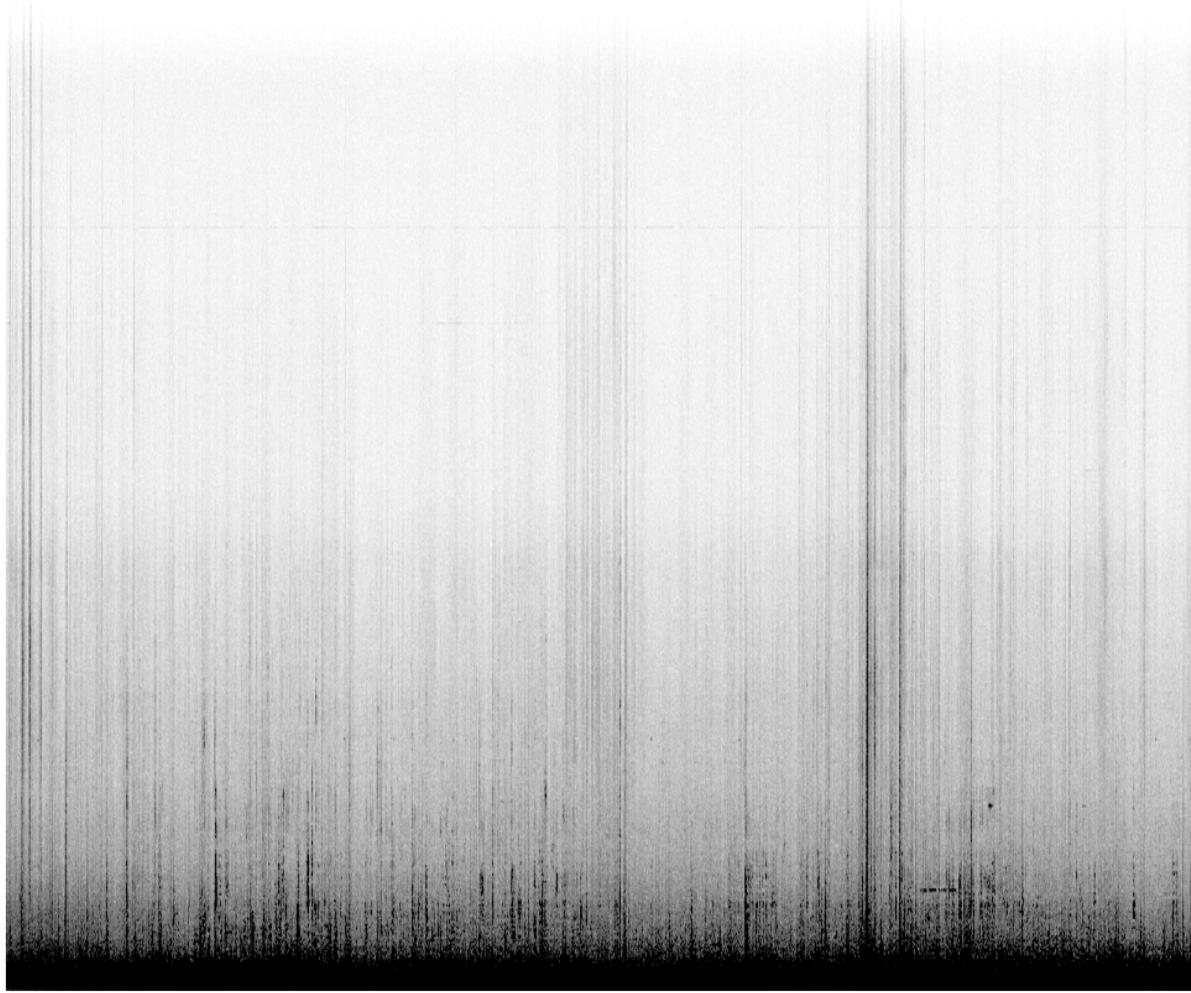


# **Library**

The Spectrogram Handbook  
Toronto Reference Library Visualizations

# **02**





# 02

## Library.

AUDITORY DISTRACTION MEETS VISUAL COMMUNICATION

RYAN GERADA

GRPH4015-17  
003

# Preface.

This thesis project was initiated with the intent of studying sound within spaces. It has quickly transformed into a broader study of acoustic ecology, inspired by the works of Walter Murch. I have set out to study the distracting sounds within three selected spaces, all three of these environments range in size and construction assemblies. The studies have been conducted using a portable condenser microphone, each of the selected sounds have been recorded five times. Additionally, this same methodology has been applied to three created sounds, dubbed *curated audio* for purposes of clarification. These recordings were played and recorded within each of the selected spaces, with the intention of establishing a better baseline comparison of the acoustic qualities of each individual environment. Lastly, five *longplay* recordings were conducted throughout each of the three environments. The 10 minute longplay recordings are an important part of the study, as it captures the atmosphere of each of the spaces.

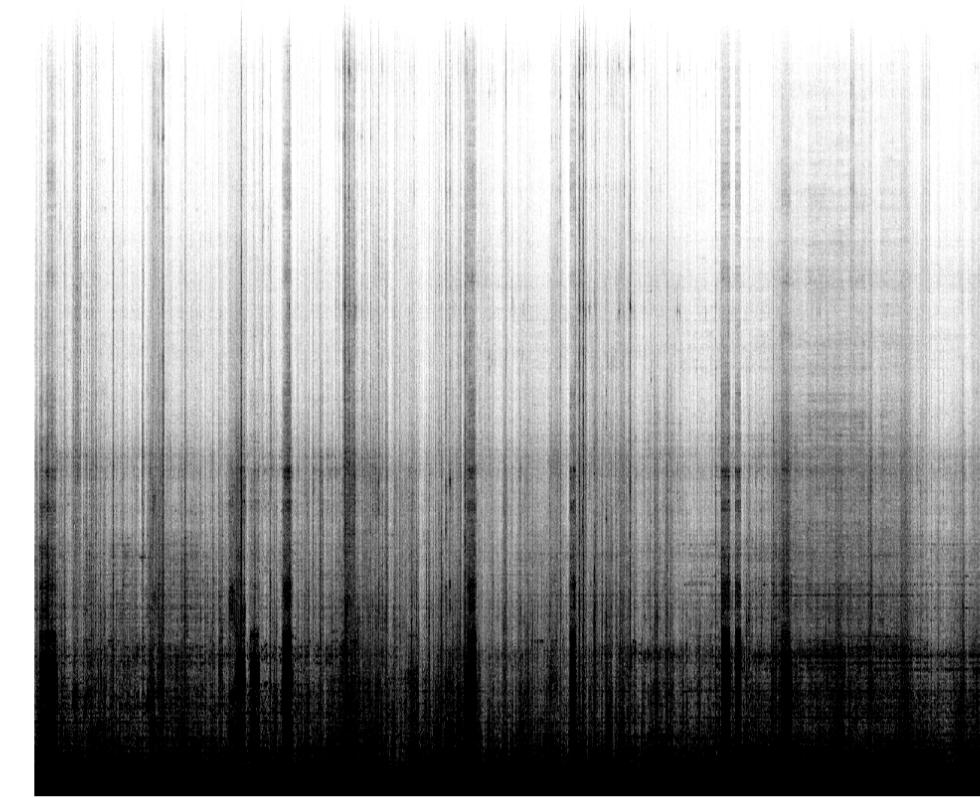
This publication is intended to act as an extension to the *Audio Graphic* posters on display. You may consider this publication a translator of sorts, its sole purpose is to lower the barrier to entry that has been established with these visualizations. The vernacular used within this manual is intended to educate, and extrapolate on the abstracted imagery you have already been presented with. Insights, comparisons and raw spectrographic visualizations are housed within this book. The content has been generated from the Toronto Reference Library.

Following this preface, the other two installations within this spectrogram handbook series will be showcased. Additionally, there will be a brief crash course on how to properly read and analyze spectrograms. Of course, you are encouraged to draw your own conclusions.

**Cafe**

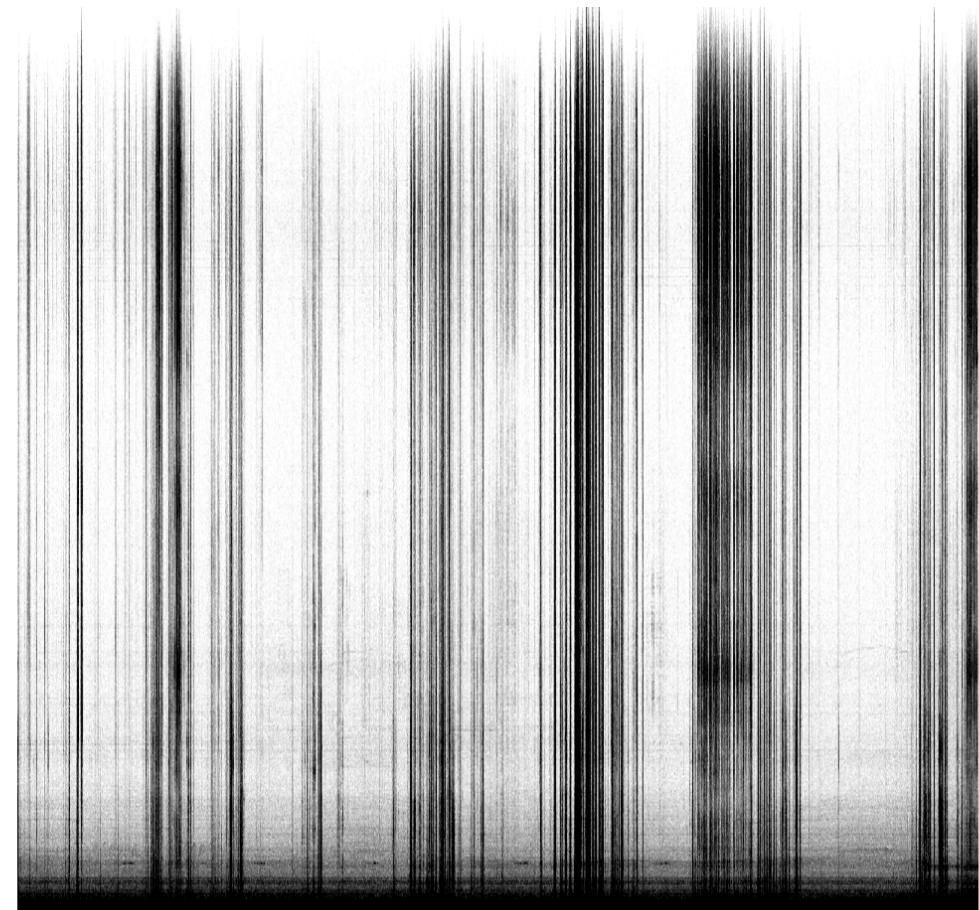
The Spectrogram Handbook  
Jimmy's Coffee Visualizations

**01**



**Studio**  
The Spectrogram Handbook  
Personal Studio Visualizations

03



# Contents.

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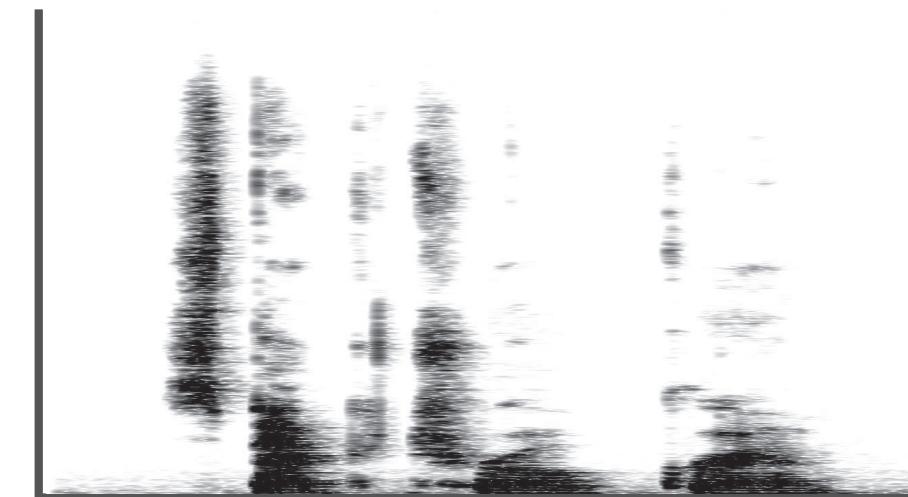
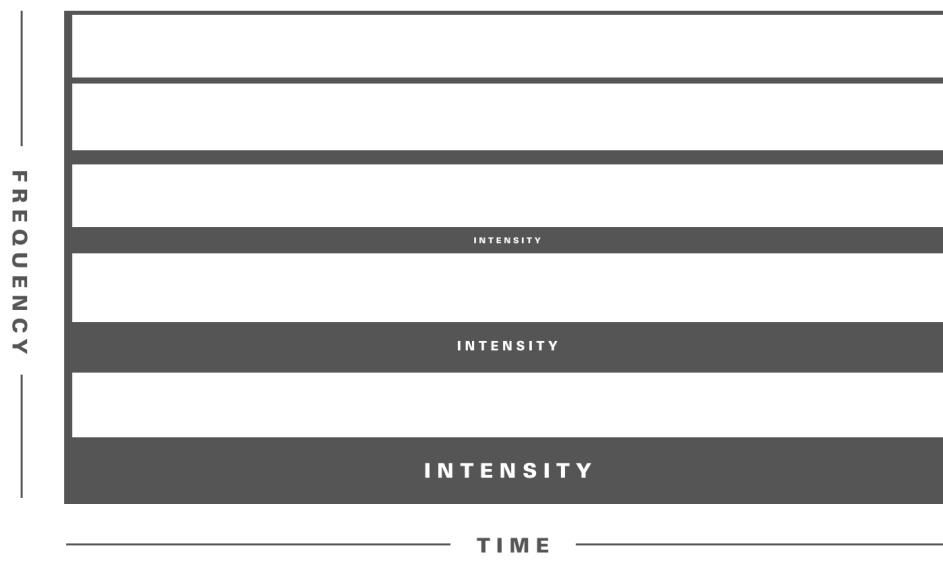
# Anatomy of the Spectrogram.

A spectrogram is a picture of sound. A spectrogram shows the frequencies that make up the sound, from low to high, and how they change over time, from left to right. The intensity of the visualization demonstrates the dynamic range of volume, measured in decibels. To the right, you will see a spectrogram visualization of the recorded voice saying "spectrogram"

**Frequency**  
Measured top to bottom.  
[22k - 0k hertz]

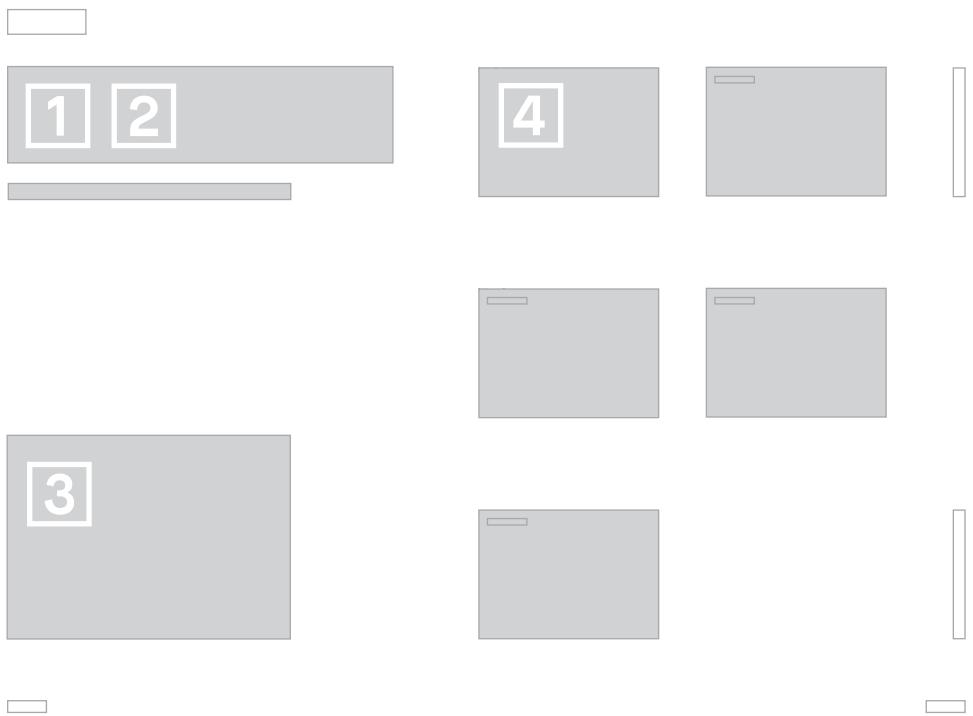
**Time**  
Measured left to right.  
[represented in seconds or minutes]

**Intensity**  
Measured in decibels.  
[represented by intensity of visual]



# Composition Breakdown.

[1-5]



**[1]  
AUDIO TITLE**

Title of the audio that is being analyzed.

**[2]  
(LUFS) READING**

Loudness units relative to full scale. The LUFS reading provides a quick look at the measured loudness of the five audio files.

**[3]  
BODY COPY**

The body copy includes a short description as to what exactly is going on with the sound, and how it pertains to this study.

**[4]  
SPECTROGRAMS**

Five recordings were conducted for each sound. These recordings were cropped into ten second soundbytes, and visualized as spectrograms. These visualizations are intended to be compared.

# Comparisons & Insights.

The comparison's and insights section will provide a valuable deep dive into the visual implications of these standardized audio recordings. The curated audio was designed to be diverse in its playback through all three instalments. Additionally, the recording conditions were encouraged to accurately represent the environment. The acoustic ecology of spaces was a major study within this body of work, it is within these comparisons that the research comes to life.

Moving forward, the curated audio samples will act as a means of comparison. Firstly, five particular recordings were conducted, using each of the three unique curated audio samples. The curated pad sample was played and recorded for 20 seconds, while both the curated synth and voice were played and recorded for 10 seconds. These five individual recordings have been amalgamated, resulting in a visually dense spectrogram. This has been done for each of the curated audio samples, within each of the individually studied spaces.

This publication will first highlight the combined visualizations with the intent of providing a visual overview of the spaces. Next, each of the curated audio samples, unique to the Toronto Reference Library will be visualized in the standard format.

It is encouraged to draw your own conclusions on the implications that these spectrograms might have.

## Curated Pad (combined)

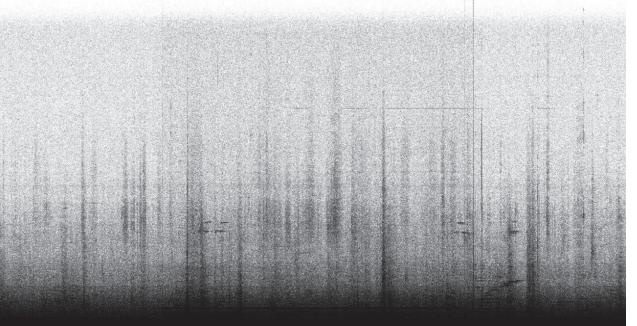
The curated pad spans for 20 seconds within each of the recordings. The audio was created to intentionally swell in two places during playback, while maintaining a discrete audio signature. Distinguishing the curated pad audio sample within the top two visualizations, Jimmy's and the Reference library, becomes quite difficult in comparison to the studio recordings. Extrapolating from these general observations, it is clear that the ambiances of the top two spaces have contributed to a large amount of distortion within the visualizations.

Focusing on Jimmy's visualization, there is a lot of congestion in the low to mid ranges, resulting in the intense blacks that litter the lower half of the spectrogram. Naturally, the bustle of a coffee shop would contribute to a great deal of noise, drowning out the unpronounced audio clip.

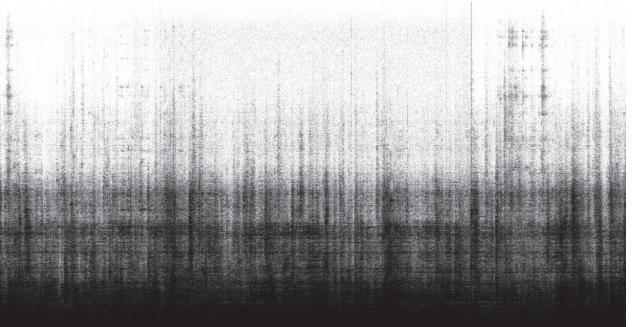
The Reference library finds itself somewhere comfortably in the middle of the other two spaces. It can be concluded by the heavily washed grey background that there was in fact quite a bit of background ambiance within the space, although it has been set into the background of the space for the most part. The peaks of the curated pad reveal themselves in the later portion of the spectrogram, around the 7 second mark. However, without the studio as a point of reference, it would be difficult to distinguish the similarities between the top two spaces.

Finally, the personal studio space reveals hints of the pad sound, however subtle it is, the lack of background noise allowed for a clean recording, later resulting in a clean visualization. The pad can be seen swelling at two points most prominently, with a bit of a low frequency hum plaguing the lower portion of the spectrogram.

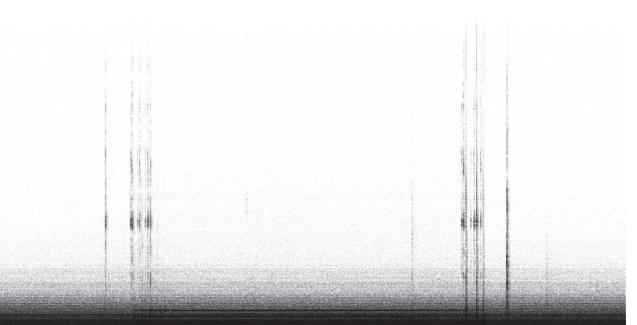
TORONTO REFERENCE LIBRARY



JIMMY'S COFFEE



PERSONAL STUDIO



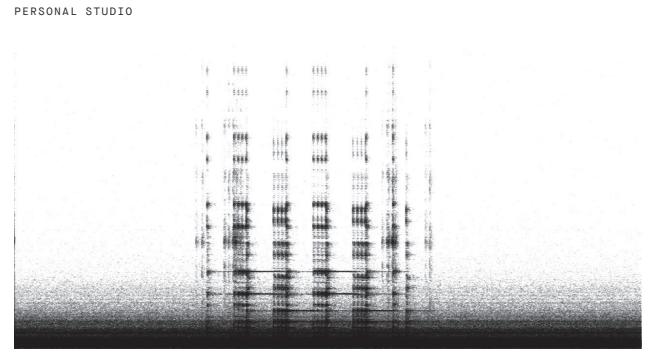
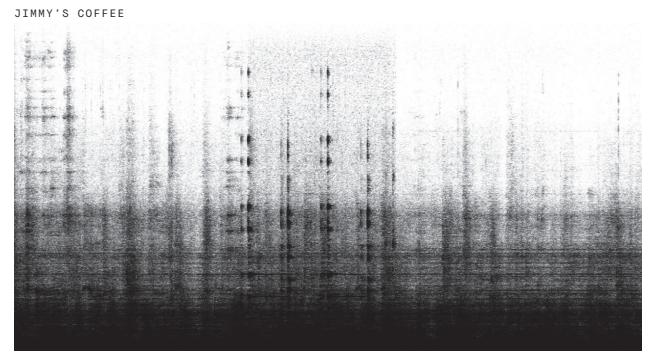
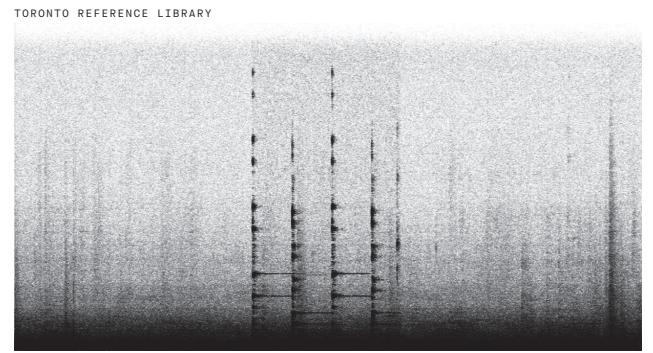
## Curated Synth (combined)

The curated synth spans for 10 seconds within each of the recordings. The audio was created to peak sharply, in rapid succession. This arpeggio of sorts was designed to be easily distinguishable, even in crowded, noisy environments. Using the personal studio visualization as a point of reference, the audio leaves a unique signature that punches through the ambiances of all three spaces. This visual can be identified clearly in all three of the visualizations.

Jimmy's visualization falls victim to the crowded acoustics of the space. However, the curated synth audio manages to pierce some of the lower frequencies, resulting in the upper half of the spectrogram revealing the synth. The ambiances of the coffeeshop have dominated the lower portion of the visualization, although the curated synth still peaks through down there because of its varied intensity.

The Reference library hosted the audio quite well. Although the space has been washed in grey, the punctuation of the curated synth audio stands strong within the visualization.

As for the studio space, it provides a strong canvas for the visualization to stand up against. The intricacies of the sound can be clearly seen here as the white background showcases the line work through nearly the entire spectrum of frequencies.



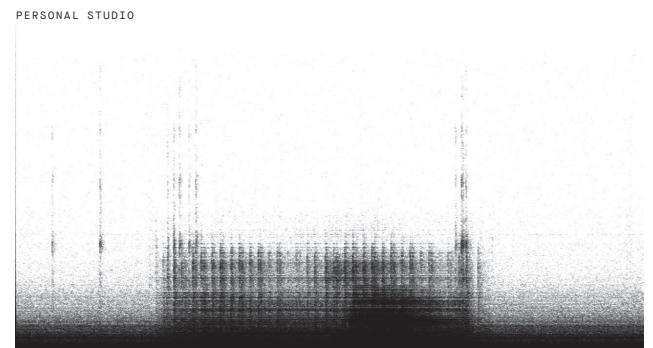
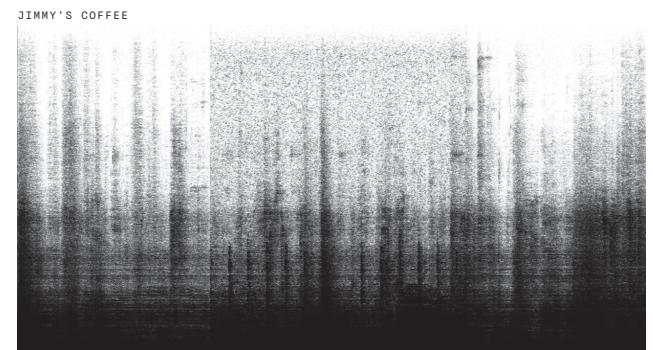
## Curated Voice (combined)

The curated voice spans for 10 seconds within each of the recordings. The audio was created to test the dynamics of the human voice when played back within each of the spaces. The intent with each of these curated sounds was to bring a unique auditory signature to the forefront, the human voice was the last logical fit in the trio. The studio recordings reveal a strong presence in the low to mid range frequencies,

The unique qualities of the curated voice audio are almost completely lost in the ambiances of Jimmy's, it is difficult to visually distinguish the particular peaks or valleys created by the presence of the voice within the space. The intense blacks flood the bottom of the spectrogram, washing away any unique attributes that the voice may have brought to the space.

The Reference library provides a strong grey washed background for the voice to sit upon. The ambiances of the library are constant, but not intense enough to destroy the visual properties of the voice.

The personal studio recording dances across the bottom third of the spectrogram, the curated voice is heavily comprised of low to mid range frequencies. The striations within the visualization show a staggering of the voice playback, as if the speaker is not confident in what he is saying.



# Conclusion.

It is clear that there is a wide variance between the visual noise that is depicted within each of the spaces. Jimmy's coffee inherits much of the ambiance that constantly swirls around the coffee shop. The Toronto Reference Library falls somewhere in the middle - it hosts the curated audio quite well, as there is little distortion of the visualization. However, the intricacies within each of the audio samples are sometimes drowned out in the visualization. As for the studio recordings, the lack of ambient noise has provided a strong platform for the audio to sit upon, this comes out clearly within the visualizations.

Ultimately, I am happy with the results of this comparative experiment. I believe the selection of the curated audio works well in its diversity, each of the sounds are unique in their structure, frequency range and theme. The visualizations themselves act as a strong metaphor for each of the spaces, visually, you are able to quickly digest the happenings of the space. The acoustic ecology of each of these environments has been clearly displayed through this series of visualizations.

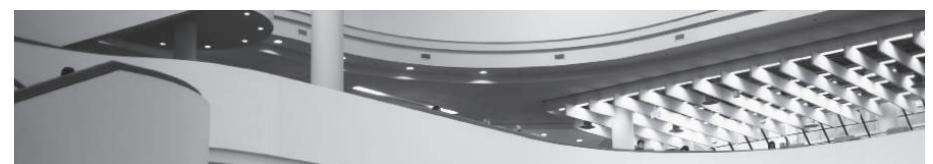
Combining the 5 recordings have worked well in amplifying the visual intensity of these spectrograms. Although accuracy has been sacrificed in the process, the next pages will display the separated visualizations of each of the recordings taken in the Toronto Reference Library.

## Shh. No talking.

The Toronto Reference Library was the most public of the three spaces analyzed during this project. The majority of the space is open to the public to do as they wish. The vast amount of choice you have once you enter the building allowed for a lot of flexibility when choosing the locations in which I recorded. Firstly, I spent a large amount of time calibrating myself within the space, observing how guests interacted with it, how they spent their time and navigated the library itself. I also paid close attention to any dialog shared within the space, if guests were chatting with one another, keeping to themselves or asking for directions. These observations would ultimately lead me to record each of the five public floors of the library. Each floor has a similar layout, with any major book cataloguing taking place on the east or west sides of the floor. The north side of the library was typically shared as a minor storage area for books, and also functioned as a communal work space, hosting guests with large tables and chairs. The south side typically hosts staff and floor specific assets, such as historical photography cataloguing or architectural documents.

The size of the Reference Library dwarfs the other two spaces analyzed in this work. Its interior design is universal throughout the entirety of the building. Concrete floors are masked with heavily padded and carpeted floors. The floors are slightly muted, but can give off a loud hiss if someone is dragging their feet or something is dragging across the surface. The ceilings are generously spacious, each of the floors has 20 foot ceilings, with a large portion of the reference library having no ceiling at all. This creates unique spatial acoustics, as much of the sound is not contained behind walls. The library begins to feel as though it is breathing, as the acoustics swell around the space similar to a stadium. A ruckus on the first floor bleeds to even the furthest reaches of the fifth floor, and vice versa. This unique auditory experience has been captured within the recordings, most notably, the long plays.

The recordings were spread out across all of the floors, firstly, I captured a single long play recording from each of the 5 floors. I then pursued the sound bytes, these, similar to the long plays, were captured across the entire building. When recording, I chose to setup in a location that would facilitate a guest if they chose to work at the library, I then proceeded to capture each of the recordings from that position.





14



15



ENVIRONMENTAL ANALYSIS

SHH. NO TALKING

## Curated Pad

**MOM (MAX): -11.25 (LUFS)** at 00:00:07.802  
**SHORT (MAX): -15.81 (LUFS)** at 00:00:10.217

This curated audio clip is 20 seconds.

A long, droning pad gathers momentum as the sound begins to swell as it almost simultaneously fades away.

Recording of the curated audio clips was conducted within the space, using a medium sized speaker to boom the pre-rendered audio into the coffee shop.

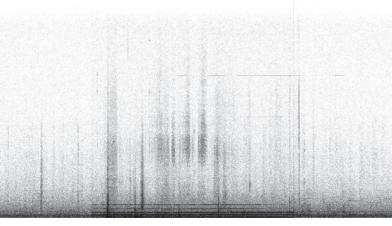
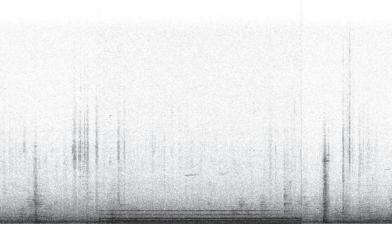
[one]

[three]

[five]

[two]

[four]



# Curated Synth

MOM (MAX): -6.50 (LUFS) at 00:00:06.316  
SHORT (MAX): -13.62 (LUFS) at 00:00:06.688

This curated audio clip is 10 seconds.

An arpeggio loops for a few seconds, then, it suddenly ends.

Recording of the curated audio clips was conducted within the space, using a medium sized speaker to boom the pre-rendered audio into the coffee shop.

[one]

[two]

[three]

[four]

[five]

# Curated Voice

MOM (MAX): -6.50 (LUFS) at 00:00:06.316  
SHORT (MAX): -13.62 (LUFS) at 00:00:06.688

This curated audio clip is 10 seconds.

An amalgamation of sampled audio of voices were combined from all three spaces, these voices were anonymous.

Recording of the curated audio clips was conducted within the space, using a medium sized speaker to boom the pre-rendered audio into the coffee shop.

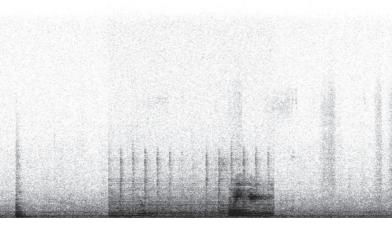
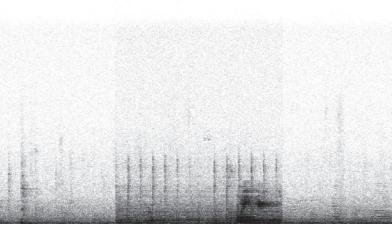
[one]

[three]

[five]

[two]

[four]



# Rustling Backpack

**MOM (MAX): -17.78 (LUFS)** at 00:00:07.059  
**SHORT (MAX): -23.38 (LUFS)** at 00:00:07.059

Opening, searching through, or closing a backpack.

With guests steadily cycling through the library, the sounds of backpacks bursting open pierce the space.

Frequency of the sound varied depending on the amount of guests within the workspace. Explosions of zippers or other compartments created an array of distracting sounds that alerted you of their presence.

These recordings were captured at a close distance, within the communal workspace of the library.

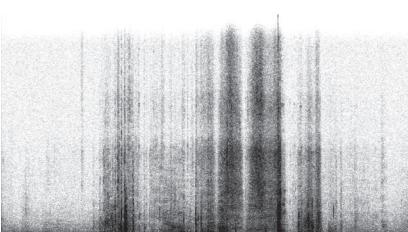
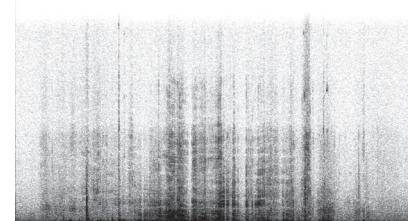
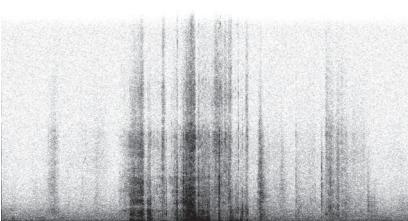
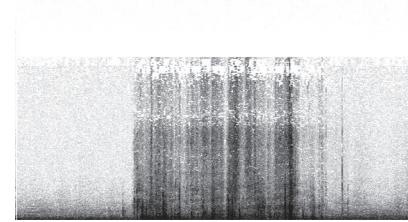
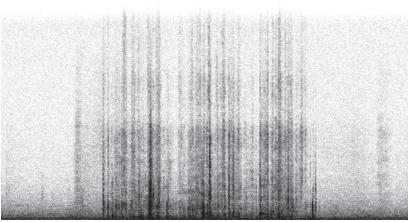
[one]

[three]

[five]

[two]

[four]



# Shelving Books

**MOM (MAX): -16.51 (LUFS)** at 00:00:02.230  
**SHORT (MAX): -21.71 (LUFS)** at 00:00:04.830

Shelving, or shuffling through a selection of books.

Whether it's a guest or a librarian, the rustling of books on the shelf is prevalent in any of the working spaces within the library.

Naturally, book retrieval is an integral function of the library, these sounds were prevalent and happened frequently. The rustling in the bookshelves pulls you out of your work as you try to locate the source of the sound.

This audio was recorded at a distance, within the communal workspace of the library.

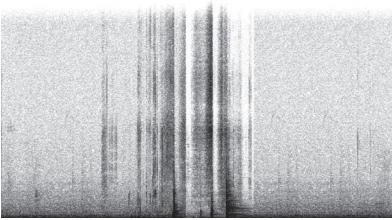
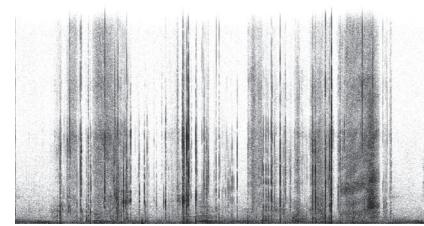
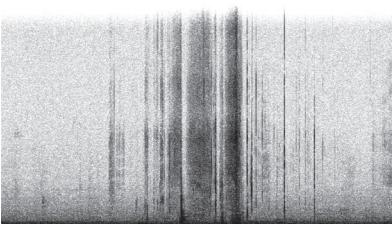
[one]

[three]

[five]

[two]

[four]



# Crunching Paper

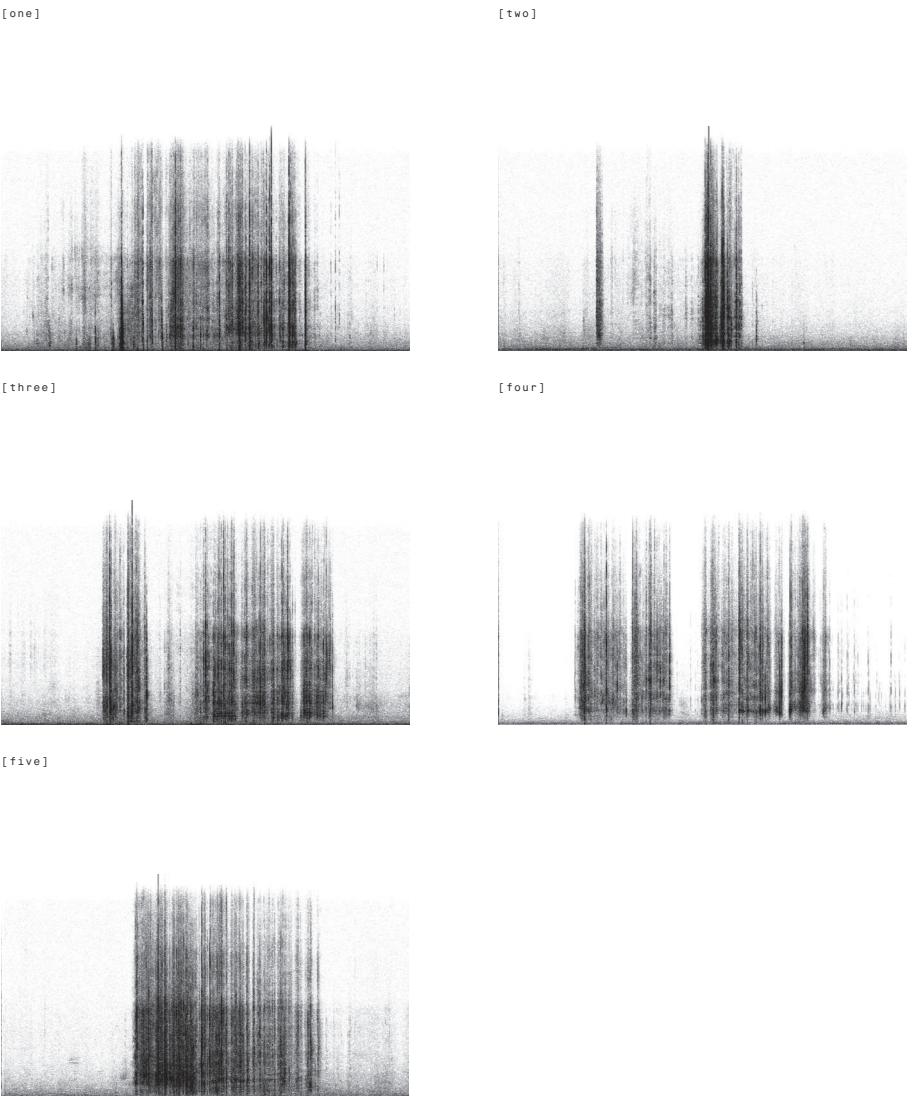
MOM (MAX): -19.38 (LUFS) at 00:00:03.901  
SHORT (MAX): -24.35 (LUFS) at 00:00:06.131

Folding or crumpling scrap paper.

The communal workspaces are often generously populated, amongst the fray you can reliably find a frustrated or frenzied worker dismissing unwanted paper.

Within the confines of the communal workspace, someone's frustration would often take form by crumpling a piece of scrap paper. The burst of sound was distracting, as you would find yourself trying to locate the source of the sound.

These recordings were captured at a close distance, within the communal workspace of the library.



ENVIRONMENTALLY SPECIFIC AUDIO

SPECTROGRAM VISUALIZATIONS

# Anonymous Footsteps

MOM (MAX): -23.75 (LUFS) at 00:00:04.644  
SHORT (MAX): -28.49 (LUFS) at 00:00:05.759

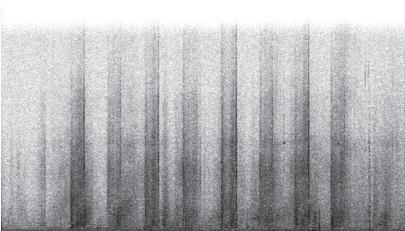
Traveling through the workspace.

As guests come and go through the libraries's workspace, the shuffling of their footsteps on the carpeted floors alerts you of their presence.

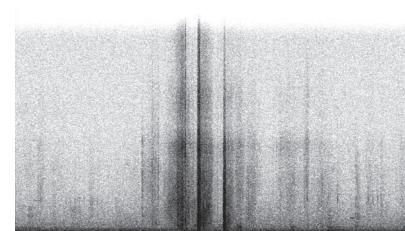
Depending on how active the workspace was, you would generally tune into the hushed whispers of a guest's footsteps sneaking across the floor. The closer these footsteps were to your immediate location, the more distracting they became. The increased volume of the step paired with the curiosity of their exact location provided a strong distraction.

This audio was recorded at a distance, within the communal workspace of the library.

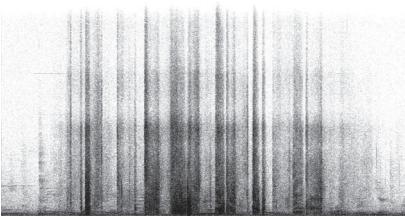
[one]



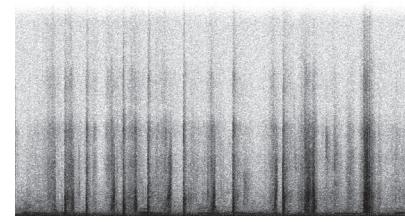
[two]



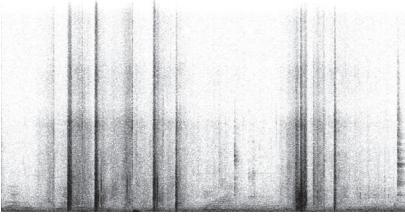
[three]



[four]



[five]



# Mouse Clicking

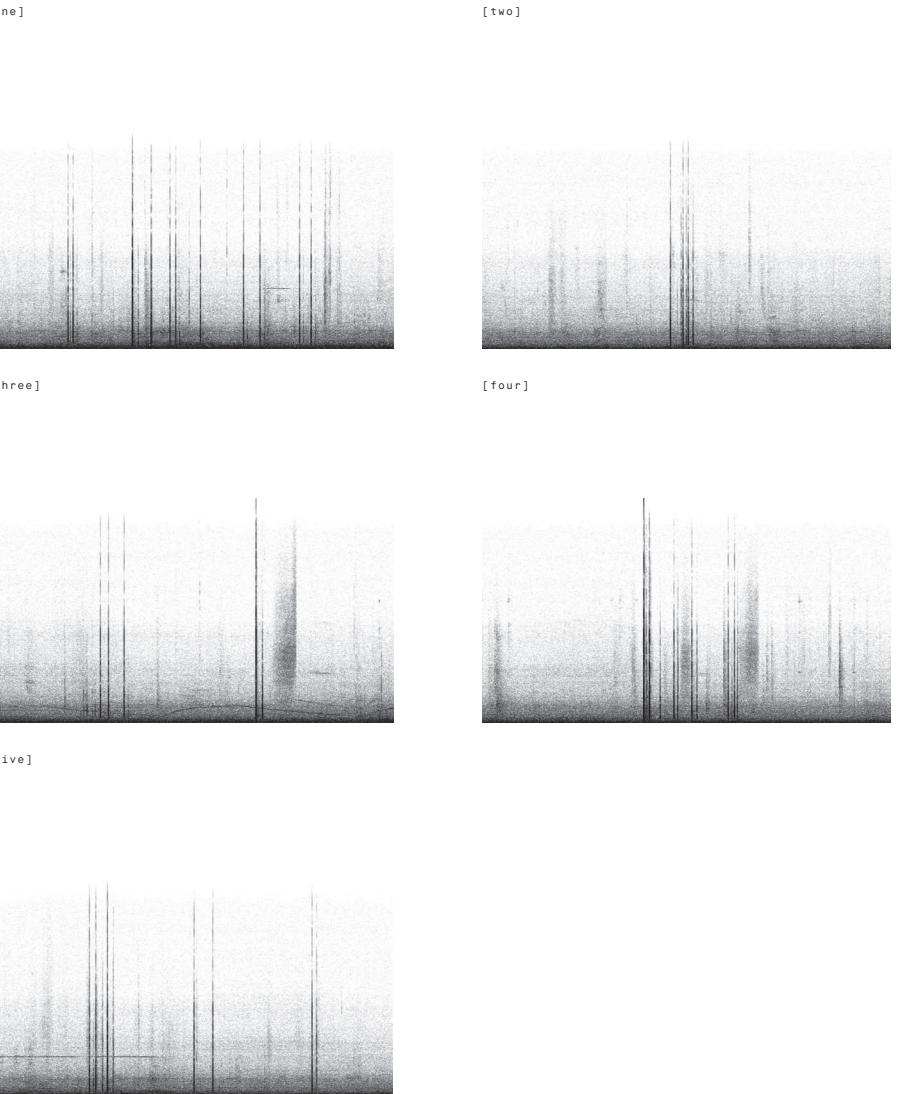
**MOM (MAX): -23.74 (LUFS)** at 00:00:04.459  
**SHORT (MAX): -28.88 (LUFS)** at 00:00:07.059

Operating a computer mouse.

Accommodating the many laptops that populate the workspace, computer mouses can be heard operating.

You're frequently greeted with an exciting burst of clicking as you enter the communal workspaces. This clicking can be sporadic, increasing the distracting nature of the small bursts of sound.

These recordings were captured at a close distance, within the communal workspace of the library.



ENVIRONMENTALLY SPECIFIC AUDIO

SPECTROGRAM VISUALIZATIONS

# Pen Writing

**MOM (MAX): -28.93 (LUFS)** at 00:00:02.044  
**SHORT (MAX): -33.00 (LUFS)** at 00:00:04.459

Scribbling or drawing with a pen.

The shearing of a pen on paper is prevalent within the workspace.

Frenzied workers race to trap their ideas on paper, it's a common to hear an army of pens frantically making contact with paper. This comes with the territory, and it's common for many of these sounds to blend together, however the auditory nuances can stand out and become distracting.

These recordings were captured at a close distance, within the communal workspace of the library.

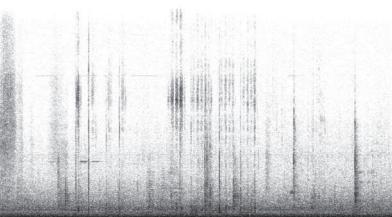
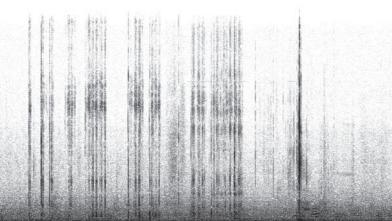
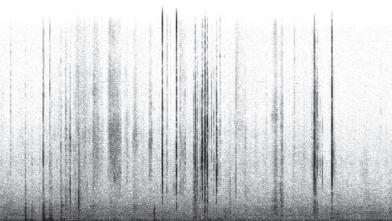
[one]

[three]

[five]

[two]

[four]



# Headphones Dropping

MOM (MAX): -16.30 (LUFS) at 00:00:02.601  
SHORT (MAX): -20.87 (LUFS) at 00:00:05.202

Dropping on a desk or table.

Getting up from the workstation to take a break, or put your music or podcast on hold, the tumbling of headphones impacting the table.

Coming or going, taking a break from music or running to the washroom  
- headphones crashing against the wooden tables of the workspaces constantly demanded your attention.

These recordings were captured at a close distance, within the communal workspace of the library.

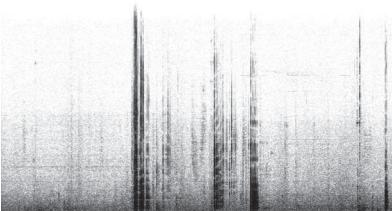
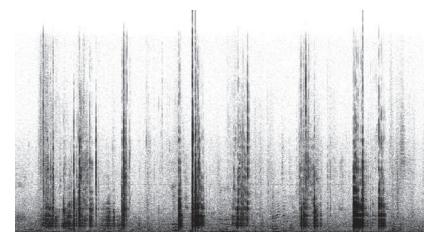
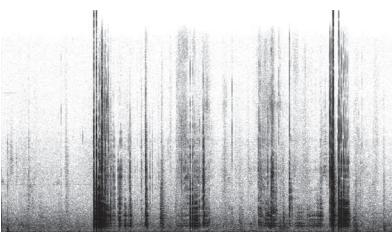
[one]

[three]

[five]

[two]

[four]



# Longplay

**MOM (MAX): -12.41 (LUFS)** at 00:07:29.353  
**SHORT (MAX): -18.10 (LUFS)** at 00:07:29.539

The longplay recording is 10 minutes.

The longplays curiously capture the ambiance of the environments.

All 5 recordings take place in different locations from around the coffee shop.

[one]

[two]

[three]

[four]

[five]

ENVIRONMENTALLY SPECIFIC AUDIO

SPECTROGRAM VISUALIZATIONS

