h} for each site and each time intervals after sound pressure levels were measured and noted during one hour for the each site visiting (Table 4.1 and Table 4.2).

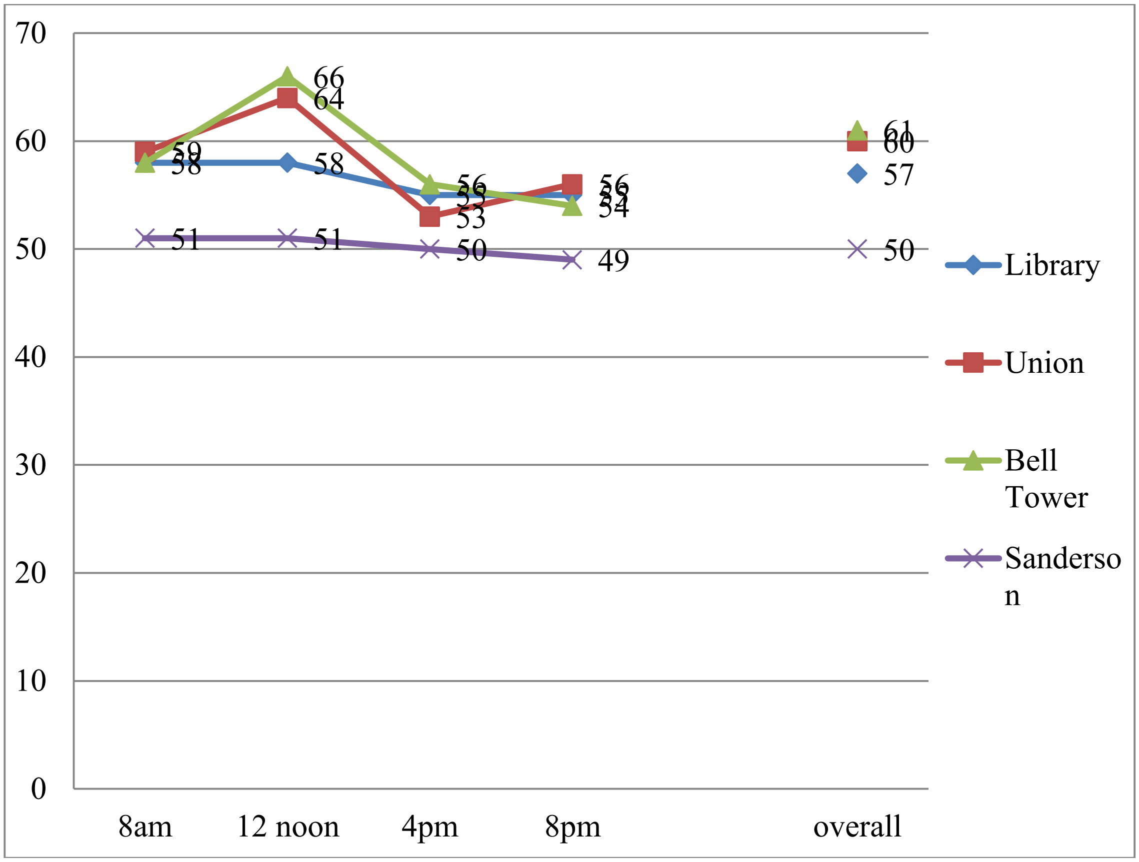
Table 4.1 L_{eq} dBA for the sites

	8 am	noon	4 pm	8 pm	Overall
Mitchell Library	58	58	55	55	57
Colvard Union	59	64	53	56	60
Bell Tower	58	66	56	54	61
Sanderson Center	51	51	50	49	50

In terms of sound pressure levels, all selected sites had different sound levels. For the morning, the site had the highest sound level was the Colvard Student Union where the sound was slightly exposed to a higher sound level than the Bell Tower. Besides, the place of the lowest sound level was the Sanderson Center for the morning time. The next measurement time was noon and the Bell Tower had the highest sound pressure levels.

The Colvard Student Union and the Mitchell Memorial Library followed it, respectively. Then, the Sanderson Center had the lowest sound pressure levels for this time measurements. The Mitchell Memorial Library was at the highest sound level for the afternoon measurements and the Bell Tower and the Colvard Student Union were following it, and the Sanderson Center had the lowest sound pressure level. Last, the Colvard Student Union had the highest sound pressure level whereas the Mitchell Memorial Library and the Bell Tower were coming behind the Colvard Student Union. The Sanderson Center had the lowest sound pressure level in this time interval again. For the overall sound pressure levels, the Bell Tower was exposed to higher sound pressure levels than the other fields. The Sanderson Center had the lowest sound pressure levels for the each category.

Table 4.2 L_{eq} for the sites



Note: Each site represents dBA

Sound and noise subjects have been studied by the World Health Organization (WHO) for a long time. The organization focuses on noise estimation and control methods. In addition, the organization creates the standards for current and proposed sound sources. The WHO organized a commission conference that created a health based protocol for the neighborhood noise (Berglund et al., 1999). The goal was to regulate a standard for the sound and noise parameters. Figure 4.6 shows the parameters in different places.

Specific environment	*Critical health effect(s)*	L_{Aeq} *(dB)*	*Time-base (h)*	L_{Amax} *(dB) (fast)*
Outdoor living area	Serious annoyance, daytime and evening	55	16	—
	Moderate annoyance, daytime and evening	50	16	—
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	—
Inside bedrooms	Sleep disturbance, nighttime	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
Hospitals, wardrooms, indoors	Sleep disturbance, nighttime	30	8	40
	Sleep disturbance, daytime and evening	30	16	—
Industrial, commercial, shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons: <5 times/year)	100	4	110

Figure 4.6 Sound and noise parameters

(Berglund et al., 1999)

In addition to the WHO, U.S.A. also created the regulations about sound and noise. The National Environmental Policy Act, the Noise Control Act, and the Levels Document are the well-known noise related guidelines. Currently, noise regulations differ state by state, even though most of them admit the noise level is 80 dBA (Kang et al., 2001).

In the research, Mitchell Library (57 dBA), Union Colvard (60 dBA), and Bell Tower (61 dBA) were exposed to quite higher sound pressure levels. If the campus is assumed a place in between outdoor environment and industrial and commercial areas, the sound levels for the sites close to the suggested sound pressure levels. For the time intervals, the sound pressure levels reach the peak points at noon periods for all selected sites and it was followed by the mornings.

In addition to the site recordings, site measurements also help to have a better understanding of overall sound characteristics. These are not helpful to understand the overall sound characteristics since site measurement equipment measure the entire site without analyzing the sounds. However, they assist to define and describe the sounds.

4.3 Campus users' perception

While previous findings explain the objective measurement of this study, it was elucidated preferences of the campus users in this section. In order to figure out the campus users' perception in regard of acoustic evaluation, a questionnaire was conducted in each site. The main aim of this study was to assess how campus users perceive and examine the sound environments. In the recent studies, quantitative contributions have been utilized to describe the evaluation of sound environment. It lasted until Schafer's (1977) perspective was created. At the beginning of his qualitative type of contributions, sound examination does not rely on quantitative analysis. Hence, the idea of soundscape has been paving the way of subjective components. This step aimed to explain the sound characteristics of the sites based on the questionnaire of the campus users.

The questionnaire consists of two parts. The first one asks participants to fill out personal information and behavior activities in the proposed sites whereas the second part is about evaluation of the acoustic environment. For the first part, there are questions about the characteristics of socio-demographic profile such as age, gender, occupation, education level, places of residence, and the particular activity at the survey sites. Acoustic environment evaluation section contains several types of questions. For instance, some questions were defined on a Likert type-scale from one to five (1 dislike most, 2 dislike, 3 neutral, 4 like, 5 like most). The goal of this question was to examine the degree of liking the specified sounds. Since the term of sound and acoustic is difficult for the participants to express, some parts of the acoustic environment evaluation are provided as a structured and open-ended combination. The last part of the questionnaire is about participants' preference. Therefore, this part consists of identifying the sounds that the campus users want or do not want to hear (See Appendix D).

A total of 51 campus users participated in the study. The demographic profiles of the campus users were shown in Table 4.3. The location and the number of participants were differed among the four locations. While 15 participants took part in the Mitchell Memorial Library, it was followed by the Colvard Student Union (13 participants), the Sanderson Center (12 participants), and the Bell Tower (11 participants). For the age, 74.5% of the participants are in between 18 and 32 years while almost half of them (45.1%) are male. The majority, 64.7%, reported the occupation as student, whilst the rest of them are service workers (13.7%), university staff (11.8%), and sales workers (7.8%). More than half (68.6%) of the participants had grown up in a rural area whereas 21.6% of the participants were from an urban area. For the education factor, roughly half of the participants have a bachelor's degree (52.9%) and that demographic is followed by participants who hold high school degrees (27.5%), graduate degrees (15.7%), and finally secondary school degrees (3.9%), respectively.

Another important part of the questionnaire is to scrutinize the campus behavior of the participants. Since each site has different functions, they also provide different sorts of activity for the campus users. In order to figure out their activity, they were asked to fill out the campus activities as the part of the questionnaire. One out of three (33.3%) participants chose usually "passing", one out of five participants (20%) picked "meeting a friend," and one out of five of them (20%) were "visiting the location" at the Mitchell Memorial Library. The Colvard Student Union activities are different than the Library.

Main activities are "having lunch" (46%), "working in the location" (30.7%), and "meeting with a friend" (23.3%). The Bell Tower also has different purposes for campus users. The major activities are "resting" (45.4%) and "passing" (27.2%). Finally, campus users reported using the Sanderson Centre mainly for the "sport activities" (83.3%). If the activities are evaluated as an overall perspective, main exercises are tied with "passing" (19.7%) and "sport activity (19.7%), and they are followed by "working in the location" (13.7%), and tied with "meeting a friend" (11.8%) and "having lunch" (11.8%).

Table 4.3 Demographic profile of the participants

		M. Library	Colvard Union	Bell Tower	Sanderson C.	Total	Percentage
	18-22	3	1	1	3	8	15.6 %
	23-27	7	8	2	3	20	39.2 %
Age	28-32	2	1	2	6	11	21.6 %
	33-37	1	2	2	0	5	9.8 %
	38-42	1	1	2	1	5	9.8 %
	48-52	1	0	0	1	2	3.9 %
	Female	6	7	5	4	22	43.1 %
Sex	Male	7	5	4	7	23	45.1 %
	Refuse	2	1	2	1	6	11.8 %
	Student	10	8	5	10	33	64.7 %
	Service worker	2	1	4	0	7	13.7 %
OCC	Sales worker	1	2	1	0	4	7.8 %
	Uni. staff	2	1	1	2	6	11.8 %
	Others	0	1	0	0	1	2.0 %
	Urban	4	3	1	3	11	21.6 %
GR	Sub-urban	1	1	1	2	5	9.8 %
up	Rural	10	9	9	7	35	68.6 %
	Secondary	0	1	1	0	2	3.9 %
	High	5	3	5	1	14	27.5 %
Edu.	Bachelor	8	7	4	8	27	52.9 %
	Graduate	2	2	1	3	8	15.7 %
Total		15	13	11	12	51	100.0 %

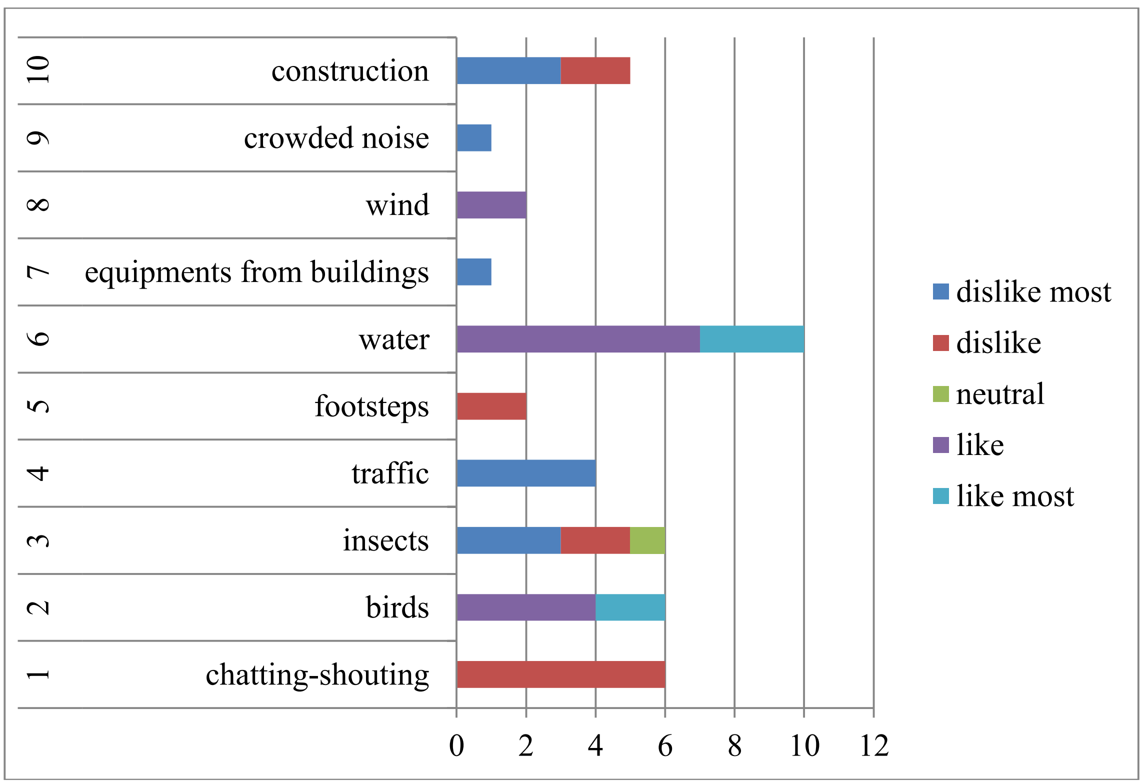
Table 4.3 (Continued)

	M. Library	Colvard Union	Bell Tower	Sanderson	Total	Percentage
What do you usually do in this location?						
Accompany friend/family	1	0	0	0	1	2.0 %
Walking	1	0	1	0	2	3.9 %
Meeting a friend	3	3	0	0	6	11.8 %
Passing	5	0	3	2	10	19.7 %
Resting	0	0	5	0	5	9.8 %
Visiting the location	3	0	1	0	4	7.8 %
Working in location	2	4	1	0	7	13.7 %
Having lunch	0	6	0	0	6	11.8 %
Sport activity	0	0	0	10	10	19.7 %
Total	15	13	11	12	51	100.0 %

In addition to personal information and campus behavior, campus users were also asked to evaluate sound environment. The first section consisted of "Likert-scale" open-ended sound evaluation. Participants were asked to name and to list what they heard in the selected sites. So, the aim was to find out the sources of sounds and the degree of liking the sound sorts of the related sites. In order to do that, a five numeric scale was used for the subjective interpretation that ranges from 1-dislike most (represents the most adverse attitude), 2-dislike, 3-neutral, 4-like, to 5-like most (represents the most admitted attitude).

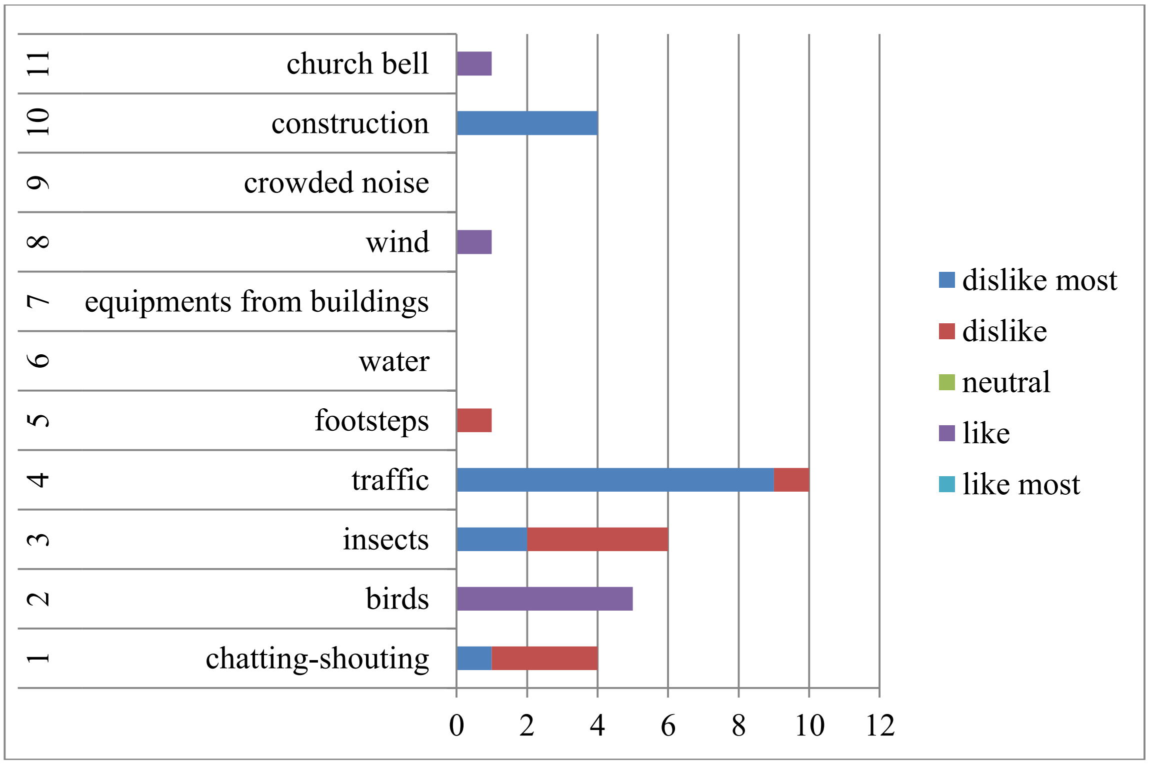
Participants listed 10 different sound sources in the Mitchell Memorial Library (Table 4.4). While all participants mentioned that they like water sounds, 6 of them like birdsongs, and 2 of them like wind sounds as sound sources; 4 out of 10 participants pointed out that they do not like traffic, 5 out of 10 participants stated they do not prefer construction and insects sounds as well as chatting and shouting sounds at the Mitchell Memorial Library.

Table 4.4 Sound sources and their evaluation for the Mitchell Memorial Library



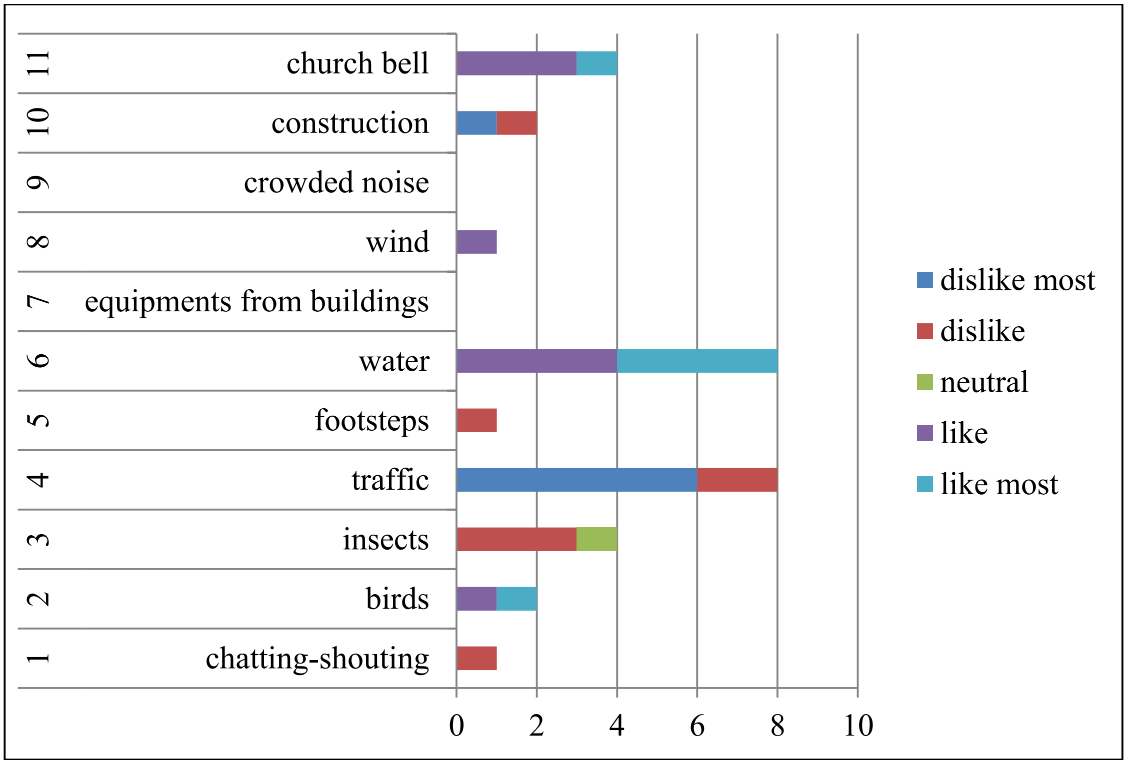
There were 8 sound varieties that were identified by the participants in the Union Colvard (Table 4.5). Crowded noise, equipments from buildings, and water sounds were not mentioned in this site. 39 % of the participants indicated that birdsongs were the most favorable sounds, and 8 % of them indicated that wind and church bells were the most favorable sounds. However, 83 % of the participants pinpointed traffic, 46 % of them showed insects, 30 % of the participants illustrated construction, and chatting and shouting were the least favorable sounds.

Table 4.5 Sound sources and their evaluation for the Colvard Student Union



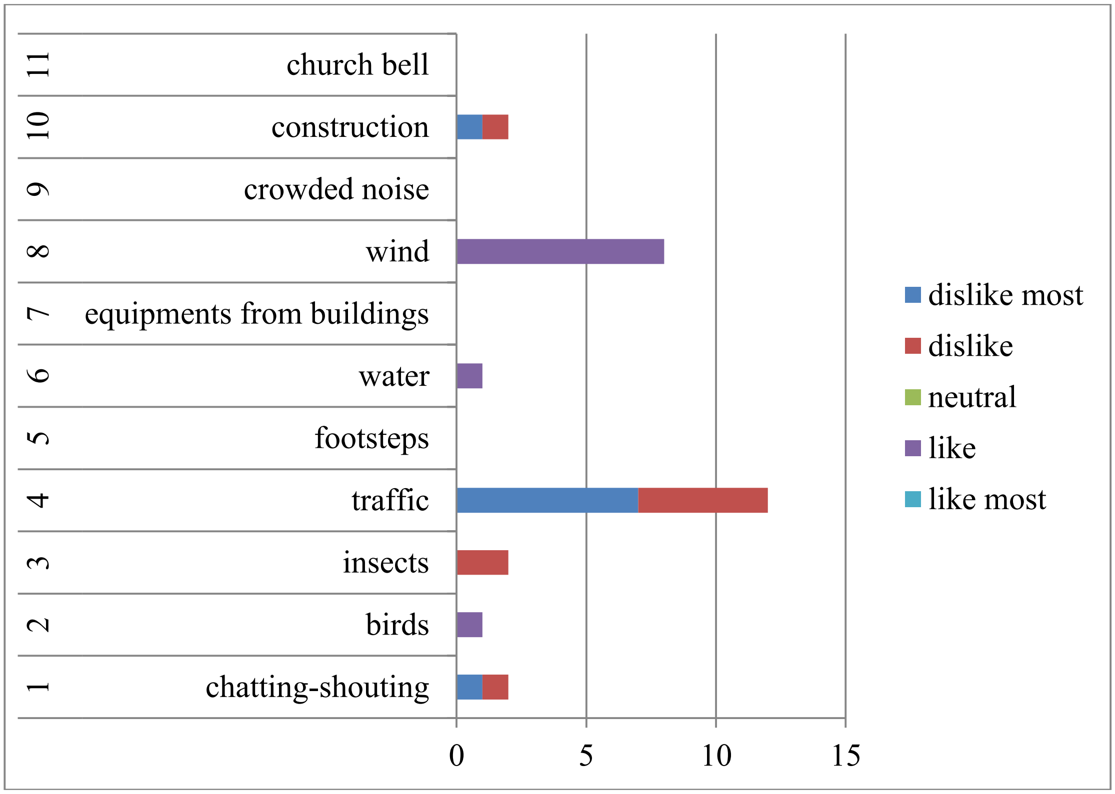
The Bell Tower also had different sound sources with different preferences (Table 4.6). Crowded noise and equipments from buildings sounds were not defined in the site. More than 70 % of the participants preferred water sounds, and roughly 40 % of them illustrated they liked church bells. After them, birdsongs were preferred by 20 % of the participants, and 10 % of them most preferred the wind sounds, whereas traffic was not preferred by the 70 % of the respondents. Nearly 25 % of the respondents indicated that construction and insect sounds were not pleasant sounds for the Bell Tower.

Table 4.6 Sound sources and their evaluation for the Bell Tower



Finally, several sounds were pinpointed in the Sanderson Center as the most favorable sounds; 66 % of the interviewees mentioned wind and 10 % of them emphasized water and birdsongs. Church bells sounds, crowded noise, equipments from buildings, and footsteps were not mentioned in this site. On the other hand, all of the participants mentioned that traffic sound was not pleasant sounds. Construction and chatting and shouting were also indicated the less preferred sounds (Table 4.7).

Table 4.7 Sound sources and their evaluation for the Sanderson Center



In addition to listing the sound sources and what participants hear in the selected sites, participants were also asked to indicate that what sorts of sounds they would like to hear and would not like to hear in the specified sites, if it was possible, and how much they would like to hear them. The idea of this part of the questionnaire is derived from theoretical scheme of Brown. He pointed out a matrix system that consisted of the level of the sounds and if humans did or did not want to hear the sounds (Brown, 2006). Hence, he emphasized the important relationship between sound characteristics and the content of the sound. So, relying on questionnaire results, statistical techniques were used to interpretation the preferred sounds.

For the all selected sites, the most wanted sound was the water sound with 100 % participants' agreement It was followed by birdsongs that were preferred by 90 % of the respondents and the sound of wind blowing trees (Table 4.8).

On the other hand, there were many unwanted sounds as well in the selected fields. Construction was the first ranked unwanted sound with 100 % of the respondents reported their dislike. Aside from, 98 % participants indicated that they do not prefer surrounding speech, and almost 95 % of the respondents mentioned that chatting and shouting were not pleasant sound sources (Table 4.8).

As a result of this analysis, water sounds, birdsongs, and wind blowing tress were the most desirable sounds (Table 4.8). So, natural sounds were commonly more favorable in the Mississippi State University Campus, except insect sounds. However, construction, surrounding speech, and chatting and shouting were unwanted sounds in the campus (Table 4.8). Thus, man-made sounds were not preferred in the campus. Table 4.10 also shows that specific research sites have different preferences for the particular sound sources. The Table 4.9 is visualized version of the ranking preferences.

Table 4.8 Evaluation of the sound environments of the participants

		Library	Colvard	Bell	Sanderson	Total	Percentage
What if you heard	neutral	1	2	0	2	5	9.8 %
the following sounds	like	9	8	8	9	34	66.7 %
in this location?	l. most	5	3	3	1	12	23.5 %
(Bird)							
What if you heard	d. most	4	3	4	4	15	29.4 %
the following sounds	dislike	3	7	4	6	20	39.2 %
in this location?	neutral	8	3	3	2	16	31.4 %
(Insect)							

Table 4.8 (Continued)

What if you heard	neutral	0	3	0	0	3	5.9 %
the following sounds	like	9	8	8	4	29	56.8 %
in this location?	like most	6	2	3	8	19	37.3 %
(Wind blowing trees)							
What if you heard	like	5	8	1	4	18	35.3 %
the following sounds	l. most	10	5	10	8	33	64.7 %
in this location?							
(Sound of water)							
What if you heard	dislike	1	2	0	0	3	5.9 %
the following sounds	neutral	9	7	2	8	26	51.0 %
in this location?	like	5	3	6	4	18	35.3 %
(Church bell)	l. most	0	1	3	0	4	7.8 %
What if you heard	d. most	6	10	7	8	31	60.8 %
the following sounds	dislike	9	3	4	4	20	39.2 %
in this location?							
(Construction sound)							
What if you heard	d. most	3	7	6	5	21	41.2 %
the following sounds	dislike	12	6	5	6	29	56.9 %
in this location?	neutral	0	0	0	1	1	2.0 %
(Surrounding speech)							
What if you heard	d. most	1	7	6	6	20	39.2 %
the following sounds	dislike	13	6	4	5	28	54.9 %
in this location?	neutral	1	0	1	1	3	2.0 %
(Chatting and shouting)							
What if you heard	d. most	0	0	2	0	2	2.0 %
the following sounds	dislike	4	7	4	7	22	43.1 %
in this location?	neutral	11	6	5	5	27	52.9 %
(Footsteps)							
Total		15	13	11	12	51	100.0 %

Table 4.9 Overall preferred sound types in all sites

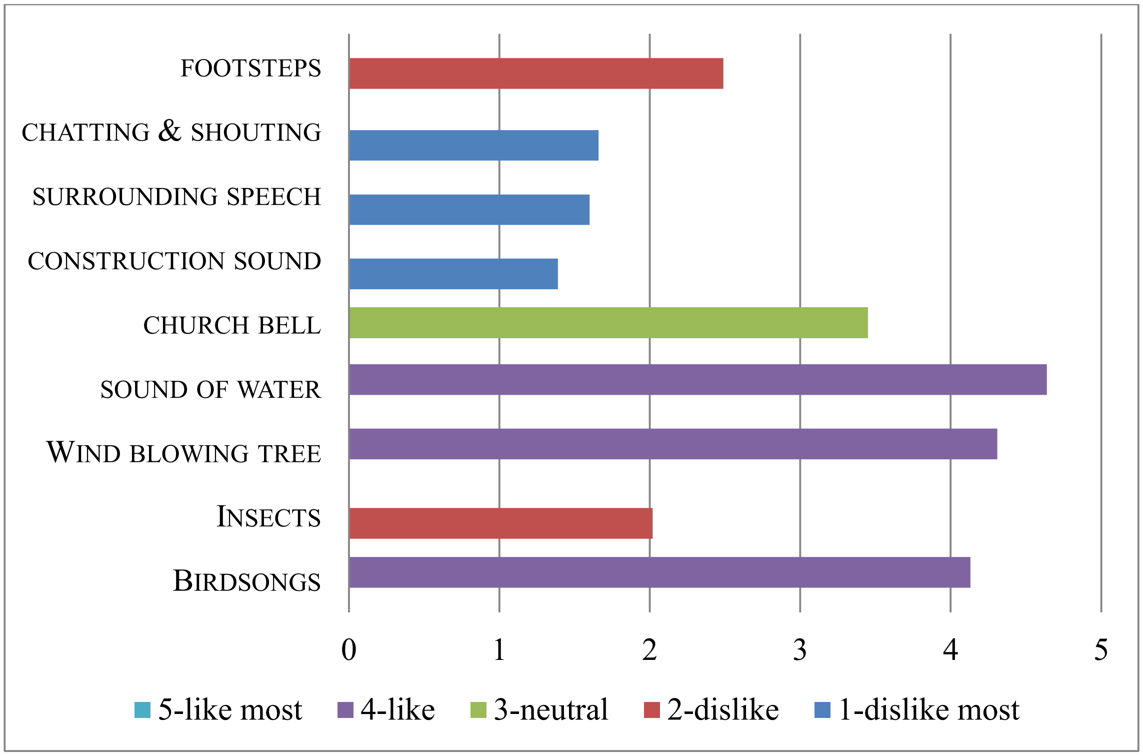


Table 4.10 illustrates what the participants wanted and not wanted to hear in the all research sites. According to the table, water sounds were the most preferred sound types in the all sites. So, almost all respondents wanted to hear water sounds in the campus if there would. Water sounds were followed by the wind blowing trees and birdsongs, respectively. The last most wanted sound types were the church bells. On the other hand, footsteps and insects were not indicated as wanted sound types. After them, chatting, shouting and surrounding speech were less favorable than footsteps and insects. Finally, construction sounds were the least preferred sound types in the research sites.

Table 4.10 Preferred sound types

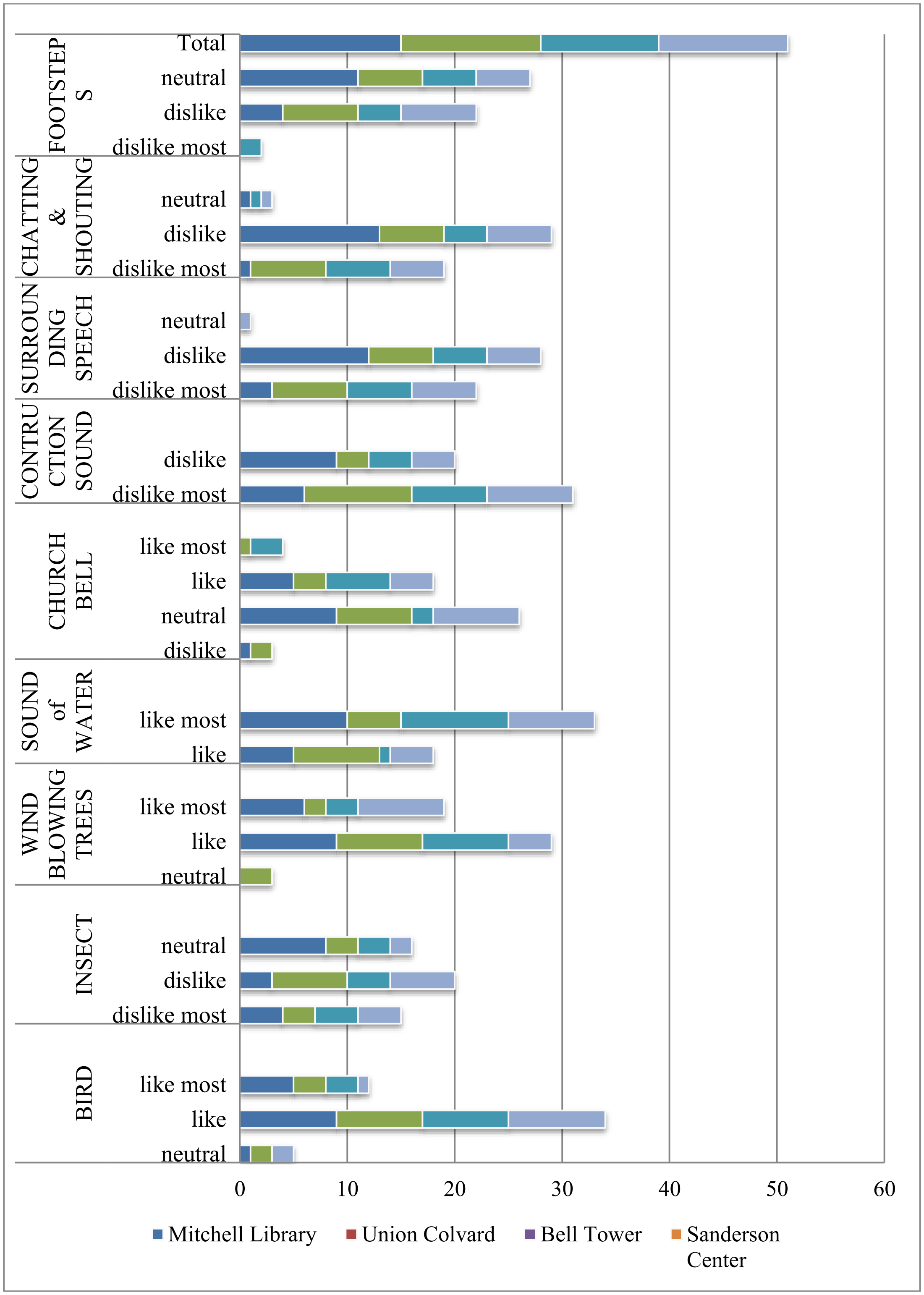


Table 4.11 shows that the relation between demographic characteristics and particular sound preferences. There is a significant difference between age and occupation and age and education level. On the other hand, there is not a significant difference among particular sound types in the all sites analysis. So, it was required to analyze significant levels site by site in order to examine the particular sound types.

Table 4.11 Impacts of demographic characteristics on sound assessment in terms of significant levels for all sites

Age/Occupation (Correlation/Significance)	
Pearson	**.627*/.000**
Spearman	**.631*/.000**
Age/Education (Correlation/Significance)	
Pearson	.274/.051
Spearman	**.297*/.034**
Age/Gender (Correlation/Significance)	
Pearson	.191/.179
Spearman	.130/.363
Age/Grown up (Correlation/Significance)	
Pearson	.123/.391
Spearman	.154/.281
Gender/Occupation (Mean difference / significance)	-.088/.541
Gender/Education (Mean difference / significance)	.192/.178
Gender/Grown up (Mean difference / significance)	.196/.169
Occupation/Education(Correlation/Significance)	
Pearson	.017/.908
Spearman	-.096/.503
Grown up/Occupation(Mean difference / significance)	-.088/.541

Table 4.11 (Continued)

Grown up/Education (Mean difference / significance)	-.041/.773
Socio-demographic Factor / Age	**All sites**
Birdsongs	-.121/.398
Insects	.125/.384
Wind blowing trees	-.014/.922
Sound of water	-.026/.855
Church bell	.024/.866
Construction sound	.013/.926
Surrounding speech	-.139/.331
Chatting and shouting	-.038/.790
Footsteps	-.166/.244
Socio-demographic Factor / Gender	**All sites**
Birdsongs	-.094/.512
Insects	.049/.732
Wind blowing trees	.102/.475
Sound of water	.083/.564

Table 4.11 (Continued)

Church bell	-.072/.615
Construction sound	.136/.341
Surrounding speech	-.015/.916
Chatting and	.084/.790
shouting	
Footsteps	.145/.310
Socio-demographic Factor / Occupation	**All sites**
Birdsongs	-.180/.207
Insects	.024/.866
Wind blowing	-.265/.060
trees	
Sound of water	-.091/.524
Church bell	-.043/.762
Construction sound	-.029/.843
Surrounding speech	-.155/.279
Chatting and	-.042/.768
shouting	
Footsteps	-.100/.486
Socio-demographic Factor / Education	**All sites**

Table 4.11 (Continued)

Birdsongs	.018/.903
Insects	.142/.319
Wind blowing trees	.190/.183
Sound of water	.026/.856
Church bell	-.164/.249
Construction sound	.104/.467
Surrounding speech	.205/.150
Chatting &	**.302*/.031**
shouting	
Footsteps	.272/.053
Socio-demographic Factor / Grown up	**All sites**
Birdsongs	-.140/.328
Insects	.199/.161
Wind blowing trees	-.022/.879
Sound of water	.173/.226
Church bell	.236/.095
Construction sound	.175/.220
Surrounding speech	-.162/.256
Chatting and shouting	-.082/.569
Footsteps	.134/.348

Note: **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.12 illustrates the relationship between demographic characteristics and significant sound evaluation levels site by site. It mentions that there is a significant difference between age and residence for the Bell Tower site. In addition, the relationship also exists between gender and education at the Sanderson Center. Apart from demographic factors, there are also significant levels for the sound environment. According to the table, the preference for sound of birdsongs and church bells are influenced by gender. In addition, birdsongs are also affected by residence. Furthermore, the choice of insects and wind blowing trees are impacted by occupation. Moreover, wind blowing trees are influenced by the residence. Finally, water sounds are affected by education and residence. According to the significant level analysis, man-made sounds, except church bells, have a less significant correlation with demographic characteristics.

Table 4.12 Impacts of demographic characteristics on sound assessment in terms of significant levels for site by site

	Mitchell Library	Colvard Union	Bell Tower	Sanderson Center
Age/Occupation				
(Correlation/Significance)				
Pearson	**.845**/.000**	.498/.083	**.713*/.014**	.572/.052
Spearman	**.864**/.000**	.505/.078	**.782**/.004**	.453/.139
Age/Education				
(Correlation/Significance)				
Pearson	.503/.056	.030/.921	.151/.657	.386/.215
Spearman	.484/.068	.-046/.880	.199/.557	.547/.066
Age/Gender				
(Correlation/Significance)				
Pearson	-. 037/.895	-.023/.941	.369/.265	.491/.105
Spearman	-.117/.678	.032/.918	.270/.422	.485/.110
Age/Grown up				
(Correlation/Significance)				

Table 4.12 (Continued)

Pearson	.115/.683	.242/.425	.549/.081	-.218/.496
Spearman	.096/.734	.070/.821	**.604*/.049**	.013/.969
Gender/Occupation				
(Mean difference/				
significance)	-.191/.496	-.131/.669	-.127/.709	.188/.559
Gender/Education				
(Mean difference/				
significance)	-.120/.670	.245/.420	.211/.533	**.633*/.027**
Gender/Grown up				
(Mean difference/				
significance)	.401/.138	.111/.719	.036/.917	.165/.609
Occupation/Education				
(Correlation/Significance)				
Pearson	.481/.070	-.356/.233	-.020/.953	.270/.397
Spearman	.277/.318	-.487/.092	-.032/.927	.272/.392
Grown up/Occupation				
(Mean difference/				
significance)	-.161/.565	.365/.221	.413/.207	-.175/.586
Grown up/Education				
(Mean difference/				
significance)	-.093/.742	-.070/.820	.257/.445	.059/.855
Socio-demographic Factor / Age				
Birdsongs	-.029/.917	.261/.389	-.203/.550	-.555/.061
Insects	.424/.115	-.186/.542	-.249/.460	.418/.176
Wind blowing	-.223/.423	.459/.115	-.342/.304	-.315/.319
Sound of water	-.357/.191	.220/.470	.392/.233	-.197/.540
Church bell	.117/.677	.128/.677	-.262/.437	.039/.903
Construction sound	-.120/.669	.242/.425	.223/.510	-.157/.625
Surrounding speech	-.232/.406	-.098/.751	.113/.740	-.327/.299
Chatting shouting	.231/.408	-.224/.461	.103/.763	-.225/.483
Footsteps	-.057/.840	**.605*/.028**	.211/.534	-.386/.216
Socio-demographic Factor / Gender				
Birdsongs	**-.550*/.034**	.091/.768	.223/.510	-.071/.826
Insects	-.374/.169	.357/.231	.264/.432	.102/.753

Table 4.12 (Continued)

Wind blowing	103/.714	.500/.082	-.322/.335	.000/1.00
trees				
Sound of water	**.656*/.125**	.077/.803	-.115/.736	.297/.348
Church bell	**-.550*/.034**	.362/.225	-.314/.348	.000/1.00
Construction sound	-.258/.352	-.177/.563	.275/.413	.000/1.00
Surrounding speech	-.253/.363	-.056/.855	.089/.796	.000/1.00
Chatting and	.300/.277	.187/.540	.118/.730	.164/.610
shouting				
Footsteps	-.057/.839	.187/.540	.294/.380	.071/.826
Socio-demographic Factor / Occupation				
Birdsongs				
Pearson	.030/.914	-.271/.371	-.310/.354	-.378/.226
Spearman	- .059/.834	-.186/.543	-.313/.349	-.384/.218
Insects				
Pearson	.371/.174	.000/1.00	**-.629*/.038**	.108/.737
Spearman	.363/.184	.000/1.00	**-.661*/.027**	.141/.661
Wind blowing trees				
Pearson	.015/.957	-.154/.616	-.310/.354	**-.632*/.027**
Spearman	.000/1.00	-.058/.851	-.313/.349	**-.632*/.027**
Sound of water				
Pearson	-.106/.708	-.177/.563	.295/.378	-.158/.624
Spearman	-.098/.729	-.097/.754	.323/.333	-.158/.624
Church bell				
Pearson	.226/.418	-.111/.717	.-214/.527	-.316/.317
Spearman	.199/.476	-.033/.916	-.262/.436	-.316/.317

Table 4.12 (Continued)

Construction sound				
Pearson	-.168/.550	.320/.286	.143/.674	-.316/.317
Spearman	-.226/.419	.334/.264	.032/.925	-.316/.317
Surrounding speech				
Pearson	-.056/.843	-.058/.852	.202/.551	-.478/.116
Spearman	-.207/.459	-.071/.819	.124/.716	-.505/.094
Chatting and shouting				
Pearson	.512/.051	-.058/.852	.024/.944	-.408/.188
Spearman	.454/.089	-.071/.819	.027/.936	-.432/.160
Footsteps				
Pearson	.045/.873	-.432/.141	-.028/.934	.076/.815
Spearman	-.083/.768	-.424/.149	-.024/.945	.076/.815
Socio-demographic Factor / Education				
Birdsongs				
Pearson	.320/.244	.036/.907	-.095/.781	.051/.875
Spearman	.307/.266	.028/.928	-.104/.760	.066/.838
Insects				
Pearson	.215/.441	.000/1.00	.213/.529	.293/.356
Spearman	.167/.552	.083/.788	.158/.643	.312/.324
Wind blowing trees				
Pearson	.042/.883	.120/.695	.427/.190	-.107/.742
Spearman	.035/.902	128/.676	.382/.246	-.092/.775
Sound of water				
Pearson	.000/1.00	-.167/.585	.184/.589	**.633*/.074**
Spearman	.018/.949	-.232/.446	.215/.525	**.623*/.081**
Church bell				
Pearson	.320/.244	-.398/.178	-.079/.817	.107/.742
Spearman	.307/.266	-.444/.129	-.119/.728	.092/.775
Construction sound				

Table 4.12 (Continued)

Pearson	-.042/.883	-.070/.820	.527/.096	.107/.742
Spearman	-.035/.902	.027/.931	.514/.105	.092/.775
Surrounding speech				
Pearson	.102/.717	.074/.810	.437/.035	-.081/.803
Spearman	.086/.762	.158/.606	.452/.030	-.058/.857
Chatting and shouting				
Pearson	.280/.313	.267/.377	**.758**/.007**	-.039/.904
Spearman	.234/.400	.362/.225	**.713*/.014**	-.002/.994
Footsteps				
Pearson	.277/.318	.074/.810	.564/.071	.051/.875
Spearman	.271/.329	.158/.606	.507/.112	.088/.875
Socio-demographic Factor / Grown up				
Birdsongs	-.079/.779	-.217/.47	**-.722*/.012**	.066/.838
Insects	.302/.274	.269/.375	-.237/.483	.381/.222
Wind blowing	-.371/.173	.068/.824	**.860**/.060**	.485/.110
Sound of water	.000/1.00	.318/.290	**.886**/.000**	-.139/.667
Church bell	.185/.509	.184/.546	.060/.860	.347/.270
Construction sound	.371/.173	.350/.241	.334/.315	-.277/.383
Surrounding speech	.038/.893	-.141/.646	-.188/.579	-.262/.411
Chatting and	-.415/.124	.225/.459	-.082/.811	-.051/.875
Footsteps	.446/.096	.225/.459	-.036/.917	.066/.838

Note: **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.13 illustrates the mean differences about sound sources between different age groups. The preferences are slightly different for the age groups. While birds and wind blowing trees sounds are more favorable for the younger participants, older people prefer sounds of insects, water, and church bells. In addition, older participants are more tolerant of the construction sounds, surrounding speech, chatting and shouting. However, young respondents are more tolerant of footsteps than older participants.

Table 4.13 Significant mean differences about sound sources between different age groups

What if you heard the	What is your age?	N	Mean	Std.	Std. Error
Bird	**18-22**	**7**	**4.29**	**.756**	**.286**
	23-27	20	4.15	.587	.131
	28-32	11	4.00	.447	.135
	33-37	5	4.25	.548	.245
	38-42	5	4.20	.447	.200
	48-52	2	3.50	.707	.500
Insects	18-22	7	2.00	.816	.309
	23-27	20	1.95	.826	.185
	28-32	11	2.09	.701	.211
	33-37	5	1.60	.894	.400
	38-42	5	2.40	.894	.400
	48-52	**2**	**2.50**	**.707**	**.500**
Wind blowing trees	**18-22**	**7**	**4.57**	**.535**	**.202**
	23-27	20	4.20	.616	.138
	28-32	11	4.55	.522	.157
	33-37	5	4.40	.548	.245
	38-42	5	4.20	.447	.200
	48-52	2	4.00	0.000	0.000
Sound of water	18-22	7	4.57	.535	.202
	23-27	20	4.65	.489	.109
	28-32	11	4.73	.467	.141
	33-37	**5**	**5.00**	**0.000**	**0.000**
	38-42	5	4.60	.548	.245
	48-52	**2**	**5.00**	**0.000**	**0.000**
Church bells	18-22	7	3.57	.976	.369
	23-27	20	3.25	.550	.123
	28-32	11	3.64	.809	.244
	33-37	**5**	**4.20**	**.447**	**.200**
	38-42	**5**	**4.20**	**.837**	**.374**
	48-52	2	4.00	0.000	0.000

Table 4.13 (Continued)

What if you heard the following sounds in this location?	What is your age?	N	Mean	Std. Deviation	Std. Error Mean
Construction sounds	18-22	7	1.33	.535	.202
	23-27	20	1.40	.503	.112
	28-32	11	1.35	.522	.157
	33-37	**5**	**1.50**	**.447**	**.200**
	38-42	5	1.40	.548	.245
	48-52	**2**	**1.50**	**.707**	**.500**
Surrounding speech	18-22	7	1.51	.488	.184
	23-27	20	1.65	.587	.131
	28-32	11	1.55	.522	.157
	33-37	5	1.40	.548	.245
	38-42	5	1.60	.548	.245
	48-52	**2**	**1.70**	**.707**	**.500**
Chatting and shouting	18-22	7	1.61	.488	.184
	23-27	20	1.65	.587	.131
	28-32	11	1.64	.674	.203
	33-37	5	1.60	.894	.400
	38-42	5	1.80	.447	.200
	48-52	**2**	**1.81**	**.707**	**.500**
Footsteps	18-22	7	2.43	.787	.297
	23-27	**20**	**2.65**	**.489**	**.109**
	28-32	11	2.36	.674	.203
	33-37	5	2.40	.548	.245
	38-42	5	2.20	.447	.200
	48-52	2	2.30	.707	.500

Table 4.14 shows the preferences for different gender. The differences indicate that female participants highly appreciate birds, wind blowing trees, water, and church bells, but do not prefer insect sounds. On the other hand, male respondents are more tolerant of the construction sounds, surrounding speech, chatting and shouting, and footsteps.

Table 4.14 Significant mean differences about sound sources between different genders

What if you heard the following sounds in this location?	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Bird	**female**	**22**	**4.23**	**.612**	**.130**
	male	23	4.04	.562	.117
	refuse	6	4.17	.408	.167
Insects	female	22	2.05	.844	.180
	male	23	1.91	.668	.139
	refuse	**6**	**2.33**	**1.033**	**.422**
Wind blowing trees	**female**	**22**	**4.50**	**.631**	**.135**
	male	23	4.30	.559	.117
	refuse	6	4.27	.548	.224
Sound of water	**female**	**22**	**4.84**	**.492**	**.105**
	male	23	4.61	.499	.104
	refuse	6	4.63	.408	.167
Church bells	**female**	**22**	**3.50**	**.740**	**.158**
	male	23	3.43	.788	.164
	refuse	6	3.33	.516	.211
Construction sounds	female	22	1.32	.477	.102
	male	**23**	**1.53**	**.507**	**.106**
	refuse	6	1.50	.548	.224
Surrounding speech	female	22	1.64	.492	.105
	male	**23**	**1.77**	**.590**	**.123**
	refuse	6	1.67	.516	.211
Chatting and shouting	female	22	1.64	.581	.124
	male	**23**	**1.83**	**.647**	**.135**
	refuse	6	1.67	.408	.167
Footsteps	female	22	2.41	.666	.142
	male	**23**	**2.67**	**.511**	**.106**
	refuse	6	2.52	.516	.211

Table 4.15 represents the differences between sound sources and occupations. Even though there are no differences of the natural sounds between occupations, students and university staff are more tolerant of artificial sounds except church bells. Mostly service workers and sale workers have a higher appreciation for natural sounds.

Table 4.15 Significant mean differences about sound sources between different occupations

What if you heard the following sounds in this location?	What is your occupation?	N	Mean	Std. Deviation	Std. Error Mean
Bird	student	33	4.18	.584	.102
	service worker	7	4.14	.378	.143
	sales worker	**4**	**4.25**	**.500**	**.250**
	university staff	6	4.00	.632	.258
Insects	student	33	2.03	.770	.134
	service worker	7	1.86	.900	.340
	sales worker	4	2.00	1.155	.577
	university staff	**6**	**2.17**	**.753**	**.307**
Wind blowing trees	student	33	4.39	.609	.106
	service worker	**7**	**4.43**	**.535**	**.202**
	sales worker	4	4.00	0.000	0.000
	university staff	6	4.17	.408	.167
Sound of water	student	33	4.64	.489	.085
	service worker	**7**	**4.86**	**.378**	**.143**
	sales worker	4	4.75	.500	.250
	university staff	6	4.50	.548	.224
Church bells	student	33	3.39	.704	.123
	service worker	**7**	**4.00**	**.816**	**.309**
	sales worker	4	3.50	.577	.289
	university staff	6	3.17	.753	.307
Construction sounds	student	33	1.42	.502	.087
	service worker	7	1.14	.378	.143
	sales worker	4	1.50	.577	.289
	university staff	**6**	**1.50**	**.548**	**.224**
Surrounding speech	**student**	**33**	**1.70**	**.529**	**.092**
	service worker	7	1.29	.488	.184
	sales worker	4	1.50	.577	.289
	university staff	6	1.67	.516	.211
Chatting and shouting	student	33	1.70	.585	.102
	service worker	7	1.57	.535	.202
	sales worker	4	1.50	.577	.289
	university staff	**6**	**1.83**	**.753**	**.307**
Footsteps	**student**	**33**	**2.55**	**.564**	**.098**
	service worker	7	2.29	.756	.286
	sales worker	4	2.50	.577	.289
	university staff	6	2.51	.548	.224

Table 4.16 shows the relationship between sound types and the places where participants grew up. Participants who grew up in suburban areas are more appreciate of the natural sounds, except birds. Urban participants enjoy bird sounds more. On the other hand, urban residents are more tolerant of artificial sounds such as construction sounds, surrounding speech, chatting and shouting, and footsteps. However, urban residents do not prefer the sound of church bells as much as suburban and rural participants do.

Table 4.16 Significant mean differences about sound sources between different residents

What if you heard the following sounds in this location?	Where did you grow up?	N	Mean	Std. Deviation	Std. Error Mean
Bird	**urban area**	**11**	**4.36**	**.674**	**.203**
	sub-urban	5	3.80	.837	.374
	rural	35	4.11	.471	.080
Insects	urban area	11	1.73	.786	.237
	sub-urban	5	2.00	.707	.316
	rural	**35**	**2.11**	**.796**	**.135**
Wind blowing trees	urban area	11	4.27	.647	.195
	sub-urban	**5**	**4.60**	**.548**	**.245**
	rural	35	4.29	.572	.097
Sound of water	urban area	11	4.45	.522	.157
	sub-urban	**5**	**4.80**	**.447**	**.200**
	rural	35	4.69	.471	.080
Church bells	urban area	11	3.09	.539	.163
	sub-urban	**5**	**3.60**	**1.140**	**.510**
	rural	35	3.54	.701	.118
Construction sounds	urban area	11	1.18	.405	.122
	sub-urban	**5**	**1.60**	**.548**	**.245**
	rural	35	1.43	.502	.085
Surrounding speech	**urban area**	**11**	**1.82**	**.603**	**.182**
	sub-urban	5	1.40	.548	.245
	rural	35	1.57	.502	.085
Chatting and shouting	**urban area**	**11**	**1.82**	**.751**	**.226**
	sub-urban	5	1.40	.548	.245
	rural	35	1.66	.539	.091
Footsteps	**urban area**	**11**	**2.57**	**.522**	**.157**
	sub-urban	5	2.00	.707	.316
	rural	35	2.45	.558	.094

Table 4.17 demonstrates the relationship between different sound sources and level of education. Participants with an increasing level of education are more tolerant to the man-made sounds, such as construction sounds, surrounding speech, chatting and shouting, and footsteps. Their preferences are different for natural sounds. While birdsongs are preferred more by bachelor's degree holders, graduate degree holders tend to prefer sounds of insects, wind blowing trees, and waters.

Table 4.17 Significant mean differences about sound sources between different education levels

What if you heard the following sounds in this location?	What is the highest degree you have completed?	N	Mean	Std. Deviation	Std. Error Mean
Bird	secondary school	2	4.00	0.000	0.000
	high school	14	4.14	.663	.177
	bachelor's degree	**27**	**4.15**	**.602**	**.116**
	graduate degree	8	4.13	.354	.125
Insects	secondary school	2	2.50	.707	.500
	high school	14	1.93	.829	.221
	bachelor's degree	27	1.85	.770	.148
	graduate degree	**8**	**2.63**	**.518**	**.183**
Wind blowing trees	secondary school	2	4.00	0.000	0.000
	high school	14	4.29	.611	.163
	bachelor's degree	27	4.26	.594	.114
	graduate degree	**8**	**4.63**	**.518**	**.183**
Sound of water	secondary school	2	4.50	.707	.500
	high school	14	4.64	.497	.133
	bachelor's degree	27	4.67	.480	.092
	graduate degree	**8**	**4.73**	**.518**	**.183**
Church bells	**secondary school**	**2**	**4.00**	**1.414**	**1.000**
	high school	14	3.64	.842	.225
	bachelor's degree	27	3.30	.542	.104
	graduate degree	8	3.50	.926	.327
Construction sounds	secondary school	2	1.50	.707	.500
	high school	14	1.29	.469	.125
	bachelor's degree	27	1.41	.501	.096
	graduate degree	**8**	**1.50**	**.535**	**.189**
	secondary school	2	1.50	.707	.500
Surrounding speech	high school	14	1.43	.514	.137
	bachelor's degree	27	1.67	.555	.107
	graduate degree	**8**	**1.75**	**.463**	**.164**
Chatting and shouting	secondary school	2	1.50	.707	.500
	high school	14	1.50	.519	.139
	bachelor's degree	27	1.63	.565	.109
	graduate degree	**8**	**2.13**	**.641**	**.227**
Footsteps	secondary school	2	2.00	1.414	1.000
	high school	14	2.36	.633	.169
	bachelor's degree	27	2.52	.509	.098
	graduate degree	**8**	**2.75**	**.463**	**.164**

CHAPTER V

DISCUSSION AND CONCLUSION

5.1 The impacts of soundscape on landscape architecture

Public open spaces are vital components for the city since they improve the quality of life both socially and culturally. Hence, planning and design professionals have paid much attention to these spaces in recent years since they are significant for visual and aesthetic purposes (Kang, 2004). Recently, professions also have started to take into account sound features for the urban open spaces. In addition, the sound preferences of the campus users were identified and analyzed.

Since visual elements are more explicable and controllable in the visual world, sound and other senses are ignored. To illustrate it, it is easy to explain any objects with their colors and shapes (Hedfords, 2003). Landscape architecture and architecture disciplines are based on more visual aspects because of previous reasons. On the other hand sound has developed around music and other disciplines. However, it is figured out that Landscape Architecture was introduced with other senses as well, particularly sound. Landscape architects are accustomed to the sound sources of any objects apart from their colors and shapes. So, these sound sources are vital design and planning resources for the human experiences.

Site design and planning are the core components of the Landscape Architecture field. The perception of a space or place does not occur only in visual manner, but also takes place with perception and senses. Sound is one of the most important senses and it helps to perceive the world. If a person does not want to see any object, he or she can close his or her eyes and does not see anything. However, hearing sense always works even during sleeping. So, it is expected from the Landscape Architecture field to take into account sound aspects in the site design and planning in addition to visual contribution. Visual aspects are mostly dominant factors in the site design up till now. However, it should be enhanced by sound in order to create a better design and planning concept. After accomplishing of integrating these visual and sound aspects, it is possible to create an ideal place where has improved quality of life.

In addition, sustainable design requires that all human sense be used (Hedfords, 2003). Sustainable site means that a site needs to fulfill all requirements for the quality of the life whilst managing the carrying capacity of supportive surroundings (Hedfords, 2003). Creating comfortable sound environment is an important concern for the urban environment that uses the resources rapidly. In addition, since noise cannot vanish without any action, it is necessary to cope with noise in a sustainable way. To do this, to create and improve sustainable sound surroundings are highly important for the sustainable life (Yu and Kang, 2011). So, in order to create a healthy and aesthetic place, it is necessary to meet all components for both rural and urban areas. Moreover, soundscape concept does not only include the physical elements, but also it has social contributions and psychological features. It provides both social and physical benefits for a healthy and sustainable society.

The natural sounds of the sites firstly should be preserved by landscape planning and design process. These sounds should be used in the site in order to create a pleasant area since any introduced sound sources from the outside might have adverse effects for the land use and for the site designs. So, these methods help landscape architecture to protect and improve the site quality with the future soundscapes.

5.2 Soundscapes

Site recordings in regard to sound frequency and waveforms illustrated that each site had different sound varieties even though there were some similarities. Traffic sounds and construction sounds were common sounds and they existed in the lower frequency bands that were shown in the spectrograms. For the Mitchell Memorial Library, morning, noon, afternoon and night recordings showed that sounds emerged in the medium and higher frequency bands since it included walking, chatting, and many natural sounds such as birdsongs, insects, and water features. The reason is that there are usually campus users' activities around the Mitchell Memorial Library. In addition, there are many site elements such as trees, shrubs, and ground cover plants that attract birds, insects, and wind blowing. Next, the Colvard Student Union had sound diversity particularly in the mornings and afternoons. Afternoons had both different sound sources and higher sound levels simultaneously. Night sounds mainly occurred in the lower frequency bands. Since the Colvard Student Union includes food, beverages, and ATM facilities, it is used for all time intervals; however, it was used comparatively less during the nights than the other times ,morning, noon, and afternoon. For the Bell Tower, the spectrograms were slightly different. Traffic and construction sounds occurred much more in the mornings. The other sound sources penetrated in the other time intervals. The sound levels fluctuated in the noon period. The higher sound levels and varieties seemed to occur in the afternoon and in the nights, particularly in the afternoons at the Bell

Tower. The reason for the higher sound levels in the afternoons and nights was that there are many sound sources such as the church organizations, birdsongs, insects, water features, and the activity of the users such as resting, reading, walking, or group gathering. Lastly, the Sanderson Center had comparatively to all time intervals less sound pressure levels. The distinguishing factor for this site is noon and afternoon sounds. Both time periods contained more sound types than morning and night sounds. Since this site has sport facilities, campus users would come to use these facilities particularly during noon and afternoon periods. In addition, sound levels took place mostly in lower frequency bands since there were not many sound sources except vehicle and human related sounds such as passing, chatting, or shouting. As the Sanderson Center is quite large and without natural sounds sources, traffic and human related sound sources were more dominant factors in this site.

For the site measurements, the Bell Tower and the Colvard Student Union were evaluated and measured have louder sound than the other sites even though the sound levels are similar for all the sites. Although general belief is that the louder sounds the sits has the more adverse soundscape evaluated. However, it was not found in this study. This finding is also supported by the study of Yang and Kang (2005). For all the research sites, both artificial and natural sounds were reported. Artificial sounds were the least preferred sounds, except church bells, by the campus users, and these findings are supported by previous studies on public squares and urban green spaces (Ge and Hokao, 2004).

No matter what type of green open spaces there are, the most important findings are the direct contact through human senses with the spaces (Thompson, 2010). So, visual, tactile, olfactory, and auditory connections enhance the benefits of the open spaces. For the auditory connections, open spaces have important features. Since open spaces provide several activities for the public space visitors, a lot of sound sources are produced by the visitors. In addition, plants and animals also increase the sound types in the open spaces. Open spaces offer several activities ,both active and passive, such as game activities, fitness and jogging circulations, playgrounds for children, sitting areas, and water features. For the open space, it is essential to appropriate activity to meet with the users' demands (Thompson, 2010). So, soundscape is also based on the users' preference on the open space. While creating an open space for the people, visual, functional, and ecological approaches are important as well as soundscape potentials.

In addition, the sound pressure levels increase with users' activities in the sites. The more users' activities, the higher sound pressure levels for the environment. Moreover, natural components such as water features, birdsongs, and insects, have significant effects on sound pressure levels. However, campus users prefer these natural sounds even though they have higher sound pressure levels. The important design criteria for this approach is to take into account what people want from the sites. The water, birdsongs, and wind sounds were perceived as desirable sound sources for the all sites. Although these sounds are preferred by the campus users, these sounds are required to design and to plan with a high concern. When the questionnaires were conducted, participants mentioned that they want to hear water features. In addition, people preferred birdsongs and wind on the all sites. Marcus and Francis (1998) have similar findings about the relationship between natural components and campus design. The results of a survey revealed that majority of the participants want to have more naturalness, trees, and greenery in the campus. In addition, the respondents did not prefer to have more buildings and parking lots in the campus. In the same survey, researchers also asked participants to indicate the favorite space on a map, and all participants emphasized that their favorite place is a natural place (Marcus and Francis, 1998).

The location and the design elements are also important factors for the sound pressure levels in the sites. Since the Colvard Student Union, the Bell Tower, and the Sanderson Center include a lot of hard grounds such as concrete pavements, and they were located near asphalt roads (Figure 5.1, 5.2, 5.3, and 5.4.).

Figure 5.1 The images of the Mitchell Memorial Library

Source: Yalcin Yildirim

Figure 5.2 The images and the activities of the Colvard Student Union.

Source: Yalcin Yildirim

Figure 5.3 The images and the activities of the Bell Tower.

Source: Yalcin Yildirim

Figure 5.4 The images and the activities of the Sanderson Center.

Source: Yalcin Yildirim

Socio-demographic factors play a major role for the preference of the open space activities. In this research, several demographic features such as age, gender, occupation, the place where campus users grew up, and education level were evaluated. According to Weinstein (1978) and Taylor (1984), there is not any correlation between sound evaluation and demographic characteristics, except age. Kang (2004) reported that there are differences among age groups for the sound perception. He noted that people are more tolerant of the sounds of nature and human activities with the increasing of age. Moreover, according to Kang (2004), younger people are more tolerant of music and mechanical sounds. This study similarly indicated that while elderly people are more tolerant of artificial sounds than young people, young users prefer natural sounds more than elderly users.

According to a research conducted by Mehrabian (1976) ,in general, there is a minor tendency for women to be more sensitive than men. According to Kang (2004), there is a minor inclination about sounds for females to be more aware than males. Kang mentions that since females act with more stimulating to some emotional circumstances, they are more aware of any changes in the environment. He also states that females can perceive the sounds differently. This study shows that it is possible that there are minor gender differences in terms of how sounds are perceived but there needs to be further studied to make an accurate claim. So, before any certain claims can be made, it is necessary to conduct a research with a larger sample size. As level of education has a positive relationship with the natural sounds, these sounds are more desirable by increasing education level. For the different professions, there is no significant difference for the natural sounds; however, there is a difference for the artificial sounds. Students are more tolerant of footsteps. Kang (2004) mentioned that there is not significant level for the occupation except students. In this study, since most of the students are young people, the differences could be explained by the age instead of occupation or education level.

Lastly, According to Kang's (2004) finding, surrounding speech was the significant sound, and non-local participants were not tolerant of this sound. For this study, based on places where participants grew up, respondents who grew up in the urban and suburban areas are more tolerant of for the sounds of birds, wind blowing trees, and water.

During the design and planning process, it is required to take into account that each design element or a site design creates many sound sources, and these sounds affect the identity or the structure of the site, after implementing the design. So, sites need to be designate by both visual and auditory aspects since it is difficult to change any designed or planned site once they are constructed (Hedfords, 2003). In addition, the socio-demographic characteristics have a relationship with the soundscape design and acoustic comforts. So, people with different demographic features expect different design and planning approaches from the sites. In addition to the land use, topographic structures, design features, and planting designs have significant effects on sound pressure levels and soundscape preferences.

5.3 Artificial sounds

5.3.1 Traffic

The artificial sounds, across the four selected places, support recent concerns over increasing sound levels from road traffic and their effects on quality of urban life (Bluhm et al., 2004). Payne et al. (2007) mentioned that the sound of background traffic was more positively interpreted compared with other sorts of artificial sounds such as construction. Future research might be needed to examine the conditions in which a variety of higher sound levels of natural sounds such as strong wind or water may be perceived as noisy by different participants. The results of this study indicated that traffic sounds, the highest proportion of artificial sounds identified, are perceived to be the least desirable sound type, and this do not vary depending on the participant's demographic characteristics. Traffic had the most effects on high sound pressure levels for the sites since all the sites are extremely close to the roads that include bicycle, personal vehicles, public transportation, and facility services. Even though it was assumed that roads only affect adjacent the roadsides, wind directions had adverse effects on the sound pressure levels for the sites.

According to Lam, traffic sounds are the more dominant sound types in the city (Lam, 2009). Since traffic is the vital concern for both rural and urban areas, traffic is required to be carefully planned. So, roads and routes should be defined accurately, and there need to be some spaces between structures for the other activities. All sounds can be the same sounds, that is chaotic and overlapping, unless the designer can solve the traffic sounds. This situation results in monotonous sound profiles in the site. So, there are many methods in order to reduce the negative effects of the traffic sounds or to use the traffic sounds in the urban areas. First of all, appropriate structures or buildings might decrease the extension of traffic sounds; for example high-tech absorbing methods can be used on the structures (The Economist, 2012). For instance, some Europe countries use the rubberized roads that is made of recycled materials in order to reduce the traffic sounds.

Another example is the poro-elastic road surface (PERS). Even though it is expensive method, it is more effective than the other solutions (The Economist, 2012). The next solution might be creating cultural, artistic, or architectural exhibitions near roadsides or heavy traffic locations. So, these sorts of activities enhance the sound tolerance and decrease the effects of "negative" traffic sounds. Hiramatsu (2003) highlights the managing methods of the sounds in the middle of the city, Kyoto, for the festivals and fiesta periods. If it is necessary to use roads and traffic, it is required to create a landmark for the pedestrians in order to warn them about the traffic problems and sounds in the site. It is essential to focus people on a well-defined position in order to find their routes and locations.

In order to eliminate or mitigate those unwanted sounds from the sites, barriers might be designated for the critical locations in the sites. Both planting designs and/or constructional solutions, such as barrier systems and sound control enclosures might be used to reduce the traffic sounds. However, the implications of the sound barriers are not the recommended solution for the urban area. It makes the site as a "mute" or pure environment in terms of sounds (Hedfords, 2003). Thus, the identity and the characteristics of the site are changed. Moreover, the structure of the barriers usually are not appropriate for the environment. Most of them look like "wall". So, the barriers do not seem to belong in the particular site, and they transform the area from natural or original to artificial. Hence, sound barriers create several major problems for the site while they are creating a "silent" area.

For the campus design, there are many alternatives to reduce the traffic and traffic sounds. One of them is closing the campus to all vehicles except service facilities and emergency situations. Accordingly, it is not possible nowadays since at least emergency and public transportation needs to enter. So, the other method is to create roads between the highways or main roads and the campus site. Bochum University from Germany is the most prominent example of this idea (Dober, 2000). Vehicle traffic is provided straightly from highways or main roads. Parking lots are also located near them. The aim is to gather the vehicles in the certain locations and isolate them from the campus. Another method is to locate the vehicles in the certain distance. Some authors emphasize that campus design that has at least 350 meters (1,000 feet) of parking space is adequate as a standard (Dober, 2000). So, roads and traffic regulations can be provided with appropriate design solutions according to this idea.

Last but not least, traffic sounds are significantly influenced by vehicle types and features. First, a ten-mile per hour reduction of the speed results in decreasing the half of the sound pressure levels. To illustrate it, the speed limit is twenty MPH in the Mississippi State University campus. If the speed limit would be ten MPH (half of the current speed limit), the sound pressure levels that are caused by the traffic and vehicles decrease half of the current sound pressure levels. Car type is also another factor that affects the sound pressure levels in the campus. Hybrid cars have dramatically less sounds compared to the other car types since they use electric battery or motor for the low speed instead of using engine (NHTSA, 2009). In addition, the types of the tires also change the sound levels. According to research, nearly 2000 tire samples were analyzed from more than one hundred tire companies, and tires might have ten dB sound levels changes in the same environment (The Economist, 2012). The surface of the roadway also alters the sound level near the roadsides. Chip seal and grooved roads produce the highest sounds whilst concrete roads make the quietest sound. Most of the roads on the Mississippi State University Campus are made of asphalt that is medium sound producer road. The difference might be four dB between the loudest and quietest roads. The shape of the road contributes to increasing or decreasing the sound levels. While roadsides with reflective components ,such as hard ground, increase the sound levels, the roadsides that have absorbing elements ,such as building or walls, reduce the sound pressure levels.

To solve these issues, Mississippi State University might regulate the parking permits for the campus users according to the car types and features of the car. So, the quieter the car with their silence features, the less money the users would pay for the their permits, game day parking, or campus entrance. For instance, people pay more taxes if they are using noisy tires or cars in some Europe countries (The Economist, 2012).

5.3.2 Construction

Construction sounds are also another unwanted sounds in the urban area. The difference is that construction sounds are not permanent sound sources. For instance, the construction sites were changed time to time and site to site in the campus during the research. So, it is necessary to find a temporary or modular solution in order to reduce the negative effects of the construction sounds. First, quieter equipment might be chosen during the construction. In addition, both aesthetic and functional sound screens or sound barriers can be used in order to decrease the construction sounds. Barriers might be made of plywood, blocks, or spoils and they can be built in the site. The length of the barrier should be bigger than the heights, and ,most important point is that, the barrier should be in close distance either sound sources or listeners (OSHA, 2011). Placing them every ten feet would decrease the sound levels by roughly 6 dBA. For instance, if the sound source produces 100 dBA and the barrier is located 10 feet away, the listener hears 94 dBA. If the barrier is located 20 feet away, the listener hears 88 dBA (OSHA, 2011). Furthermore, according to Occupational Safety and Health Administration, risk management meetings are another solutions for the construction sounds. Workers can share their ideas or situation in regard of the sounds and they can come up with a solution with the contractor. Since long-term exposure to sound increases the possibility of hearing loss, it is necessary to limit the working hours or to limit staying near the construction sites. It is recommended that sound levels should be limited below 85 dBA for the eight hours limitation or 70 dBA with the twenty hours limitation (OSHA, 2011). In the study, sound pressure levels were sometimes above the 70 dBA; however, they were not constant.

5.3.3 Church bells

The sounds of church bells have been instrumental since the Middle Ages. So, "it represents a communication method, informing the community of significant events such as the time for church services, a wedding, or a birth; the bells would solemly toll for a death. They would summon the community in times of emergency such as attack or fire" (Kiser and Lubman, 2008). Thus, church bells have a sound identity for a place. In addition, some studies revealed that characteristic sounds or soundmarks might make a site distinguishable from other sites (Schafer, 1977). This idea is supported by the study of the Bell Tower in this research. Even though the sounds of church bells were identifiable by the participants, the participants in the Mitchell Memorial Library and the Sanderson Center did not mention that they heard the church bells. The reason might be sound of church bells at these sites were masked by other sounds, poor completion rates that were supported by Porteous and Mastin (1985) of participants for the questionnaire, or visual perception of the site have a positive effect on soundscape perception since the tower of church bells can be seen by the Colvard Student Union and the Bell Tower participants who mentioned that they heard the church bells.

Church bell sounds are the only artificial sound types that are preferred by the campus users. Since the church and its surroundings offer a quiet and peaceful atmosphere for the visitors, water elements are quite suitable for around the church. For the Bell Tower study site, there were two main water features. The area is used for several activities such as passing, resting, working, and visiting the location for the special events such as fraternity initiation ceremonies, receptions, funerals, and weddings. While one of the water features is located in the pathway zone, the other one ,which is located on the other side of the church, creates more peaceable atmosphere for the users. The latter looks like the example of the water features from the Catholic middle ages (Johansson, 1993). Since the latter water feature is surrounded by arch-shaped walls, it has its own ambiance and acoustic feature.

5.4 Natural sounds

5.4.1 Water

Human preference for water has long been known; settlements have always been located near water because of the resources that water offers for life (Faggi et al., 2013). Different professions mentioned that the existence of water in any place is one of the most significant and desirable visual elements of the landscape. Hubbar and Hubbard (1917) found out the refreshing aesthetic assessment of water for the landscape. While Bachelard (1983) claimed that the aesthetic value of water is related to its naturalness, Kaplan and Kaplan (1989) stated that the effects of water as a natural element improve the well-beings. In terms of perception, "water is a great example of an aspect of the natural environment that is highly preferred"(Kaplan and Kaplan, 1989). Kaplan and Kaplan (1989) also mentioned that people are especially aware of the visual information; however, it does not imply that people only get the information by visual manner. The sight of the water features suggest many sensory possibilities for the people. In addition, Kaplan (1989) argued that there are elements called "primary landscape qualities" that have a particular impact on preference, and water is one of those elements. In a similar way, sounds of water also might be described as a "primary soundscape quality." In the research sites, water was selected the most desirable sound source by the participants. Water sounds range from the form of fountains, springs, cascades, and they have been demonstrated to have infinite impacts on soundscapes (Kang, 2004).

Water is an essential part of the sound and sound levels for the living area. It may create a great variety of sounds. The location and the flow affect the water sounds. For the planning scale water components might be introduced from larger perspectives. The large site might have water sounds with water flowing through a rainwater management (Lonngren, 2001). In these sites, water shows the site plastics and seasonal changes. On the other hand, these water features should be created appropriately. The first reason is that water tables or waterways underground might be dry or diminish, and the efforts of creating the water sound would be unsuccessful. So, the water sources should be used economically and wisely. Another reason is the source or main branch of the water stream should be covered or screened by the landscape elements or site furniture such as bridge if the main part is too noisy.

For the smaller scale, water can be used in either artificial or natural forms. Water fountains draw attention to the current landscape or topography. The fountain makes the area more dynamic with its flowing functions. Marcus and Francis (1998) suggested that designing a fountain in to a major plaza creates a focal point both for eyes and ears. Streaming water might be applied for to mask sound or unwanted sound types such as surrounding speech or traffic. For instance, the water feature in Paley Park in New York City (Hedfords, 2003). For the research sites, a streaming water feature can be used for screening and drawing attention from traffic sounds to the different points on the sites.

On the other hand, water surface is a good reflective element in nature. If a water feature is located near traffic or construction, chaotic or unwanted sounds that consist of the traffic and water mix-up might be heard from a greater distance (Hedfords, 2003). So, while planning and designing the water features of a recreational area, a campus, or any open spaces, reflective function of the water is required to take into account.

5.4.2 Plants

Plants are important components for open spaces. Since each plant has its individual color, texture, form, and shape, designers should place it appropriately. The vegetation might be used for the direction purposes, visual screen purposes, reducing or increasing the sounds in the certain locations, enhancing the quality of the air, and aesthetic intentions (Dober, 2000).

Soundscapes have a strong relationship with the plants and plant design. Sounds in an enclosed area would bring in a sense of calmness, and can create a natural symphony that brings relief to people (Lau et al., 2014). The sounds of plants could be accompanied with the rhythms of wind and rain, birds and small insects that sing in trees, and a fountain that spouts tiny water columns. In addition, the effects of seasonal changes on the plants influence the sound. While deciduous plants have fewer effects on sound levels in the winter, the effects of evergreen plants on sound levels are steady. However, there are many migratory birds and insect species that live on Mississippi State University's Campus, particularly in the summer and fall seasons no matter the vegetation type or profile, that affect the soundscape. Therefore, sounds are enhanced by the wooded and vegetated urban or rural surroundings (Anderson et al., 1983). Since wind blowing trees were one of the most preferred sound sources, it is necessary to address the plants and plant design according to the wind. The branches, leaves, and fruits of the plants are important elements of the wind's sound sources. Broad-leaf trees and conifers are the good example of this. On the other hand, the root and body of the plants should have strong structures in order to resist strong climate conditions such as storms. For instance Pin oak (*Quercus palustris*), Sugar maple (*Acer saccharum*), or Japanese maples (*Acer palmatum*) are highly susceptible to strong winds. So, these types of plants should not be preferred for the wind blowing trees sounds unless they are surrounded by other strong vegetation.

Hence, any planting design should be organized by the shape of different seasons, heights, colors of the different time periods, textures, flowers and fruits of the plants. On the other hand, while designating any plant to any site for a purpose, it is required to know that plant provides another sound source to the site. For instance, a planting design is created for reducing the traffic sounds. While placing a broad-leaf tree for that purpose, the tree can also bring songbirds and insects to the site.

5.4.3 Birds

Birdsongs are one of the most preferred sound sources in the open spaces. Since land use has been changed by the people year by year, it is difficult to create an ideal environment for the birds. The human activities ,such as fragmenting the ecosystems and agricultural initiations, have an adverse effect on the population of the songbirds. Therefore, there is an opposite relationship between songbirds and urbanization. Krause mentioned that accompanying noise might “block” birds calling and if mating calls go unheard, a species could die out (Krause, 1993). According to the research conducted by the Royal Society for the Protection of Birds (RSPB), birds living near roads cannot hear one another which leads to difficulty in learning songs and communicating with potential mates” (Krause, 1993). A variety of birds is confidently related to improved structural complexity (White et al., 2005). Irvine et al. (2009) mentioned that "species-rich bird communities impact directly on the quality of the soundscape in the urban parks, in an effect mediated by vegetation structure." This suggests that design methods for the urban spaces that might affect soundscapes indirectly with its implications on biodiversity. In addition, introducing birds, bats, butterflies, and insects into an urban open spaces ecosystem encourages the wildlife and provides sustainable pest management (Marcus and Francis, 1998).

In order to enhance the number of birds there are some methods. It is necessary to have a better understanding about what birds need and what attractions might be done for the birdsongs as sound sources in the public open spaces. Even though all bird species are not songbirds, their demands are similar. First, they need a shelter or a reproductive place. Each species prefer different types of nesting areas. While most of nature adapted species prefer low-nesting, urban adapted species need to use high-nesting locations (Reale and Blair, 2005). Or, some species are accustomed to living in urban areas with changing their nesting and other characteristics, while some of them are not. So, this alteration causes the changing the vegetation profiles from tall and native trees to short and ornament shrubs in the urban areas (Reale and Blair, 2005). Besides planting design, other elements and structures ,such as vents, niches, chimneys, and rain pipes, also increase the adaptation possibilities. As for the material, artificial materials such as nest boxes or real nesting areas are helpful for the songbirds. Planting design and the plants have effects on the abundance and variety of the birds for the urban areas. So, native design elements are more helpful to attract the songbirds. For bird habitats, either edges or plant layers can be used for those purposes (Kelly, 2012). The campus might be included in edges habitat since the campus has plants, shrubs, and distance between them in order to suggest the area for the birds. In addition, the campus can be included as plant layers habitat as it provides many canopy trees, shrubs, and groundcovers.

The second necessary items are food and water. Food can be provided by two types either artificial or vegetation (Kelly, 2012). The artificial feeding might be a bird feeder that includes eggshells, mealworms, or nectar sweetened foods. Plants also provide a lot of food sources for the birds such as seeds, nuts, fruits, and nectars (Kelly, 2012). Since researchers suggest natural food sources, the importance of the planting design needs to be taken into account. Potable water and bird baths are the necessary components of the birds' water requirement. There are many alternatives for providing the water to birds such as small or large ponds with water plants and animals for the recreation purposes of the sites, birdbaths, water sprinkler or dripper.

5.4.4 Insects

The insect sounds are the only natural sound types that are not preferred by the campus users. Most of the insects that make sounds on the Mississippi State University campus are most likely either crickets, katydids, or cicadas. Crickets and katydids belong to Orthoptera (Walker, 2005). These insects have an antenna that is longer than their body. They create sounds by rubbing their legs or bodies to each other (Walker, 2005). Cicadas are the subcategory of Homoptera that can be distinguished by its members that have opalescent wings over the body (Walker, 2005). Their sounds can be distinguished if the location and the season are considered. Despite the fact that, it is mostly hard to identify; however, in certain conditions, it is possible to define them(Walker, 2005). While crickets produce appropriate frequency bands with clear and low bands, katydid and cicada make unclear and higher frequency bands like murmuring and raspy sounds. In addition, cicadas prefer to live shrubs and trees; they produce the sounds during daylight times. On the other hand, katydids make sounds mostly at nights and they prefer to live forested vegetation. Therefore, crickets call from the ground while katydids and cicadas usually call from higher herbaceous vegetation or trees and shrubs.

As it can be seen from the aforementioned information, water, vegetation, birds, and insects are dependent to each other. While creating a soundscape design for an open space with the landscape elements, it is necessary to take into account that any introduced element has either negative and/or positive effects for the environment. More importantly, human dominance on natural environments has been causing the loss of biodiversity (Chapin et al., 2000; Perrings et al., 2010). The loss of biodiversity is extremely significant since some species might become extinct. With the loss of species, sites lose their natural sounds (Wrightson, 2000). In addition to design and planning approach for the soundscapes, it is also required to educate the site users about importance of the biodiversity. It will result in preservation of the existing natural sounds. In addition, biodiversity that is enhanced by plants, birds, insects, and butterflies is preferred by the people. Increased biodiversity has a positive effect on psychological well-being for the people. Thus, there is a strong connection between biodiversity, human well-being, and urban open spaces (Fuller et al., 2007). Open spaces should provide habitats for diverse species. Vegetation and wildlife such as birds, bats, and butterflies would help to reduce the effects of monotonous artificial sounds (Irvine et al., 2009).

5.4.5 Conclusion

The research illustrates soundscape evaluation in the open space and the preferences of the campus users. Sound is one of the major elements in the environment and it is an inevitable source unlike sight or touch senses. So, while creating the important relaxation area, sound is a factor that needs to be considered as a source rather than a problem. In addition, demographic characteristics are essential factors for the urban open space design and planning since different socio-demographic features might have different preferences on acoustic comfort. Thus, this research draws attention to the soundscapes on the campus as an open space through the contributions with the demographic features. As a result, examining the preferences of the users and design perspectives on soundscape might provide a connection with the landscape architecture field since the main goal of this research is to contribute to the development of the landscape architecture field.

Since the research sample is not large, it is required to examine a larger sample with different sites. So, the greater samples and variables, the more accurate research in this mix-type methods of study. Furthermore, the campus users might be encouraged to talk more and elaborate about their ideas on sounds apart from the questionnaire.

Moreover, soundscape research might be conducted with professionals such as urban planners, architects, landscape architects, acousticians, policy makers, and so on. The aim would be to investigate the different perspectives of the different professions on soundscape. There are recently increasing efforts to of integrate soundscapes into different disciplines. So, soundscape analysis can be a guideline for design and planning fields. As Brown et al. (2011) suggest, soundscape studies could be used to create standardizations included methodology, questionnaire protocols, description of sounds, and different perceptual dimensions of the soundscape.

The soundscapes of the open spaces are affected by the users' activities and the physical conditions of the environment. So, the main limitation of this study is that the sites could not be analyzed year round. Therefore, the investigation about seasonal effects on the sounds could not have taken place in the research. In addition, the sample size would be larger for the study. A larger sample could suggest different results for the study. Last, the research sites were selected by the number of the site users. For this research, each sound sources might be examined separately, and their effects on soundscape might be claimed. In addition, other sites that have different functions on the campus would be selected for the further analysis.

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APPENDIX A

PARTICIPANT RECRUITMENT SCRIPT

Dear (person),

I am a graduate student at the Department of Landscape Architecture and seek to recruit volunteers to be a part of my thesis study. I am looking to figure out that the relation between human and environment through sound. Therefore, I am requesting person as a campus user to make an evaluation about sound features in the selected locations of the campus. If you are willing to be a part of my research, I can provide the questionnaire that takes a couple minutes to fill out consists of six pages. The questionnaire includes three main parts that are your personal information, usage of campus, and sound environment evaluation.

Should you have any detailed request about the research, I can present more information about it. All information that you contribute for this research will be placed rigorously private since these information can be accessed only by me and my thesis committee. On the other hand, it is requested for you that the reports that are about this research may be held by the state; hence, these information subject to declaration if the information are need. The information of this study could be allocated with the Mississippi State University Institutional Review Board (IRB).

Thank you for taking part,

Yalcin Yildirim
Graduate Student
Department of Landscape Architecture
Mississippi State University, MS 39762
Phone: 662-694-1728
e-mail: yy214@msstate.edu

APPENDIX B

COVER LETTER FOR THE INTERVIEWEE

MISSISSIPPI STATE UNIVERSITY

DEPARTMENT OF LANDSCAPE ARCHITECTURE

Dear participant,

I appreciate for your taking part of my study that is the last requirement for the graduation degree. I am studying for the relation about sound and acoustic between human and environment. The conclusion of this research may be a tool for the architects, urban and city planners, and landscape architects who are shaping and creating the outdoor areas.

Your contribution is extremely precious and valuable in order to create a sustainable and attractive open space. While you are completing the questionnaire, the sound level will be measured and recorded by the equipment. The questionnaire is 6 pages long and it will take 5-10 minutes. The questionnaire consists of three main categories that are personal information, your behavior on the campus, and the evaluation of sound environment.

The following page is consent information form that is required by the university and Institutional Review Board (IRB) since this thesis is university-related study. Since this research is anonymous-based, I will not request your name, contact information, or signature in any page.

Should you have any questions or concerns about the research, do not hesitate to contact me by e-mail or phone.

Thank you many for participating this research.

Yalcin Yildirim
Graduate Student
Department of Landscape Architecture
Mississippi State University, MS 39762
Phone: 662-694-1728
e-mail: yy214@msstate.edu

APPENDIX C

CONSENT INFORM FORM

Mississippi State University

Informed Consent Form for Participation in Research

Title of Research Study: Soundscape perception and evaluation on Mississippi State University

Study Site: MSU Campus (Mitchell Memorial Library, Colvard Student Union, Bell Tower, Sanderson Center)

Researchers: Yalcin Yildirim, Mississippi State University

We would like to ask you to participate in a research study.

The research is about soundscape perception and evaluation in the Mississippi State University Campus. So, the aim of this study is to acquire and define particpants' perception about the sound. Moreover, this study is seeking to understand what the people' perception and the environment.

Questions

If you have any questions about this research project, please feel free to contact Yalcin Yildirim at 662-694-1728.

Advisor: Dr. Chuo Li (cl1004@msstate.edu)

Voluntary Participation

Please understand that your **participation is voluntary.** Your **refusal to participate will involve no penalty or loss** of benefits to which you are otherwise entitled. You **may discontinue your participation** at any time without penalty or loss of benefits.

Please take all the time you need to read through this document and decide whether you would like to participate in this research study.

If you decide to participate, your completion of the research procedures indicates your consent. Please keep this form for your records.

APPENDIX D

QUESTIONNAIRE

QUESTIONNAIRE

Date:	
Time:	
Location:	

PART I: Personal Information

What is your age?			
	18-22		43-47
	23-27		48-52
	28-32		53-57
	33-37		Above 58
	38-42		

What is your gender?					
	Female		Male		Refuse

What is your occupation?			
	Faculty member		Sales worker
	Student		Retired
	Manager		University Staff
	Service worker		Others

Where did you grow up?							
	Urban area		Sub-urban		Rural		Other

What is the highest degree or level of school you have completed?			
	primary school or below		bachelor's degree
	secondary school		graduate degree
	high school		

PART II: Acoustic Environment Evaluation

Please list the sorts of sounds that you have heard, here. Please use the number between 1 and 5 to indicate how strongly you like or dislike it. (1 for strongly dislike and 5 for strongly like it)					
Sound source	1	2	3	4	5
	Dislike most	Dislike	Neutral	Like	Like most
a.					
b.					
c.					
d.					
e.					
f.					

Among the sounds that you mentioned above,
a) The most favorable sounds;

____

b) The most unfavorable sounds;

____

Besides the sounds you heard, being within the area, what are you
c) Most willing to hear;

____

d) Most unwilling to hear;

____

	What if you heard the following sounds in this location?						
	Sound source		1	2	3	4	5
			Dislike most	Dislike	Neutral	Like	Like most
Natural		Bird					
		Insect					
		Wind blowing trees					
		Sound of water					
Artificial		Church bell					
		Construction sound					
		Surrounding speech					
		Chatting & shouting					
		Footsteps					

APPENDIX E

TIMELINES AND SOUND LEVELS OF THE SITE MEASUREMENTS

	19 July Saturday / Mitchell Memorial Library				21 July Monday / Colvard Student Union				23 July Wednesday / Bell Tower				25 July Friday / Sanderson Center			
8:00 AM	8:05	57,4	8:35	59,8	8:05	57,2	8:35	59,0	8:05	57,4	8:35	53,7	8:05	51,2	8:35	57,3
	8:10	53,9	8:40	58,6	8:10	58,1	8:40	57,1	8:10	53,9	8:40	52,6	8:10	48,1	8:40	48,1
	8:15	56,2	8:45	55,5	8:15	56,5	8:45	56,3	8:15	52,6	8:45	60,3	8:15	46,7	8:45	47,6
	8:20	52,5	8:50	57,2	8:20	60,1	8:50	54,4	8:20	56,5	8:50	53,4	8:20	52,3	8:50	43,4
	8:25	60,1	8:55	61,2	8:25	62,3	8:55	55,8	8:25	49,1	8:55	55,1	8:25	51,4	8:55	47,0
	8:30	62,3	9:00	59,4	8:30	67,0	9:00	58,1	8:30	55,3	9:00	52,0	8:30	50,9	9:00	51,2
Noon	12:05	54,2	12:35	61,9	12:05	60,2	12:35	57,4	12:05	57,7	12:35	57,6	12:05	51,3	12:35	49,7
	12:10	56,1	12:40	60,5	12:10	58,3	12:40	58,6	12:10	53,1	12:40	53,4	12:10	48,5	12:40	50,4
	12:15	60,2	12:45	62,7	12:15	56,7	12:45	56,5	12:15	56,2	12:45	55,8	12:15	47,2	12:45	49,8
	12:20	59,7	12:50	58,1	12:20	54,1	12:50	61,4	12:20	59,3	12:50	57,0	12:20	48,1	12:50	51,9
	12:25	58,6	12:55	57,6	12:25	59,9	12:55	59,2	12:25	62,7	12:55	59,2	12:25	49,5	12:55	50,6
	12:30	59,4	1:00	56,5	12:30	61,3	1:00	58,6	12:30	51,9	1:00	58,7	12:30	51,9	1:00	48,5
4:00 PM	4:05	55,1	4:35	54,2	4:05	49,7	4:35	49,2	4:05	52,7	4:35	56,4	4:05	50,2	4:35	52,6
	4:10	51,9	4:40	53,8	4:10	48,2	4:40	51,7	4:10	53,5	4:40	53,6	4:10	51,3	4:40	51,8
	4:15	54,2	4:45	51,4	4:15	49,3	4:45	52,5	4:15	50,4	4:45	50,1	4:15	49,5	4:45	49,7
	4:20	53,7	4:50	57,6	4:20	51,2	4:50	50,6	4:20	51,2	4:50	48,6	4:20	48,7	4:50	48,5
	4:25	52,8	4:55	52,8	4:25	53,4	4:55	51,2	4:25	56,8	4:55	52,4	4:25	52,1	4:55	50,2
	4:30	54,0	5:00	56,0	4:30	50,9	5:00	50,9	4:30	52,1	5:00	53,0	4:30	51,9	5:00	51,6
8:00 PM	8:05	56,3	8:35	53,6	8:05	58,3	8:35	57,8	8:05	52,9	8:35	64,3	8:05	46,1	8:35	51,2
	8:10	57,2	8:40	51,2	8:10	52,4	8:40	56,5	8:10	57,6	8:40	57,1	8:10	48,3	8:40	50,6
	8:15	54,1	8:45	56,9	8:15	51,9	8:45	54,2	8:15	52,5	8:45	66,2	8:15	51,2	8:45	52,9
	8:20	55,5	8:50	57,2	8:20	59,5	8:50	57,1	8:20	62,8	8:50	58,2	8:20	52,5	8:50	53,4
	8:25	56,2	8:55	63,5	8:25	58,3	8:55	53,5	8:25	61,6	8:55	54,3	8:25	50,2	8:55	54,0
	8:30	59,9	9:00	51,8	8:30	52,6	9:00	56,4	8:30	62,4	9:00	49,7	8:30	48,9	9:00	51,4

	27 July Sunday / Mitchell Memorial Library				29 July Tuesday / Colvard Student Union				31 July Thursday / Bell Tower				2 August Saturday / Sanderson Center			
8:00 AM	8:05	58,1	8:35	59,9	8:05	56,6	8:35	56,9	8:05	53,9	8:35	52,6	8:05	46,3	8:35	51,2
	8:10	57,3	8:40	61,2	8:10	59,9	8:40	58,8	8:10	54,7	8:40	51,7	8:10	44,2	8:40	49,3
	8:15	59,2	8:45	57,3	8:15	62,8	8:45	55,1	8:15	51,3	8:45	49,3	8:15	47,1	8:45	47,6
	8:20	56,5	8:50	59,2	8:20	61,6	8:50	53,2	8:20	52,6	8:50	58,6	8:20	49,9	8:50	49,4
	8:25	54,9	8:55	57,9	8:25	60,3	8:55	54,8	8:25	49,2	8:55	51,3	8:25	47,2	8:55	50,1
	8:30	56,4	9:00	58,8	8:30	52,4	9:00	54,1	8:30	54,9	9:00	50,2	8:30	49,3	9:00	52,3
Noon	12:05	54,2	12:35	56,3	12:05	59,6	12:35	56,3	12:05	54,6	12:35	51,7	12:05	49,2	12:35	48,4
	12:10	53,7	12:40	53,4	12:10	57,1	12:40	57,2	12:10	52,5	12:40	52,3	12:10	47,1	12:40	51,3
	12:15	54,2	12:45	52,9	12:15	56,7	12:45	59,1	12:15	53,1	12:45	53,9	12:15	46,0	12:45	46,5
	12:20	53,8	12:50	56,6	12:20	55,3	12:50	56,9	12:20	54,5	12:50	59,4	12:20	49,3	12:50	52,6
	12:25	52,7	12:55	57,2	12:25	60,1	12:55	61,4	12:25	49,2	12:55	58,5	12:25	48,1	12:55	51,7
	12:30	50,9	1:00	59,5	12:30	58,8	1:00	62,5	12:30	50,5	1:00	51,8	12:30	52,6	1:00	49,8
4:00 PM	4:05	54,4	4:35	53,1	4:05	48,5	4:35	60,2	4:05	49,2	4:35	57,2	4:05	48,1	4:35	48,3
	4:10	52,1	4:40	52,9	4:10	47,2	4:40	51,3	4:10	47,6	4:40	51,9	4:10	51,2	4:40	49,6
	4:15	53,6	4:45	50,5	4:15	46,9	4:45	54,7	4:15	51,3	4:45	49,3	4:15	50,8	4:45	50,7
	4:20	52,8	4:50	52,1	4:20	51,3	4:50	49,3	4:20	52,4	4:50	48,4	4:20	51,7	4:50	48,2
	4:25	51,2	4:55	51,8	4:25	52,6	4:55	48,9	4:25	51,9	4:55	51,8	4:25	50,2	4:55	51,1
	4:30	53,9	5:00	54,0	4:30	53,0	5:00	51,1	4:30	52,5	5:00	52,6	4:30	49,6	5:00	48,8
8:00 PM	8:05	54,1	8:35	52,7	8:05	57,2	8:35	58,1	8:05	57,2	8:35	66,1	8:05	47,4	8:35	48,1
	8:10	52,9	8:40	54,4	8:10	51,3	8:40	57,6	8:10	53,5	8:40	58,3	8:10	45,8	8:40	52,3
	8:15	54,3	8:45	52,8	8:15	54,8	8:45	53,9	8:15	58,1	8:45	49,9	8:15	47,1	8:45	51,4
	8:20	55,1	8:50	57,7	8:20	55,6	8:50	58,0	8:20	57,6	8:50	47,7	8:20	46,5	8:50	50,5
	8:25	53,4	8:55	59,6	8:25	52,9	8:55	52,2	8:25	59,0	8:55	49,8	8:25	49,0	8:55	49,7
	8:30	57,8	9:00	52,3	8:30	57,7	9:00	55,6	8:30	62,9	9:00	52,6	8:30	51,2	9:00	51,2

	4 August Monday / Mitchell Memorial Library				6 August Wednesday / Colvard Student Union				8 August Friday / Bell Tower				10 August Sunday / Sanderson Center			
8:00 AM	8:05	56,9	8:35	58,2	8:05	57,7	8:35	57,7	8:05	51,5	8:35	50,5	8:05	49,1	8:35	50,2
	8:10	54,5	8:40	57,1	8:10	60,9	8:40	58,8	8:10	52,6	8:40	51,3	8:10	46,2	8:40	49,3
	8:15	57,2	8:45	59,3	8:15	61,1	8:45	51,3	8:15	54,3	8:45	49,2	8:15	47,6	8:45	51,6
	8:20	56,1	8:50	61,2	8:20	50,2	8:50	52,1	8:20	53,5	8:50	48,1	8:20	50,3	8:50	49,5
	8:25	54,4	8:55	59,7	8:25	52,8	8:55	53,7	8:25	49,7	8:55	47,6	8:25	51,6	8:55	51,3
	8:30	56,5	9:00	60,2	8:30	50,3	9:00	51,8	8:30	51,2	9:00	49,5	8:30	49,5	9:00	48,0
Noon	12:05	53,1	12:35	55,1	12:05	56,5	12:35	55,2	12:05	54,8	12:35	52,4	12:05	47,1	12:35	48,9
	12:10	52,8	12:40	52,6	12:10	57,2	12:40	57,9	12:10	52,2	12:40	53,1	12:10	47,4	12:40	50,2
	12:15	53,9	12:45	53,7	12:15	59,1	12:45	58,1	12:15	51,4	12:45	54,2	12:15	48,3	12:45	47,3
	12:20	54,2	12:50	52,9	12:20	61,2	12:50	60,3	12:20	50,3	12:50	58,5	12:20	48,7	12:50	48,9
	12:25	53,9	12:55	53,1	12:25	60,4	12:55	59,9	12:25	49,7	12:55	61,4	12:25	49,1	12:55	50,1
	12:30	51,8	1:00	51,8	12:30	59,7	1:00	58,4	12:30	51,3	1:00	52,6	12:30	48,5	1:00	49,3
4:00 PM	4:05	54,5	4:35	53,9	4:05	47,4	4:35	51,2	4:05	50,2	4:35	57,3	4:05	46,5	4:35	48,3
	4:10	53,4	4:40	54,3	4:10	50,1	4:40	48,4	4:10	51,7	4:40	52,5	4:10	50,2	4:40	47,2
	4:15	54,2	4:45	53,8	4:15	52,3	4:45	46,1	4:15	49,5	4:45	49,7	4:15	47,3	4:45	48,4
	4:20	55,1	4:50	56,7	4:20	48,4	4:50	49,9	4:20	50,7	4:50	48,9	4:20	47,0	4:50	50,0
	4:25	56,7	4:55	55,9	4:25	49,2	4:55	52,7	4:25	51,9	4:55	51,2	4:25	48,8	4:55	48,7
	4:30	54,3	5:00	54,6	4:30	50,9	5:00	54,6	4:30	53,8	5:00	52,6	4:30	52,9	5:00	49,4
8:00 PM	8:05	52,7	8:35	53,5	8:05	56,1	8:35	58,6	8:05	56,2	8:35	57,6	8:05	47,2	8:35	49,1
	8:10	54,1	8:40	52,9	8:10	50,4	8:40	57,5	8:10	53,4	8:40	58,1	8:10	46,8	8:40	48,7
	8:15	52,6	8:45	55,4	8:15	49,3	8:45	54,8	8:15	51,9	8:45	58,0	8:15	47,9	8:45	52,6
	8:20	53,1	8:50	52,1	8:20	51,5	8:50	56,2	8:20	60,6	8:50	57,5	8:20	50,2	8:50	51,3
	8:25	54,2	8:55	49,1	8:25	53,9	8:55	51,3	8:25	59,5	8:55	56,3	8:25	49,3	8:55	49,5
	8:30	51,9	9:00	47,8	8:30	49,2	9:00	54,9	8:30	58,1	9:00	58,1	8:30	48,7	9:00	50,6

	12 August Tuesday / Mitchell Memorial Library				14 August Thursday / Colvard Student Union				16 August Saturday / Bell Tower				18 August Monday / Sanderson Center			
8:00 AM	8:05	64,1	8:35	55,7	8:05	56,9	8:35	58,8	8:05	52,1	8:35	52,7	8:05	47,2	8:35	49,1
	8:10	62,3	8:40	57,8	8:10	59,2	8:40	57,2	8:10	53,4	8:40	51,8	8:10	43,1	8:40	48,3
	8:15	54,7	8:45	54,1	8:15	60,1	8:45	50,1	8:15	49,9	8:45	50,5	8:15	46,0	8:45	46,4
	8:20	59,3	8:50	59,2	8:20	52,3	8:50	51,7	8:20	52,6	8:50	49,8	8:20	45,5	8:50	45,1
	8:25	61,4	8:55	58,6	8:25	53,7	8:55	52,0	8:25	49,7	8:55	50,6	8:25	48,8	8:55	46,2
	8:30	53,0	9:00	60,1	8:30	50,9	9:00	52,8	8:30	56,8	9:00	51,2	8:30	50,1	9:00	46,9
Noon	12:05	52,9	12:35	54,4	12:05	62,1	12:35	68,4	12:05	53,7	12:35	51,9	12:05	47,4	12:35	49,5
	12:10	52,7	12:40	53,6	12:10	57,8	12:40	57,3	12:10	51,1	12:40	52,0	12:10	48,6	12:40	48,7
	12:15	54,1	12:45	51,9	12:15	59,6	12:45	64,1	12:15	52,3	12:45	53,1	12:15	47,7	12:45	47,6
	12:20	52,8	12:50	52,7	12:20	63,7	12:50	62,8	12:20	51,4	12:50	59,3	12:20	48,0	12:50	48,9
	12:25	51,9	12:55	53,5	12:25	61,4	12:55	66,1	12:25	50,2	12:55	60,9	12:25	48,6	12:55	50,4
	12:30	53,2	1:00	52,9	12:30	71,3	1:00	62,9	12:30	49,8	1:00	52,4	12:30	49,2	1:00	48,9
4:00 PM	4:05	53,5	4:35	53,7	4:05	46,7	4:35	59,3	4:05	47,3	4:35	58,1	4:05	47,2	4:35	47,6
	4:10	52,7	4:40	51,8	4:10	49,3	4:40	53,1	4:10	49,1	4:40	58,5	4:10	49,3	4:40	48,5
	4:15	51,8	4:45	50,9	4:15	48,2	4:45	47,2	4:15	48,2	4:45	48,6	4:15	48,1	4:45	51,3
	4:20	51,9	4:50	52,3	4:20	47,6	4:50	46,4	4:20	50,4	4:50	47,6	4:20	47,6	4:50	49,2
	4:25	52,1	4:55	51,6	4:25	50,5	4:55	51,2	4:25	51,2	4:55	50,2	4:25	48,2	4:55	50,3
	4:30	52,5	5:00	52,0	4:30	53,4	5:00	58,1	4:30	52,4	5:00	51,3	4:30	51,6	5:00	47,9
8:00 PM	8:05	54,4	8:35	53,8	8:05	55,6	8:35	59,8	8:05	54,6	8:35	70,6	8:05	44,1	8:35	55,0
	8:10	53,2	8:40	54,1	8:10	53,2	8:40	56,3	8:10	51,4	8:40	49,4	8:10	50,2	8:40	46,8
	8:15	54,1	8:45	54,9	8:15	49,5	8:45	52,1	8:15	56,3	8:45	47,5	8:15	44,9	8:45	47,3
	8:20	56,3	8:50	53,4	8:20	48,2	8:50	55,2	8:20	58,2	8:50	50,9	8:20	51,8	8:50	44,6
	8:25	55,7	8:55	56,2	8:25	50,5	8:55	49,7	8:25	63,1	8:55	53,4	8:25	49,5	8:55	47,3
	8:30	56,6	9:00	55,1	8:30	52,7	9:00	52,6	8:30	69,3	9:00	48,1	8:30	53,9	9:00	49,6

	20 August Wednesday / Mitchell Memorial Library				21 August Thursday / Colvard Student Union				22 August Friday / Bell Tower				23 August Saturday / Sanderson Center			
8:00 AM	8:05	58,1	8:35	53,1	8:05	59,7	8:35	62,6	8:05	58,6	8:35	61,4	8:05	52,1	8:35	53,1
	8:10	56,7	8:40	54,9	8:10	60,2	8:40	61,4	8:10	59,1	8:40	57,6	8:10	53,3	8:40	52,6
	8:15	55,4	8:45	53,7	8:15	61,3	8:45	61,7	8:15	60,3	8:45	56,8	8:15	54,0	8:45	53,8
	8:20	52,6	8:50	53,5	8:20	58,6	8:50	59,6	8:20	61,5	8:50	57,5	8:20	52,5	8:50	53,0
	8:25	51,9	8:55	54,2	8:25	59,2	8:55	58,7	8:25	60,9	8:55	56,1	8:25	53,7	8:55	51,7
	8:30	52,5	9:00	57,1	8:30	60,1	9:00	59,5	8:30	62,0	9:00	57,3	8:30	52,9	9:00	52,8
Noon	12:05	63,4	12:35	62,9	12:05	73,1	12:35	53,6	12:05	69,2	12:35	58,7	12:05	54,0	12:35	53,6
	12:10	66,7	12:40	57,6	12:10	65,2	12:40	59,4	12:10	64,0	12:40	57,6	12:10	54,8	12:40	54,1
	12:15	59,3	12:45	53,4	12:15	63,3	12:45	56,7	12:15	63,5	12:45	55,1	12:15	53,7	12:45	52,7
	12:20	57,6	12:50	64,1	12:20	61,7	12:50	64,3	12:20	62,8	12:50	56,4	12:20	53,5	12:50	53,4
	12:25	63,5	12:55	53,0	12:25	59,8	12:55	49,5	12:25	63,7	12:55	55,8	12:25	55,2	12:55	54,5
	12:30	61,4	1:00	57,2	12:30	56,7	1:00	56,0	12:30	60,1	1:00	54,0	12:30	54,9	1:00	53,2
4:00 PM	4:05	54,6	4:35	56,4	4:05	53,1	4:35	48,5	4:05	53,0	4:35	46,3	4:05	52,1	4:35	51,1
	4:10	55,1	4:40	52,0	4:10	51,9	4:40	49,2	4:10	52,8	4:40	48,7	4:10	53,0	4:40	50,4
	4:15	53,9	4:45	53,1	4:15	50,6	4:45	49,9	4:15	51,5	4:45	49,1	4:15	52,5	4:45	50,3
	4:20	53,8	4:50	54,5	4:20	48,8	4:50	51,3	4:20	50,6	4:50	50,6	4:20	51,8	4:50	58,6
	4:25	57,3	4:55	53,7	4:25	54,6	4:55	48,7	4:25	51,2	4:55	47,3	4:25	51,7	4:55	49,2
	4:30	59,7	5:00	51,1	4:30	49,7	5:00	51,5	4:30	49,0	5:00	50,5	4:30	52,3	5:00	47,5
8:00 PM	8:05	53,3	8:35	54,6	8:05	51,2	8:35	49,5	8:05	51,5	8:35	52,0	8:05	49,1	8:35	48,5
	8:10	52,7	8:40	55,1	8:10	52,7	8:40	50,3	8:10	52,0	8:40	51,4	8:10	48,6	8:40	49,2
	8:15	54,9	8:45	54,3	8:15	49,3	8:45	51,7	8:15	50,6	8:45	50,9	8:15	48,7	8:45	48,4
	8:20	51,6	8:50	49,7	8:20	48,6	8:50	52,5	8:20	49,3	8:50	49,2	8:20	47,6	8:50	47,8
	8:25	53,8	8:55	50,2	8:25	52,2	8:55	50,8	8:25	50,1	8:55	48,8	8:25	47,9	8:55	48,2
	8:30	55,2	9:00	48,6	8:30	51,7	9:00	49,7	8:30	51,4	9:00	48,2	8:30	48,3	9:00	49,7

	24 August Sunday / Mitchell Memorial Library				25 August Monday / Colvard Student Union				26 August Tuesday / Bell Tower				27 August Wednesday / Sanderson Center			
8:00 AM	8:05	52,5	8:35	56,4	8:05	60,2	8:35	60,2	8:05	59,2	8:35	53,2	8:05	50,5	8:35	52,6
	8:10	58,3	8:40	55,7	8:10	61,3	8:40	59,7	8:10	61,3	8:40	55,6	8:10	51,2	8:40	53,3
	8:15	53,6	8:45	53,9	8:15	59,6	8:45	60,3	8:15	57,8	8:45	56,4	8:15	51,9	8:45	51,7
	8:20	57,1	8:50	52,1	8:20	61,2	8:50	61,5	8:20	60,4	8:50	64,5	8:20	50,2	8:50	50,9
	8:25	56,5	8:55	54,0	8:25	58,7	8:55	60,6	8:25	59,5	8:55	63,1	8:25	52,5	8:55	52,6
	8:30	55,1	9:00	53,7	8:30	59,5	9:00	63,9	8:30	54,7	9:00	59,7	8:30	51,4	9:00	51,9
Noon	12:05	56,3	12:35	52,7	12:05	68,9	12:35	71,7	12:05	66,1	12:35	58,6	12:05	51,6	12:35	51,8
	12:10	55,1	12:40	53,1	12:10	66,6	12:40	69,2	12:10	65,2	12:40	47,9	12:10	52,8	12:40	49,7
	12:15	54,2	12:45	52,5	12:15	71,2	12:45	68,5	12:15	63,3	12:45	59,5	12:15	53,9	12:45	46,3
	12:20	53,8	12:50	54,3	12:20	69,7	12:50	67,3	12:20	62,3	12:50	58,7	12:20	52,5	12:50	47,4
	12:25	54,5	12:55	55,0	12:25	68,8	12:55	68,7	12:25	64,0	12:55	59,3	12:25	51,7	12:55	48,5
	12:30	56,0	1:00	51,8	12:30	70,2	1:00	70,8	12:30	61,2	1:00	60,1	12:30	52,4	1:00	48,8
4:00 PM	4:05	54,3	4:35	61,1	4:05	57,1	4:35	48,6	4:05	54,3	4:35	54,7	4:05	51,2	4:35	52,6
	4:10	54,1	4:40	63,9	4:10	54,6	4:40	49,7	4:10	55,1	4:40	51,2	4:10	52,0	4:40	49,3
	4:15	53,8	4:45	59,2	4:15	53,5	4:45	52,5	4:15	53,7	4:45	50,3	4:15	51,8	4:45	47,6
	4:20	55,6	4:50	57,8	4:20	53,0	4:50	49,8	4:20	54,6	4:50	49,2	4:20	52,3	4:50	48,4
	4:25	56,1	4:55	59,1	4:25	54,2	4:55	56,5	4:25	58,2	4:55	48,6	4:25	51,5	4:55	48,7
	4:30	58,7	5:00	59,9	4:30	54,7	5:00	54,2	4:30	53,5	5:00	47,0	4:30	51,9	5:00	49,4
8:00 PM	8:05	54,8	8:35	55,3	8:05	56,1	8:35	55,1	8:05	51,2	8:35	49,5	8:05	48,8	8:35	46,5
	8:10	53,6	8:40	53,1	8:10	55,8	8:40	54,9	8:10	52,6	8:40	48,6	8:10	49,5	8:40	48,2
	8:15	55,1	8:45	49,7	8:15	59,3	8:45	56,0	8:15	53,8	8:45	48,3	8:15	49,1	8:45	49,3
	8:20	56,2	8:50	49,0	8:20	54,2	8:50	54,7	8:20	51,4	8:50	49,0	8:20	48,6	8:50	48,8
	8:25	53,9	8:55	48,9	8:25	54,0	8:55	53,2	8:25	52,7	8:55	49,5	8:25	47,9	8:55	48,4
	8:30	54,0	9:00	48,2	8:30	53,8	9:00	54,4	8:30	50,1	9:00	53,1	8:30	48,6	9:00	49,1

	28 August Thursday / Mitchell Memorial Library				29 August Friday / Colvard Student Union				30 August Saturday / Bell Tower				31 August Sunday / Sanderson Center			
8:00 AM	8:05	53,2	8:35	53,7	8:05	52,5	8:35	50,2	8:05	59,3	8:35	61,3	8:05	48,2	8:35	49,2
	8:10	54,1	8:40	54,1	8:10	53,1	8:40	51,5	8:10	58,5	8:40	60,9	8:10	48,9	8:40	48,7
	8:15	54,5	8:45	55,8	8:15	54,0	8:45	50,7	8:15	59,2	8:45	60,2	8:15	49,1	8:45	49,3
	8:20	55,0	8:50	56,9	8:20	49,8	8:50	52,6	8:20	60,0	8:50	68,8	8:20	49,5	8:50	50,8
	8:25	54,4	8:55	58,3	8:25	51,2	8:55	51,3	8:25	61,4	8:55	59,7	8:25	50,4	8:55	49,1
	8:30	54,8	9:00	60,2	8:30	49,7	9:00	49,5	8:30	60,5	9:00	61,3	8:30	51,0	9:00	51,2
Noon	12:05	58,8	12:35	61,5	12:05	56,1	12:35	57,6	12:05	75,2	12:35	77,3	12:05	51,3	12:35	52,7
	12:10	53,7	12:40	56,3	12:10	55,0	12:40	60,3	12:10	74,9	12:40	78,8	12:10	52,5	12:40	52,3
	12:15	54,6	12:45	55,4	12:15	54,7	12:45	61,3	12:15	75,1	12:45	79,6	12:15	52,7	12:45	53,9
	12:20	53,5	12:50	53,7	12:20	53,8	12:50	58,4	12:20	77,0	12:50	76,5	12:20	53,0	12:50	53,4
	12:25	57,3	12:55	57,0	12:25	56,9	12:55	56,5	12:25	76,3	12:55	73,3	12:25	52,5	12:55	52,6
	12:30	62,2	1:00	56,8	12:30	52,5	1:00	52,7	12:30	78,4	1:00	75,2	12:30	53,1	1:00	54,0
4:00 PM	4:05	56,7	4:35	56,9	4:05	48,5	4:35	53,5	4:05	79,5	4:35	78,1	4:05	51,0	4:35	51,4
	4:10	57,0	4:40	55,1	4:10	47,9	4:40	58,9	4:10	78,6	4:40	79,3	4:10	49,5	4:40	49,8
	4:15	55,5	4:45	53,7	4:15	49,6	4:45	62,1	4:15	73,4	4:45	78,5	4:15	49,8	4:45	49,0
	4:20	56,3	4:50	54,0	4:20	51,7	4:50	48,2	4:20	77,7	4:50	78,0	4:20	50,6	4:50	50,2
	4:25	53,2	4:55	58,2	4:25	55,0	4:55	47,7	4:25	78,4	4:55	78,6	4:25	51,3	4:55	51,3
	4:30	57,5	5:00	59,6	4:30	53,7	5:00	49,8	4:30	74,9	5:00	79,2	4:30	50,6	5:00	50,7
8:00 PM	8:05	53,2	8:35	54,2	8:05	55,3	8:35	56,0	8:05	80,3	8:35	80,5	8:05	48,5	8:35	48,0
	8:10	52,8	8:40	54,0	8:10	54,2	8:40	57,1	8:10	81,4	8:40	81,3	8:10	49,0	8:40	49,1
	8:15	53,7	8:45	55,3	8:15	56,5	8:45	56,4	8:15	79,6	8:45	82,9	8:15	47,1	8:45	47,7
	8:20	53,2	8:50	58,1	8:20	55,7	8:50	55,8	8:20	82,0	8:50	80,4	8:20	47,2	8:50	48,2
	8:25	51,0	8:55	56,6	8:25	57,9	8:55	57,5	8:25	79,5	8:55	79,6	8:25	48,8	8:55	47,5
	8:30	54,9	9:00	59,0	8:30	54,4	9:00	58,2	8:30	78,8	9:00	80,2	8:30	47,9	9:00	47,2