Soundscapes of Public Places: Towards an Understanding of Wholeness

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THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

Soundscapes of Urban Spaces: Towards an Understanding of Wholeness

A PROFESSIONAL PROJECT

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

MASTER OF URBAN DESIGN

By
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Norman, Oklahoma
2019

Soundscapes of Urban Spaces: Towards an Understanding of Wholeness

A PROFESSIONAL PROJECT APPROVED FOR THE

URBAN DESIGN STUDIO

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Introduction

This project's primary goal is to understand sound & its relationship to the experience of urban spaces. Humans live in a vison dominant world. In design, little consideration is given to the sound of places & how we can potentially design to highlight positive sounds, or minimize negative.

I am interested in the idea that places and environments can add to our overall well-being in a positive way. Many researchers in fields such as, environmental psychology, urban planning and design have found that places can be a therapeutic, restorative experience (Gunnar 2016, Kaplan, 1998 Marcus, 1999). While humans continue to urbanize and lead increasingly stressful lives, it will become even more important to consider ways of implementing well-being and health in public spaces.

Noise can be a major contributor to stress. Long exposure to noise can create long term effects on health. Some places can be characterized by their noise. Loud construction, honking cars, aircraft noise, loud music can all be categorized as contributing to the noise of the city. Preference to sound is subjective so while many enjoy the noise of the city, long exposure can be detrimental to health and well-being and though many noises heard in urban places are not at volumes to cause damage to health, they are nonetheless apart of that place. Positive sound design is not typically a consideration in the planning of public places so what is left are generated sounds that may not be adding positive value to that place.

This projects attempts to understand the elements that characteristics of positive and negative soundscapes by researching, recording, and developing a framework to understand the qualities of each sound. If it is possible to understand which sounds are considered positive and negative then can certain sounds be added to a place in order to contribute to a more positive and enjoyable soundscape.

In order to test this, two different groups of individuals were asked to participate in a sound walk in downtown Tulsa. The first group acted as the control group and were asked to evaluate different naturally occurring soundscapes at different sites during the walk. A second group was brought through but they were exposed to a change at a site which was predicted to have a low preference rating. Sounds of bird calls, water and musical notes were added through the use of a hidden speaker system.

Literature Review

"With rapid urbanization and overcrowding, the high stress and rapid pace of city life has caused mental and physical exhaustion of the urban residents, which requires restoration." Zhang et. al, 2017

One of the primary research questions is to find out which environmental sounds are considered positive and which ones would be considered negative. A positive sound being one that is generally preferred by most people. A negative sound being one that is generally disliked. This question came from contemplating the large spectrum that sound operates in. Music (depending on who is listening) is enjoyed and able to create an emotional response. Natural sounds can be soothing and relaxing, while noise, defined as unwanted sound can be extremely irritating and cause harm both physically and psychologically. In order to understand the range of effects that sound creates a literature review and field work was conducted. Through this research it became clear of certain patterns were occurring between positive and negative sounds.

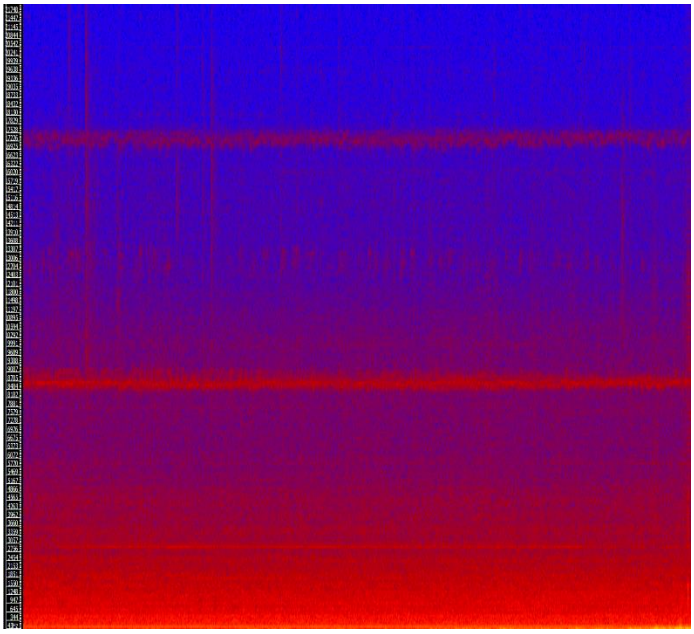
Sound in the form of noise pollution can have adverse effects on humans. Ambient background noise can make it hard to concentrate, lowering productivity amongst workers in open office settings and in classroom for both students and teachers (Klatte et al. 2010, Yadav et al. 2017). Noise can be very pervasive to the point that it goes unnoticed or it becomes so seemingly normal that it is tuned out. It may be safe to assume that most people even in their quiet homes are not immune to some traffic or airplane noise. The noise pollution from ongoing traffic noise or sudden loud noises can cause sleep deprivation, stress, and annoyance which has been researched as leading to higher occurrences of cardiovascular disease (Münzel et. al, 2014). Noise policies and mitigation efforts focus on individual sound sources, which look for the source of the pollution and find ways to minimize or remove the pollution. This works to reduce the exposure but it does not necessarily lead to a more pleasing soundscape (Kang, 2005).

Soundscape is a term that encompasses all of the sounds that occur in a place. Rather than identify the individual sounds, soundscape evaluates the sonic environment as a whole and measures sound based on human perception rather than by sound level alone. Coined in the 1960's by R. Murray Schaeffer, soundscapes look beyond just the noise to find the collection or ecology of sounds that make up a place. Soundscape research is conducted mostly from a human centered focus combined with sound level readings. Sound walks and surveys are common in soundscape research. Sound walks are exercises with the sole intention of listening to one's environment (Bild, 2016) Surveys are implemented to understand human preference to environmental soundscapes. Both sound walks and surveys were used in this study.

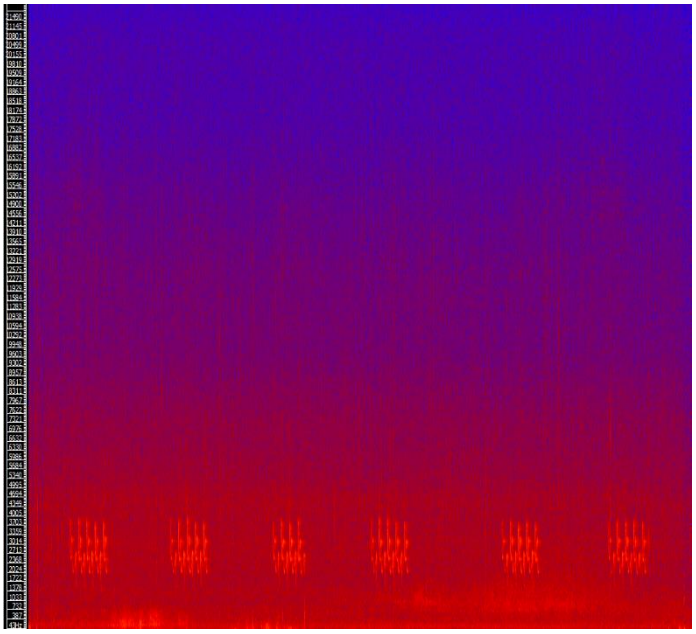
Literature Review

Research has shown that preference to natural sounds such as birds and water is most often given preference enjoyed and preferred by people. Whereas mechanical sounds of traffic, aircraft noise, a/c units are more often thought of as annoying or irritating (Gunnar 2016). Other research fields have drawn a similar conclusion to nature and recognize its potential ability to restore mental fatigue (Kaplan 1998).

By using the understanding that certain sounds create more positive reactions than others, field recordings were collected at different sites throughout Tulsa, OK. These sites include wilderness areas, active parks, and downtown urban areas. Recordings were collected through a handheld Zoom H4N recorder and Rode NT1. The process for collecting recordings was to simply go to these sites and collect sounds that appeared interesting or appeared to be a places signature sound. A signature sound meaning, the sound that pulls the most attention. Once recording were made, they were then uploaded to the free software called Sonic Visualizer and converted to a spectrogram. Once the audio files were convert, the spectrogram revealed different patterns between the sounds that could be considered positive vs. sounds that are negative. Below are examples of the images that were generated. The following page contains a explanation on how to understand the images using a sound clip of people playing basketball at an outdoor park.



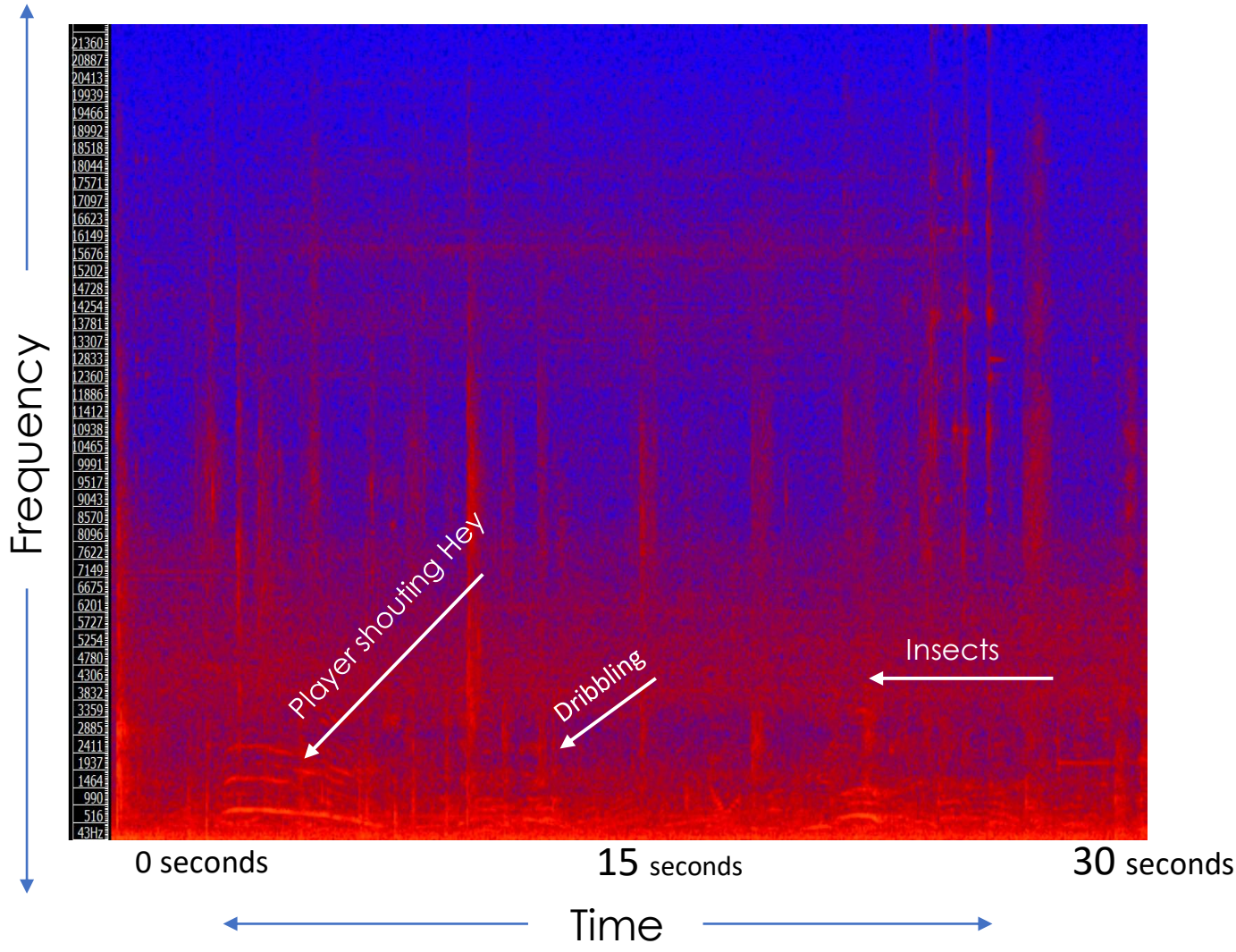
15 second clip of exhaust fan, Downtown Tulsa, OK



30 sec clip of a bird call during rainstorm at Turkey Mountain, Tulsa, OK

How to read a spectrogram

A Spectrogram is a visual representation of a sound recording. A spectrogram has an X & Y Axis to represent time & hertz frequency. The colors of the spectrogram represent loudness, or acoustic energy. The stronger the red the more energy is taking place at that particular frequency level.



The image above is the visualization of people playing basketball at the Gathering Place in Tulsa, OK. The players voices occupy a range of around 500Hz to 2500Hz. The sound of dribbling echoes because of materials involved in activity. Insects produce a constant sound but at a different frequency range allowing it to remain audible.

Sonic Patterns

Recording sounds through the use of handheld field recorders occurred frequently during the beginning on this project. The purpose of field recording allowed for data collection, observation, and also as a sort of ear training to really start to hear the whole of different places. Listening to field recordings allows for subjective feeling towards different soundscapes but in order to analyze different recordings they needed to be visualized through the use of audio software to convert the files into spectrograms.

As outlined on the previous page, Spectrograms are a visual representation of audio data. They demonstrate the duration, hertz frequency and the intensity of a sound file. It is clear that there is a difference in how a rural place may sound compared to how a busy city street may sound but, by seeing the soundscapes allowed for more patterns to appear which give clues to what positive or negative soundscapes look like on a spectrogram

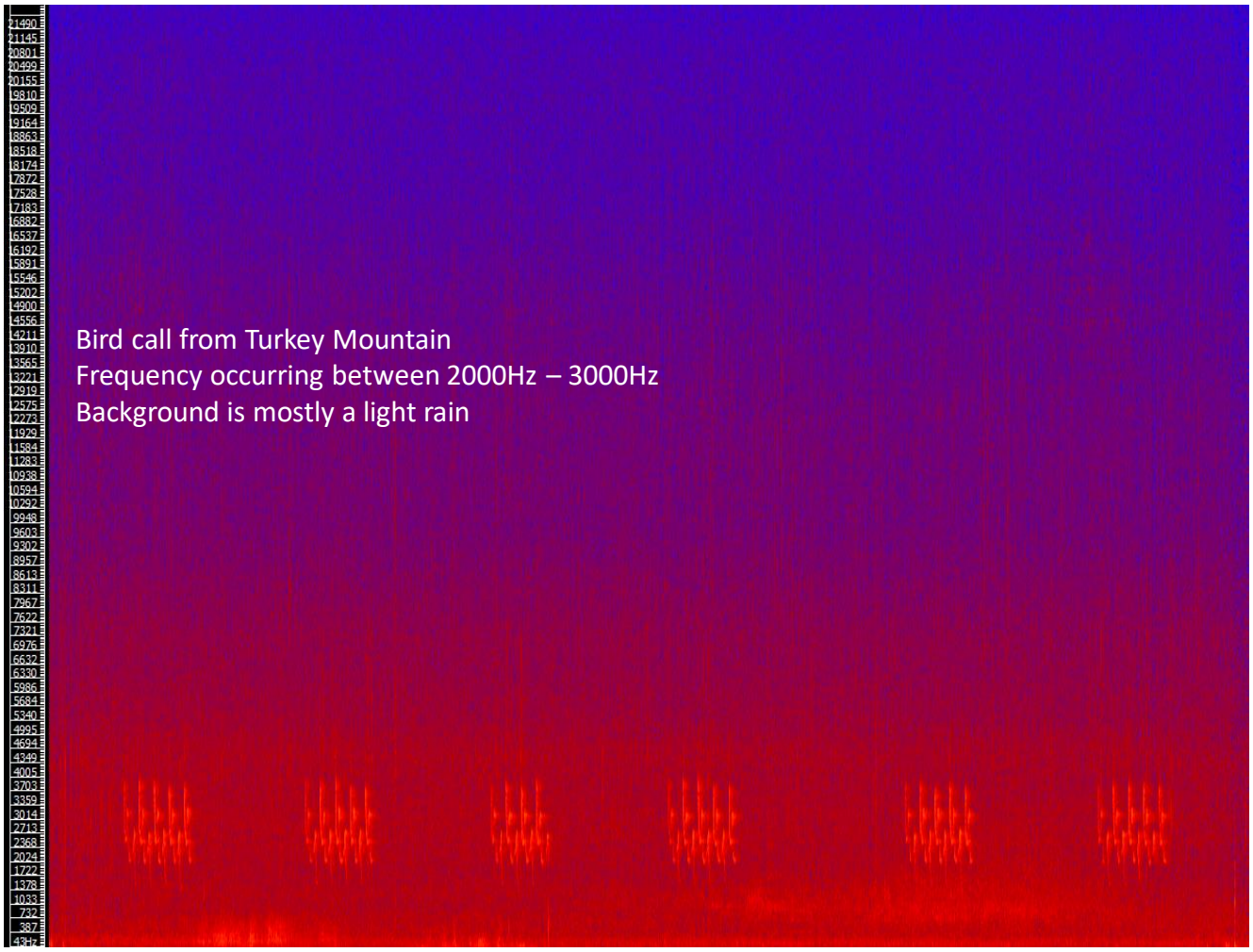
Christopher Alexander presented theory of design properties in his 2001 book titled The Nature of Order which allows him to. To Alexander these principles are able to define whether a physical object has "life". His theory was dependent on his expertise and developed on looking at thousands and thousands of images side by side to determine which image contained more life than the other.

After he determined which contained the most life, he then determined the 15 properties that could be found in these images. Life in this regard is defined by a sense of wholeness, so Alexanders question became, are there some structural features that within objects that give them more life or wholeness.

From this theory, he presented 15 properties to argue his theory, those 15 include: 1. Levels of Scale 2. Strong Centers 3. Boundaries 4. Alternating Repetition, 5 Positive Space 6. Good Shape 7.Local Symmetries 8.Deep Interlock & Ambiguity 9. Contrast 10. Gradients 11. Roughness, 12. Echoes, 12. The Void, 14. Simplicity and Inner Calm, 15. Not-Separateness.

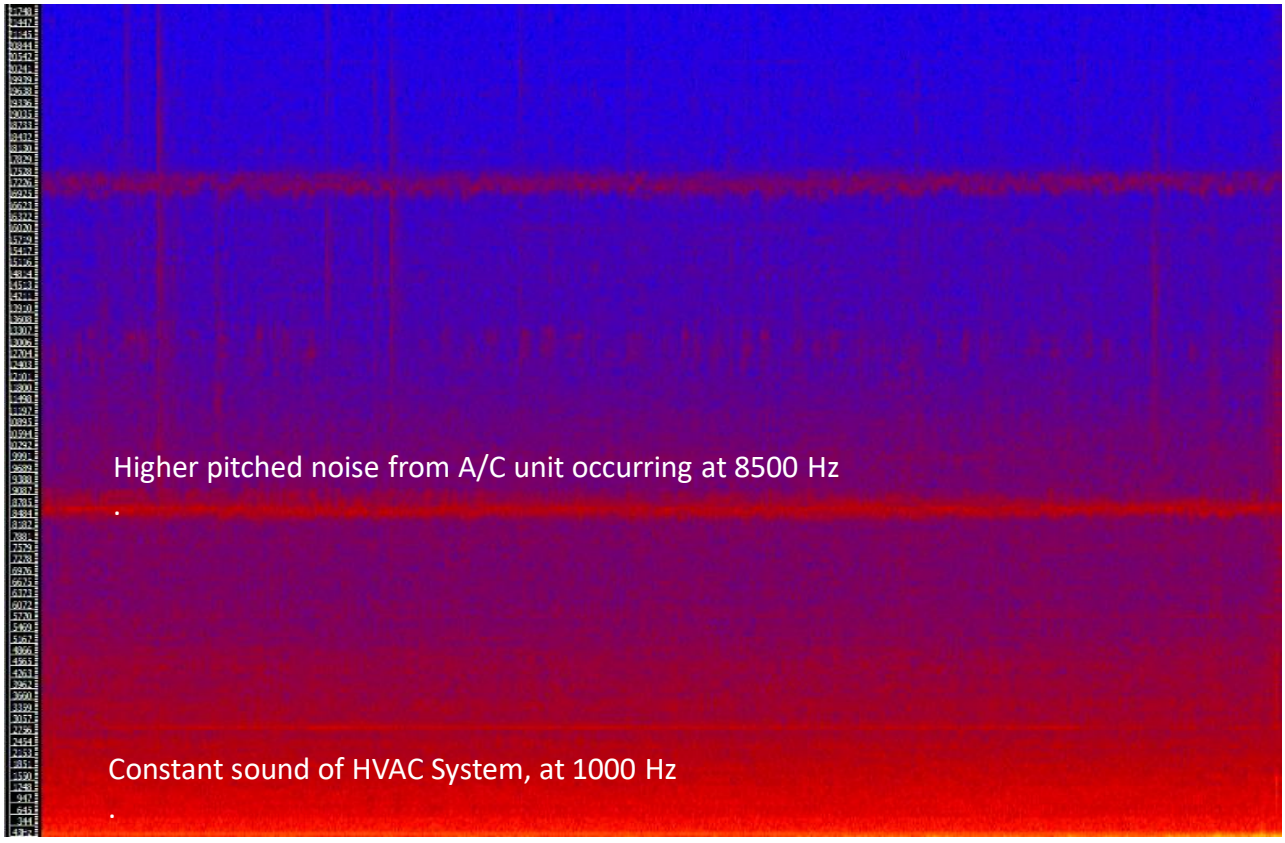
Sonic Patterns

Patterns in acoustic space should theoretically follow the same framework that Christopher Alexander had presented because sound is a physical object that occurs in space in the form of waves. Below is a closer look at an image of a birdcall recorded at Turkey Mountain during a light rain storm. The bird call is the obvious center, in sonic terminology, it would be the signature sound. However, just as important as the call it is the space between each call that allows for the other sounds to contribute to the wholeness of the soundscape. Properties that this potentially follows are levels of scale, strong centers, alternating repetition, positive space, simplicity and inner calm



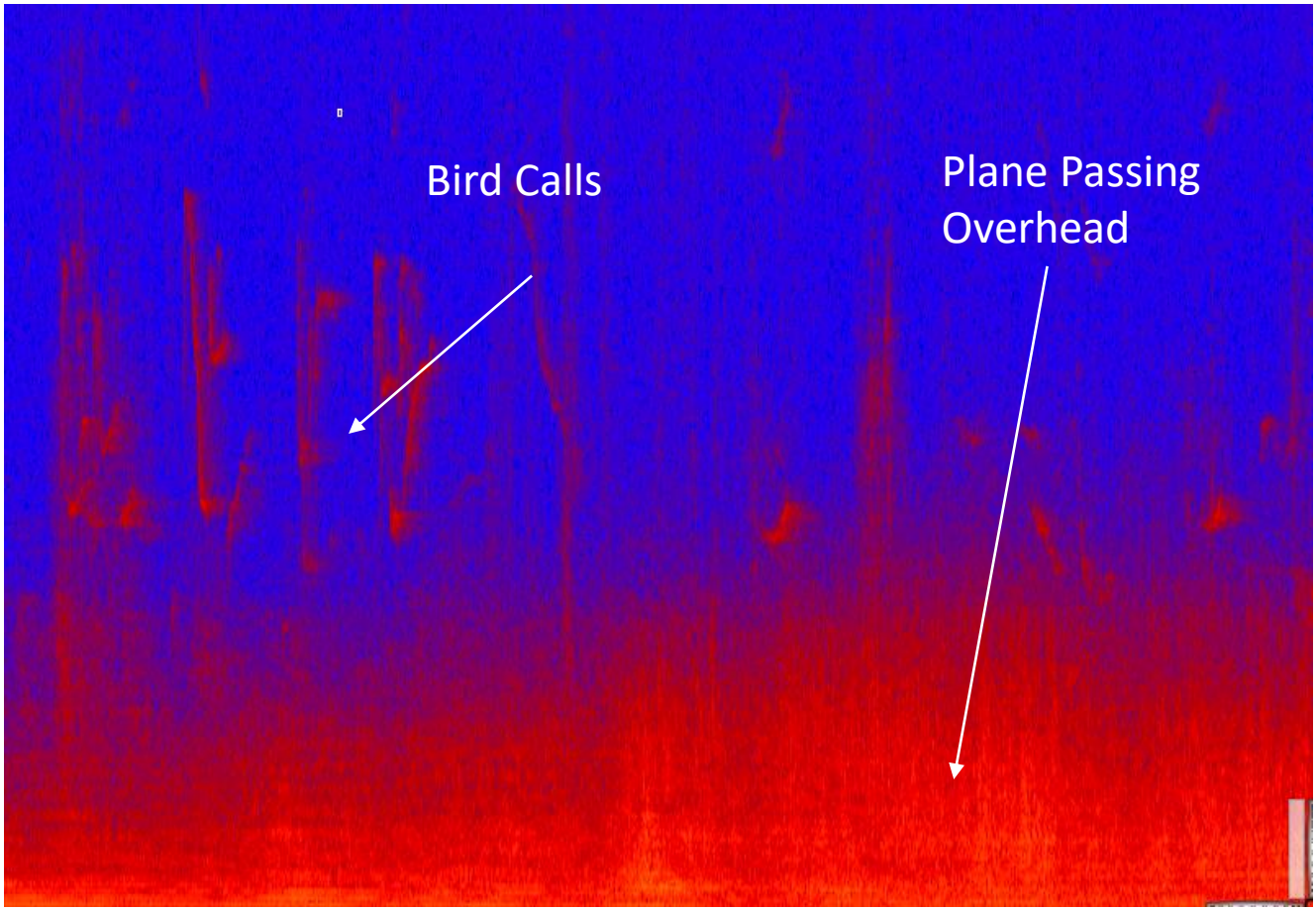
Sonic Patterns

This example is of a short clip of exhaust fan located in an alleyway in Downtown Tulsa. The predominant frequency is taking place around 800 Hz – 1200 Hz. The constant lines at higher frequency are either different mechanical sound sources generating a higher pitch or it could be overtones of the main sound source. It is important to remember that the X axis represents time, so this soundscape is stacked with no breaks. These constant drones at this frequency can be recognize as potential sources of stress for the listener. This type of sound is frequent in engines and fans, whether that is a car engine or a computer fan, each contributing to the overall soundscape as background noise. Sounds such as these take up a lot acoustic space which makes it difficult to experience a balanced environment because the nuanced frequencies are covered up.



Sonic Patterns

Another close up of a recording that includes both natural and mechanical sounds. These are recording during the same recording. It demonstrates the amount of acoustic energy some mechanical sounds are able to generate. In the example the levels of scale ultimately disappear as the plane passes by. Occurrences like this can disrupt not only human communication but also communication happening amongst animal species. Communication can resume to full effectiveness after the plane has passed.



Methodology:

Once a better understanding was formed on the patterns and physical nature of positive and negative sounds, the question arose that if we know that certain sounds create a more positive effect, then can the addition of those sounds in a negative sonic environment create a more positive effect. In order to test this, an experiment was formed to take 2 groups on a sound walk through a small area of Tulsa. At the site, there are six locations where the participants stop to listen and evaluate the sounds they hear by filling out a survey that measured different emotional descriptors. One group experienced no changes the environment while a second group experienced changes created by a speaker system.

Methodology: Selecting the site

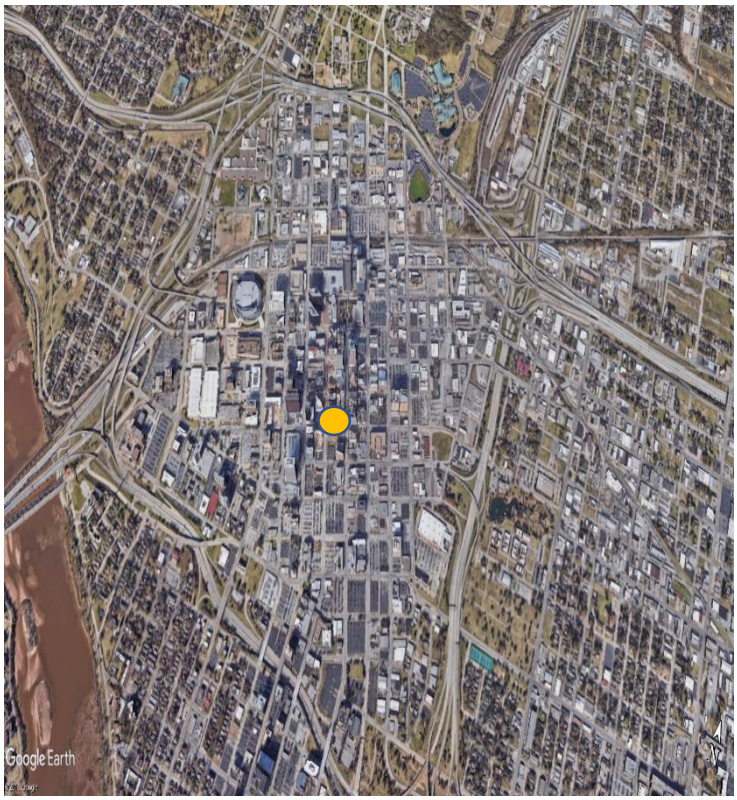
This site was chosen due to prior familiarity of the area through other projects and after finding out that a public art project was taking place to transform the alleyway into a pedestrian friendly environment.

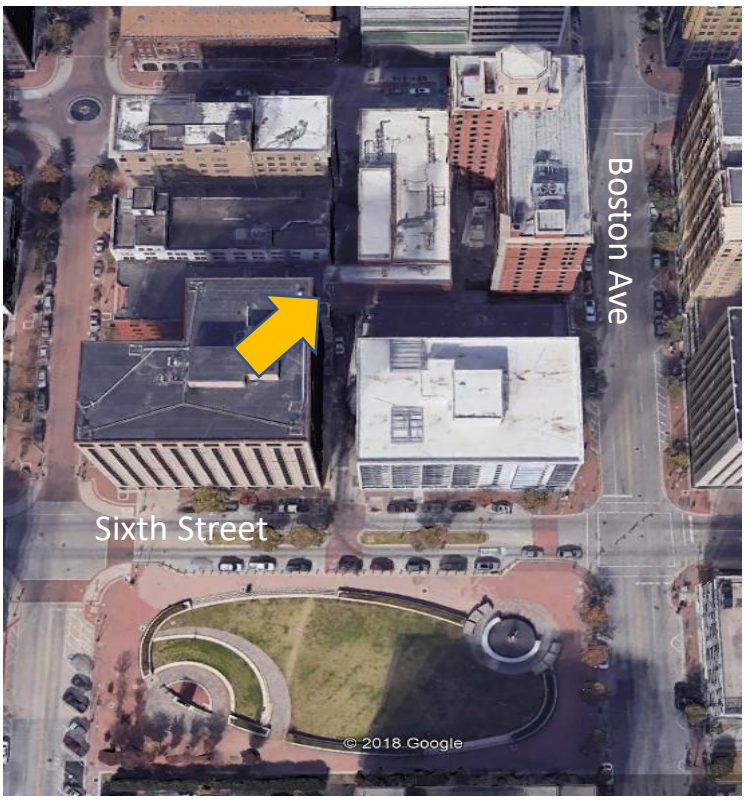
The area surrounding the alley way is called the Deco District and it is located in the urban core of Tulsa. It has seen several changes and has gain interest with new restaurants, new residential buildings, hotels, and public art installations.

There are several unique sonic features in this area including:

1. Music from retail shops along Boston Ave
2. Frequent bird calls located at the Chapman green, the green space on 6th Street
3. Two fountains are in the area added to the soundscape with water features
4. Church Bells ringing a certain times during the day

While data was collected at 6 different locations, The main focus of the area for the study is in the alleyway. The alley way has several different mechanical sounds that reverberate off the hard surfaces.





Methodology: Creating the Experiment

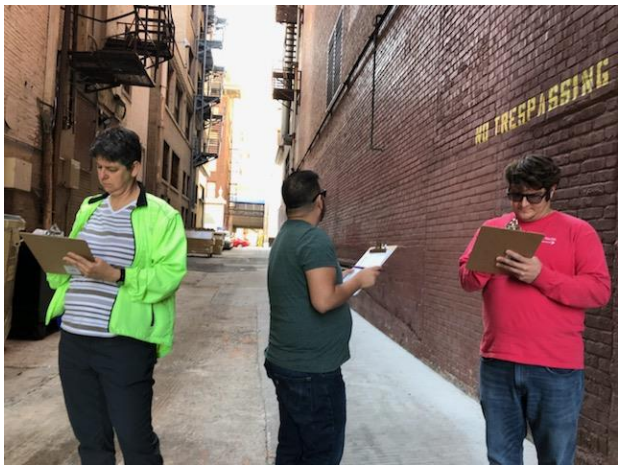
Participants for the study were recruited through an e-mail list sent out by Tulsa Foundation of Architecture. Those who saw the posting and wished to participate were prompted to follow a link which allowed them to choose a time and date to participate. Once time selections were made, two groups were formed, one at 1:00pm on a Sunday and the second at 3pm on the same day. There was little variation in the overall of ambient environment between the two times.

Participants were asked to meet on the Northwest corner of Boston Ave and 6th Street. The first group consisted on 9 participants while the second group only contained 5. At the start of the sound walk, the participants were told that the entire walk would take place in silence. They would walk to six different sites along with the researcher and at the arrival of each walk the researcher would tell them what site they were at. They had one minute to simply listen to the surrounding acoustic environment. Some chose to close their eyes to listen, others chose to look around. After the minute finished, they were given 30 seconds to finish the portion of a survey.

The survey consisted of five descriptors and a section to take notes of what they were hearing. The survey measured for Pleasantness, Annoyance, Acoustic Comfort, Noisiness, and Calming.

While they were asked to rate at each site, the primary focus was a site located in an alley way. At this site a constant low frequency sound is generated by a mechanical source, (LAeq = 54.5 dBA). This site was chosen as the focus because prior research suggests that mechanical sounds such as this one are typically rated with a low preference. The control group (n=9) conducted their sound walk experiencing no changes to the acoustic environment. A treatment group (n=5*) conducted the same sound walk, however the acoustic environment that they experienced at the alley way site was alter with a speaker system.

*A third walk occurred later in an attempt to increase the sample size of the treatment group, however the experiment was unable to reproduced to the quality needed for an appropriate comparison**

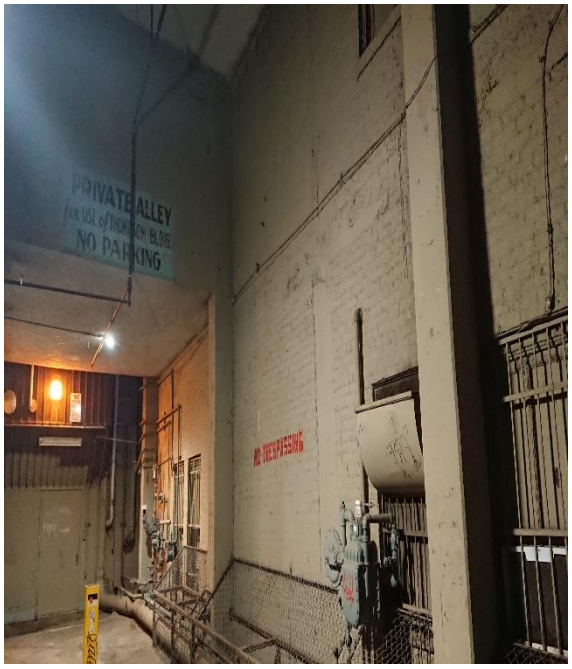


Methodology

Entrance to alley off of sixth street

Different look down alleyway

AC units are located behind the black caged area producing high pitch noises



Main source of sound on right side of wall from HVAC system

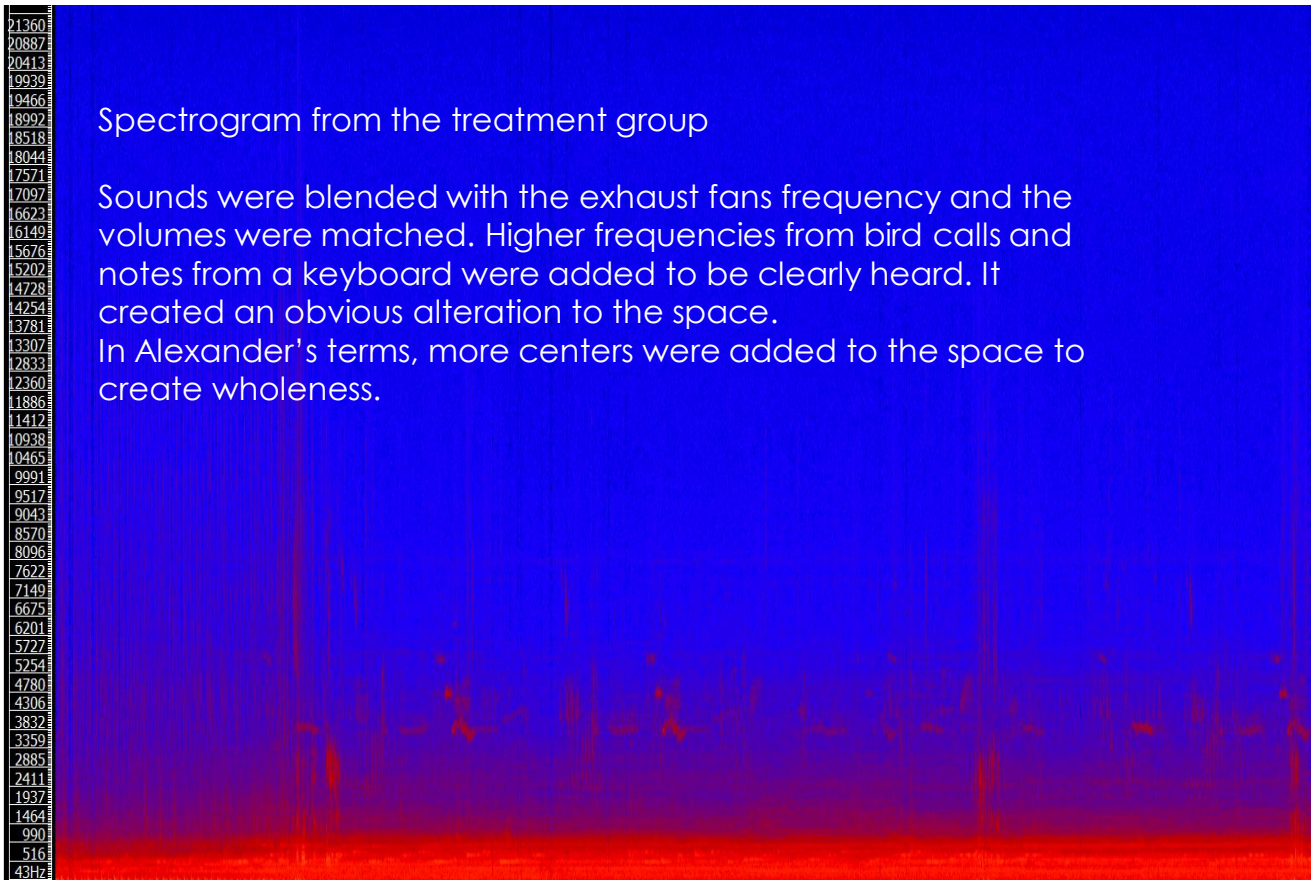
Methodology: Creating the treatment sound

The sound used for the treatment study was created using field recordings and a Yamaha CP reface.

Field recording were recorded using a Zoom h4n handheld recorder.
It was created after several trips to the study site and creating recordings to learn the characteristics of the site and by analyzing the current frequency ranges.

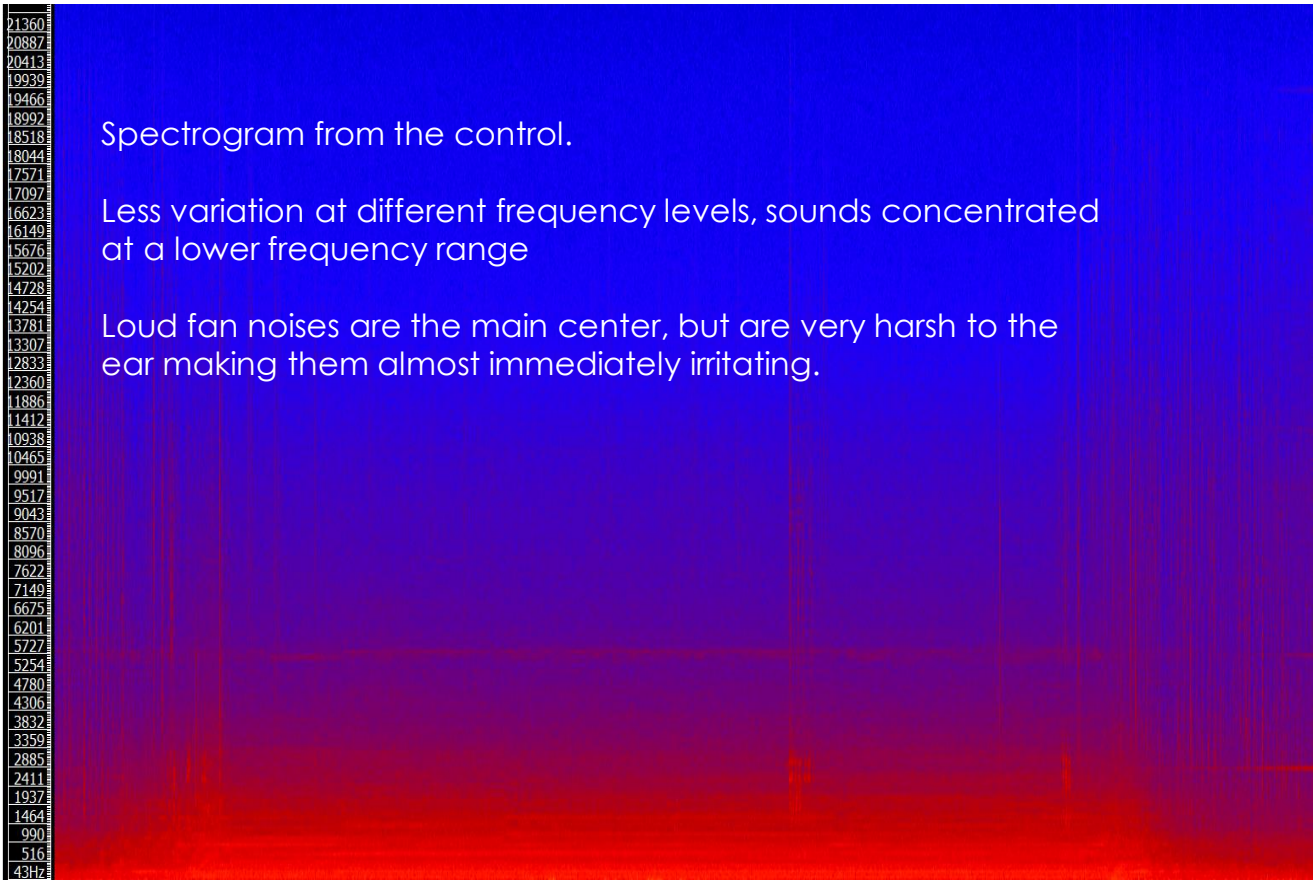
The sound consists of three sections

1. The lower tone creating on the Yamaha is chords that match closely to the current sounds of the site, the attack and decay were removed in order to create a droning sound, this with the intention of blending.
2. Field recordings of a light rain and of active bird sounds were added as the main masking element and also the "positive" and "restorative" sounds
3. The sounds of rain & piano chords were placed at the frequency range of the exhaust fan in the alleyway. This allowed for the exhaust fan to be blended with and it also allows for higher frequency ranges to be more prevalent and pull the most attention
4. A very simple melody was added over the top of all the sounds to catch the listener's ear that something was added. It was doubled than offset



Spectrogram from the treatment group

Sounds were blended with the exhaust fans frequency and the volumes were matched. Higher frequencies from bird calls and notes from a keyboard were added to be clearly heard. It created an obvious alteration to the space.
In Alexander's terms, more centers were added to the space to create wholeness.



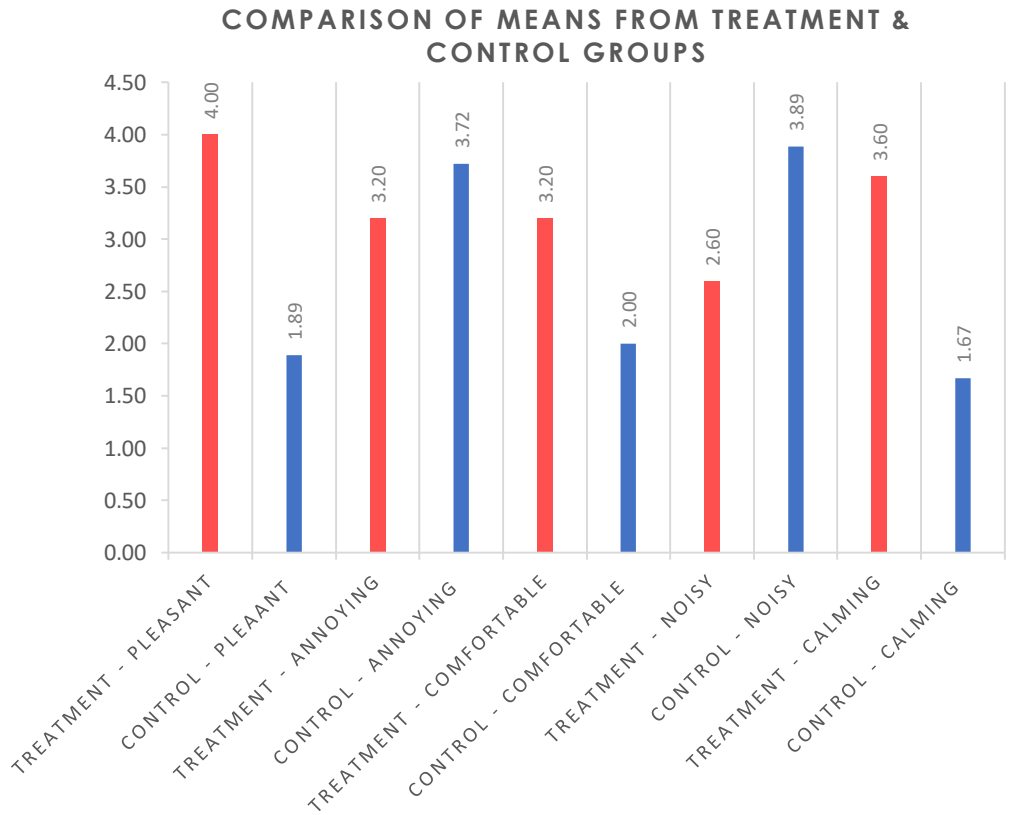
Spectrogram from the control.

Less variation at different frequency levels, sounds concentrated at a lower frequency range

Loud fan noises are the main center, but are very harsh to the ear making them almost immediately irritating.

Results

Survey results were analyzed and the two groups were compared by collecting the mean for each research question and running an independent samples t-test to test if any of the results from the survey were statistically significant in supporting the hypothesis. The hypothesis that is being tested if "positive" sounds are added to a "negative" sonic environment, listeners of this environment will change their perception of the space to a higher preference of the space. For the question of pleasantness, the control group (n=9) had rated this descriptor as low (mean = 1.89 , SD= .93), while the treatment group (n=5) rated it as strongly agreeing that the area was pleasant (mean =4.00, SD = .71. When these two are compared using the t-test, the results show a statistical significance with a p-value <.005 in support of the hypothesis. The results from the questions representing acoustic comfort and calming also resulted in a statistical significance with a p-value = <.05 in support of the hypothesis. Annoying and noisy both showed an effect in favor of the hypothesis but not in a significant way. The results from this study show promising potential that the addition of sounds in order to blend or mask a negative soundscape can result in a higher preference from listeners.

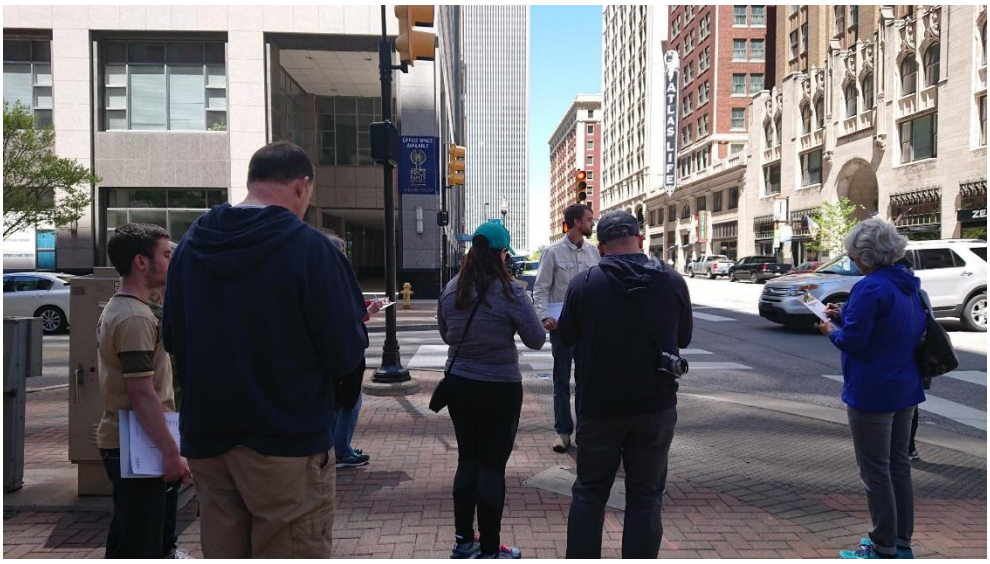


Results

Limitations to the study included a small sample size, and need for more rigorous treatment placement & recording procedure in order to replicate the study. Also, the nature of the study may have influenced the way people answered on their responses, because they were participating in a sound walk versus a random user of the space. Participants, who knowingly are on a sound walk may find sounds more interesting than they would otherwise, which could lead them to rank something higher.

Another limitation to this study is the fault in procedure, which led to not using some data. When the treatment group with technical errors data is added to the overall analysis, it rejects every hypothesis. This is because their survey results align much closer to the participants who experienced no sound at all,.

However, it is interesting to note the order in which the extra group had filled out on the written portion of the survey for the study site. While they could still the higher frequency register of the treatment that was placed at site 4, it was not the predominant sound. In each case the *participant* listed *buzzing, loud fan, motors running* first in their description followed by a reference to music or bells. In the treatment group where the speaker system was at an appropriate volume, the descriptors are listed with *music/chimes, chimes, birds* first, then followed by loud fan, HVAC system. This could be an indicator that even though all sounds are occurring at the same time, the sound listed first is the signature sound of the space.



Conclusion

This project began as a method to better understand how sound influences the way that humans experiences their environments. Research on urban sound design is a relatively new field beginning in the late 1960's. It is still very relevant today because of growing urban densities and introduction of more cars and technologies that may contribute to a noise issue. There is very little focus on sound design professions. We plan and design for the physical elements of a place but rarely do we ask, what might this place sound like. Because we live in a visual culture understanding the differences between seeing and hearing is necessary to understand how to combine the two for an overall design strategy. Objects that we see appear to be more static in time whereas sound sources are more temporary. Sound is an all surrounding but subtle and powerful sense that humans rely on to operate, which could be an equally powerful tool in design of public places

This study worked towards a framework to understand soundscape preferences amongst humans and developed a methodology for testing a site specific sound installation. The results from the study were promising enough to suggest that more research in this area is appropriate, both at the site chosen for this study and at other sites. By conducting sound walks and surveys results showed favorably that with the addition of certain sounds to mask noisy and annoying sounds, it is possible to influence the sonic environment to one that is more pleasant, calming & comfortable. As was shown with significance through the experiment conducted for this study.

Natural sounds are something that are lacking in most urban settings, however they are increasing understood as being important to our overall well-being. Sound installations may be a quick and inexpensive way to reintroduce some of those elements missing from an urban environment. Sound can also be used to create an identity to a space as is done with different water features. In this instance, a negative sounding alley way was altered to a space with water sounds, bird calls, and musical notes. Ultimately, the goals of a design intervention such as the one conducted for the study should create attention and engagement by those who happen to listen to it.

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