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Citizen Impulse Responses: City Protest Spaces and Echo Chambers

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Abstract: Echo chambers are both spaces where sounds reflect until they lose their sharp edges and ways for citizens to lose perspective until only one viewpoint is reflected back. Echo chambers and their equivalencies have been used in music for decades. In our social and mass media, echo chambers have only recently made the headlines, particularly leading up to and following the 2016 U.S. presidential election. These cultural and physical echo chambers can be captured and studied, but what about the echo chambers found in the soundscapes of urban streets? The process and creation of the Citizen Impulse Response Library has connected these echo chambers of politics, democracy, media, and the streets of the U.S. capital. It is a collection of impulse response files created from recordings at protests in Washington, D.C. This conceptual yet tangible product grew from the history of spatial sonic effects, urban, and democratic soundscapes.
Keywords: echo chambers, impulse response, spatialization, protest soundscape, politics and sound.

Respostas impulsivas do cidadão: espaços de protesto na cidade e câmaras de eco

Resumo: Câmaras de eco são tanto espaços onde os sons refletem até perderem seus limites claros como maneiras pelas quais os cidadãos perdem a perspectiva, até que apenas um ponto de vista é refletido de volta. Câmaras de eco e seus equivalentes têm sido usadas em música há décadas. Em nossos meios de comunicação de massa e mídias sociais, câmaras de eco só recentemente têm ocupado as manchetes, particularmente no que antecedeu e sucedeu a eleição presidencial de 2016 nos Estados Unidos. Essas câmaras de eco físicas e culturais podem ser apreendidas e estudadas, mas e quanto aquelas câmaras de eco encontradas nas paisagens sonoras das ruas das cidades? O processo e criação da Biblioteca de Respostas Impulsivas do Cidadão tem conectado as câmaras de eco da política, democracia, mídias e das ruas da capital estadunidense. Trata-se de uma coleção de arquivos de respostas impulsivas criadas a partir de gravações dos protestos em Washington, D. C. Essa resultante tangível, apesar de conceitual, emergiu da história dos efeitos sônicos espaciais, urbanos e paisagens sonoras democráticas.
Palavras-chave: Câmaras de eco. Resposta impulsiva. Espacialização. Paisagem sonora de protesto. Política e som.

1. Introduction

The sounds heard within a space are not just the sounds created in the space, but the coloring and reflections of those sounds by that space. The tonality of a space is dependent upon the reflectiveness and absorptive abilities of the materials, the angles and the distance between reflective surfaces. Cities are not built with absorptive materials in mind. The materials in an urban center need to endure yet sparkle. Absorptive materials are intended to do neither.

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Echo chambers are both spaces where sounds reflect until they lose their sharp edges and ways for citizens to lose perspective until only one viewpoint is expressed and reflected back. In music and recording, echo chambers and their recreated equivalencies have been used for decades. In our lives, political or otherwise, echo chambers have only more recently made the headlines. Echo chambers in mass media and culture can be captured and studied, but what about the echo chambers found in the soundscapes of urban streets? And how do the echo chambers of politics, democracy, media, and the streets of the U.S. capital connect? There is a tangled history of echo chambers and spatialization through urban, music, and recorded histories.

As an artist, I have been creating, experimenting with and researching a conceptual yet usable impulse response library from the 2016 American presidential election and the resulting protests in Washington D.C. These impulse responses can reflect the physical, public, and political movements that went into its creation, and I will share the process of building a citizen impulse response library. The history of spatial sonic effects and echo chambers, urban, and democratic soundscapes are the building blocks from which the library has been created.

In order for sounds to be heard, they require an input and output, a transducing of energy. This project is not just the soundscape of capital city streets during protest marches, but the compilation of the reflections of these soundscapes, reflections of the movements through outdoor public spaces, reflections of the echo chambers, reflections of ourselves. And through this lens of echo chambers, examines how our culture and news reflect on us.

2. Spatial effects

The interaction of sound and space have changed over time. For most of history, the sound of a space has been intertwined with that space in the sound. These two concepts were not just linked, they had been inseparable. It was through the creation of rooms made entirely for reflections, echo chambers, that the concept of separating space and sound was first born.

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2.1 Reverberations

Reverb is a time-based modulator that for much of history has required three things: sound, space, and time. Both reverb and echo, as time-based effects, change the length of the original sound, utilizing time as part of their modulation. When these effects are added digitally or in a real space in real time, the listener experiences a shift in time, the sound of the past mixed with the sound of the present. (BLESSER, 2009, p. 16)

Reverb consists of three parts: early reflections, the original sound, and the later arriving reflections. The early reflections are the first sonic element of reverb to be heard, arriving after having traveled to and from the closest non-absorptive materials in a space. We hear early reflections within approximately 100ms of the original sound, dependent on the size of the room. These early reflections combine with the original sound and later arriving diffused sound waves to create the overall sound in that space at that time. Reverb is interactive and enveloping. (BLESSER, 2009, p. 62) Not only can it give us a sense of place, but it can give us a sense of what is in the space as well. (VÄLIMÄKI, 2012, p. 1421)

Reverb is measured in the amount of time it takes for the reverberated sound to decay 60 dB, otherwise known as RT60. This is the time for the late reverberation signals to have fully decayed, through its process of diffusion and filtering. If the space is large, that will result in longer RT60 time and delay between the direct sound and the first early reflection, typically called pre-delay.

These terms, RT60, pre-delay, and early reflections are now familiar to those who work with time-based effects, recording, design, and architecture. The vocabulary might be new, but these concepts of spatial acoustics have been around for thousands of years. Vitruvius was one of the first spatial architects. He created guidelines incorporating sound and architecture for Roman forums and theaters in the first century BCE. It was not until the late nineteenth century when Wallace Sabine brought science and sound together to create methods of measuring, controlling, and deadening reverberant spaces.

Spatial acoustics are not just about science, they are about the experience of sound in a place. That experience creates and evokes memories. It gives aural clues of the size, contents, and materials of the space. The acoustics affect the types of sounds that work

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well in a space, and determines the types of activities that should occur there. As recording audio and music moved into dedicated spaces, the previously incomprehensible act of removing the space from the sound, what Jonathan Sterne termed the "detachable echo," became possible. (STERNE, 2015, p. 111) By the middle of the twentieth century, engineers gained the ability to control and craft the sound of the space, and in doing so, the place and space in recording began losing its uniqueness and the connection between the two became tenuous.

2.2 Recording and spatialization

The space in which a recording has taken place has traditionally remained sonically imprinted in that recording. Recording sessions were live events in live spaces. Sonic reflections and the sound of the space, particularly after the 1920s with the development of the phonograph and microphone, became part of the recording. (DOYLE, 2004, p. 33)

Reverberation began with live reverberant spaces and distant microphone placement that could not isolate the recording artist but captured the original and reflected sounds. Specific rooms dedicated to sonic reflections, reverb or echo chambers, started to be used in radio broadcasts as early as the 1920s. Recorded music did not start using artificial reverb with reflective rooms until the 1940s. These chambers began as existing spaces: bathrooms, attics, or stairways where sound was sent to, played back in, and recorded. Specialized echo chambers, with the sole purpose of creating reverb, were built at commercial and label recording studios starting in the 1940s and 50s. Some studios and labels still utilize their echo chambers, having been in service for decades.

Portability was the next frontier for spatialization, starting with plate reverb in 1957. Sound was sent from the control room to the plate reverb, a heavy wooden box containing a large metal plate. The sound would bounce off and around the metal plate in its enclosure, to be picked up by a microphone that would transduce and return the reverberant sound to the studio. Plate reverb added even more control of sound and space, with the ability to change the reverberation time with the turn of a knob.

Plate reverb was portable, in theory, however a unit weighed hundreds of pounds and needed to be in a fairly quiet space with no extreme temperatures. While plate reverb was being made available at the commercial level, spring reverb was finding its way into

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studios and homes via Hammond organs starting in the 1930s. Spring reverb was also to be found in guitar amplifiers in the 1960s, and stand-alone devices for recording studio and home hi-fi use.

Echo or delay effects, using magnetic tape, were used in music production starting in the 1940s. These spatial effects gave a sense of space, but not of realistic habitable spaces. During the 1940s and 50s, they helped to change the linearity and types of spaces in certain musical recordings (DOYLE, 2004, p. 38).

Reverb is fickle. A single sound may not always create the same resulting sound in a space, even given the exact same circumstances. A reflection, one of perhaps millions, that takes even just one second to arrive after the initial sound, has traveled over 1100 feet. This travel changes the sound based on minute differences in humidity, temperature or the number or placement of furniture or people in the room. The reflections happen in a space that even if the listener has not been to, inherently understands some of its sonic properties.

Metal was the preferred medium for creating reverberation, one in a line of successors to hold or sample the audio for multiple seconds while not adding noise or filtering the sound excessively (BLESSER, 2009, p. 123). Other mediums included air, tape, film, and electronics. Newer and better spring and plate reverbs were being released throughout the second half of the twentieth century. This artificial reverb that both represented and constructed a space was a sign of things to come (STERNE, 2015, p. 113).

The 1970s and 1980s brought with it the ability to digitally create and modify sonic space. What began as DSP (Digital Signal Processing) algorithms in the 1980s were followed by ICs (Integrated Circuits) in the 1990s. This created two paths for digital reverb development: modeling and simulation of existing spaces or the creation of virtual spaces (BLESSER, 2009, p. 117). Reverb became available as a rack-mounted unit in the studio, sitting alongside a compressor or equalizer. Then reverb transformed even further, becoming available as a virtual effect, including digitized simulations of the artificial versions of itself.

Convolution reverb is the latest in the long line of spatial effect iterations, beginning in 1999. It recreates the sonic qualities of a space using impulse response files. These files

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have been recorded in the space and are encodings of the spatial reaction to a click, loud transient, or set of frequencies. An impulse response is going to let the reverb know what reflections occur in that space over a series of frequencies. Typically, impulse response files are created at the quietest moments, when there are no sounds, movement, or people. Convolution reverb is used to add a sense of space in general for music and for post-production sound for film, to give a sense of a particular space.

Convolution reverb has the ability to recreate any space. In reality, that is not quite the case. It is difficult to capture an entire space in one recording, just as a snapshot cannot take in an entire visual environment. Convolution reverb can also be used to combine other files, not strictly used for reverb. Any two files can be convolved, from white noise to cymbals, to create spaces that are not spaces (DERUTY, 2010).

The ability to create and modify spatial effects in music recordings was happening simultaneously to architects and scientists creating and modifying the sound qualities of physical spaces. As long reverb times in living and working spaces became less sonically appealing, architects lowered their recommended reverb times from 3 seconds in 1923 to 1.5 seconds in 1930 (BLESSER, 2009, p. 108). This control over reflections in the physical environment mirrored the control engineers were being given over reverb in the recording arena. As digital spaces were created and modified through electronic and digital reverb, digital environments and echo chambers were becoming part of our everyday lives and affecting not only what we heard but what we understood to be truth and fact.

3. Echo Chambers in the United States

The Cambridge Dictionary defines an echo chamber, in part, as “a situation in which people only hear opinions of one type, or opinions that are similar to their own” (CAMBRIDGE, n.d.). People in echo chambers only encounter news and opinions that they agree with, believing it is the only side of the issue (DUBOIS, 2018, p. 729). According to Google Trends, the use of the word “echo chamber” jumped in popularity in online searches in the United States starting in September 2015, with a jump in November 2016 and peaking in August 2017 (GOOGLE, n.d.).

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Even before the 2016 U.S. election was underway, many U.S. citizens were choosing only to use those information sources that echo their same point of view. Throughout 2014, the nonpartisan Pew Research Center closely examined political polarization in the United States. Researchers examined sources of news, based on political leanings. They found that people who lean consistently to the left utilize a variety of news sources, including the New York Times (10%), NPR (13%), CNN (15%), and MSNBC (12%) and trusted 28 of the 36 listed news sources (MITCHELL, 2014).

Almost half of conservatives (47%) primarily received their news from Fox News and trusted 12 of the 36 listed news sources (MITCHELL, 2014). By 2020, the divide has widened. Pew revisited their 2014 study and found that Republicans have increased their distrust of most news sources over the past five years (JURKOWITZ, 2020). This media environment, or as James N. Cohen has termed it 'echo-system' is, like reverb, all-encompassing (COHEN, 2018, p. 147). Sometimes the echo is all that you can hear, and it masks the sounds of anything and everything else.

Echo chambers censor or underrepresent "competing views by enforcing social homogeneity" (BASTOS, 2018, p. 2). Media diversity is crucial to minimize the effects of political echo chambers. Examining the root of the term can also be helpful in remedying the problem. Echoes are the reflection of a single sound source that is repeated, returned, and renewed (VALLEE, 2017, p. 99). The original sound is created and gone, while an independent but tethered abstraction returns one or multiple times (VALLEE, 2017, p. 99).

Factual news vacuums are dangerous to democracy, as citizens become agitated due to false information. In order for democracy to be heard literally and figuratively, journalists need to be able to cover events, locally, regionally, nationally and globally. Between 1990 and 2017, the workforce of daily and weekly U.S. newspapers were more than cut in half, while Internet publishing jobs more than doubled (SHAFER, 2017). A liberal democracy requires more than journalistic coverage of public affairs. It requires discussion and compromise. These things are not possible if nobody can agree on the facts or what the truth is.

While there are still uncertainties over how influential Russia and other propagandists were in creating and spreading false information through social media, it

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is known that there were entities who successfully helped create and enforce digital echo chambers or filter bubbles. This came to light in February 2018 when thirteen Russians and three companies were indicted by the U.S. Justice Department in a "sophisticated network designed to subvert the 2016 election and to support the Trump campaign" (APUZZO, 2018). It was also revealed that the private company Cambridge Analytica surreptitiously collected a third of the U.S. electorate's Facebook user data, to manipulate the 2016 election through echo chambers (MARTINEZ, 2018).

There are many ways to interpret what led to and the outcomes of the 2016 U.S. presidential election. The citizens of the United States, through its established yet flawed democratic system, elected an unqualified, xenophobic, misogynist, narcissistic, uncreative, uncaring reality television personality to lead the country.

The shock of this election led to many feeling shocked, disappointed, scared, and angry. Most channeled their frustrations into protest through social media, to their elected officials' offices and phones lines, and most visibly and audibly, onto the streets. This was especially true for women, people of color, and LGBTQIA citizens.

After the election, many pundits stated that the election results were only surprising to urban dwellers, as they were living in their own echo chambers, in their own realities (SHAFER, 2018). The implication was that those living in cities, who cast ballots for Hillary Clinton, the winner of the popular vote, were not listening to the rest of the country.

It is the soundscapes of the streets of these cities that changed almost immediately after the 2016 election, as protestors gathered in public spaces to voice their concerns. City streets in the United States became physical echo chambers, with government, public, and commercial buildings reverberating the sounds of a diverse concerned citizenry. From 2016 through 2020, city streets from Washington D.C. and beyond have been filled, then silenced, then filled again with the voices and the reflections of those demanding change.

4. "This is what democracy sounds like"

While American cities have hosted many protests, the 2016 election results brought people from across the country onto the streets. Many public spaces in U.S. cities are

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commercialized, designed more for consumption and congregation than for democratic assembly and discussion (CHUN, 2014, p. 657). Despite this, citizens rediscovered their collective voices. The resonance, through street and public spaces, reflected throughout the unique spatial acoustics for urban and democratic soundscapes.

4.1 Sonic reflections in city streets

For the space to be heard, a sound has to activate it. In doing so, the activation modifies the sound (BLESSER, 2009, p. 15). The space responding to sound is what Blesser and Salter term 'aural architecture'. It is dynamic, reactive, and enveloping (BLESSER, 2009, p. 16). Cities offer public and walkable spaces and architecture for visual and sonic reflection.

It is important for cities to have public places to talk and discuss politics, meet, and gather with visibility and symbolic importance. City sidewalks are where one steps out and into the public, shadowing the public square (LABELLE, 2010, p. 91). Sidewalks are the space that is in between inside and out, private and public, where "the meeting of city policy and private use" can be experienced (LABELLE, 2010, p. 108). Community cohesion can be enhanced through shared experiences, including in public spaces, conversational "third places" and in informal social spaces that have been labeled "fourth places" (AELBRECHT, 2016, p. 134). Quentin Stevens, in examining urban spatial experiences, divides public spaces into paths, intersections, boundaries, props, and thresholds (STEVENS, 2006, p. 807). These are thresholds, edge spaces, paths, and nodes, places that are publicly accessible but possibly privately owned, where people walk, watch, and wait (AELBRECHT, 2016, p. 134-135). Jane Jacobs noted that streets and sidewalks are "the main public places of a city, are its most vital organs" (JACOBS, 1993, p. 37).

These public and in-between places, city sidewalks and streets, are the primary sound sources. What happens to these sounds depends on the structure and spatial architecture of the city. On city streets with low buildings, where the height to width ratio is low and the visible sky to entire surface is large, sound energy dissipates and scatters into the sky, not remaining in the street for long (ONAGA, 2007, p. 319). But sound lingers and reverberates in streets with high buildings. The width of the street also plays

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a part in the reflections. In narrow streets, the number of sound waves reflected towards the ground will be higher than those reflected towards the sky which increases the number of total reflections (CAN, 2015, p. 86-87). Diffuse reflections with low frequencies remain in the street but high frequency reflections, which are also reflected in more directions, dissipate and are absorbed into the air (PICAUT, 2005, p. 167). A sound source in the middle of the street, as opposed to an intersection, is also creating back-diffusion, where the sound, particularly high frequencies, have emanated from all sides of the sound source, including behind the sound source, to return with longer arrival times to the listener (PICAUT, 2005, p. 171).

Most modern cities are constructed from glass and steel. Mirrors and glass are geometrically reflective surfaces that reflect light and sound. They also project sound at higher levels with longer reverberations and decay times than other building materials (MANABE, 2015, p. 244). Main and side urban streets have long reverb times, even longer than what is acceptable for interior spaces. Reverb on city streets average one to three seconds with an early decay time of about the same (KANG, 2001, p. 292).

More textured and irregular materials like concrete help with diffusion. Absorptive materials, in and around buildings, like trees, spaces between buildings, open windows that can act as sound energy sinks, can help lower reflection energy and reduce urban sound pressure levels (KANG, 2001, p. 287). These softer materials, of air, trees and people absorb more sound, particularly in the higher frequencies. (MANABE, 2015, p. 244).

When there are no people on the streets, the city sounds are much different. An examination of urban sounds during the lockdown periods of the COVID pandemic deserves entire articles, issues, and books. During March and April 2020, the regular background sounds of a city, so often minimized, masked and ignored, became the topic of national newspaper headlines. Seismological data being collected in cities dramatically changed when we all went inside and businesses and transportation shut down (ANDREWS, 2020). These sounds that we take for granted were not reflected off the buildings, but in the media as the roar of urban life as we know it turned into a whisper, all over the world (ANDREWS, 2020).

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4.2 The sounds of protests

People join protests for many reasons. They want others to know about a problem, to inform. They want to express their feelings or dismay. They want their politicians to listen, to change, to learn. They want to disrupt public space or interfere with the established order (LABELLE, 2010, p. 115). They might want to be with others who believe in the same goals, to be part of a community. Participation in a democratic action, working together on a common goal can bring joy (PAIT, 2017, p. 235). It is not just the act of protesting, but the sounds that "can, and must, be summoned to generate, harness, and leverage emotional energy toward collection actions" (PRESLEY, 2018, p. 310).

Unlike photographs and video, political and protest soundscapes tend to be temporal and in the moment, technically capturable on video and audio with a vibrancy that digital and physical media have trouble capturing. No matter the outcome of the protest, it can be these sonic moments, where voices are echoing, resonating, amplifying and becoming one that are the most memorable in sensory, if not physical, memory.

Cities with narrow streets and reflective buildings can create echo chambers. These reverberant and sonically alive spots can excite, energize and build the sense of solidarity among protestors (MANABE, 2015, p. 241). Others have written about protests and events seeking energy from a space of acoustic resonance. Matt Sakakeeny writes of a New Orleans funeral parade detouring to play under a bridge to "orient individuals as a collective occupying a shared space" (SAKAKEENY, 2010, p. 3). Noriko Manabe has written of favored sonic conditions for anti-nuclear protests in Shibuya, Japan. During one protest, a protest march was temporarily halted by the police in a very narrow road with tall glass and steel buildings on both sides.The echo and reverb created an "impressive cacophony" that energized the protestors vocally and sonically (MANABE, 2015, p. 253). During many of the protests that I have attended in Washington D.C. since the 2016 election, any time the route takes protestors past the privately and controversially owned Trump International Hotel, protestors yell "SHAME" in a way that upon reflections and various timings echoes and grows in resonance. This space of resonance can focus the sound and energize, making the crowd seem and feel more powerful.

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5. Citizen Impulse Response

Before and after the 2016 American presidential election, the metal, concrete, and glass of government and privately-owned buildings lining the streets of Washington D.C. and other cities have created reflective surfaces for amplified politician's speeches and the call-outs of collective citizenry in protest. The sounds are political, from their content and context to their localization. What we might typically think of as noise in the recording of a political space contains the sounds of action and reaction by citizenry and the physical reflections of the politics in that space. This noise can be isolated and examined with noise cancellation software, doing the exact opposite of what the software is supposed to do. The echo chamber of that moment in time is contained in what is typically disregarded, the noise.

Convolution reverb digitally recreates a space by using a recording from that space, an impulse response (IR) file. Most impulse response libraries, collections of these IR files, are of silent unoccupied interior private spaces: concert halls and echo chambers. They are also typically recorded by white straight men. The input is generally a digitally created file, a sweep of frequencies, crescendoing from low to high. The output is a digitally recreated sanitized interior space. How different would an impulse response library be that has been created from spaces and speeches, activism and reactions, filled with tens and hundreds of thousands of people of all genders, sexuality, races, and ethnicities not standing quietly but yelling their concerns in exterior public spaces? The frequency sweep here is not digitally created, but human made, ranging from the low beat of drums carried by protesters through the frequency range of human speech. The Citizen Impulse Response Library grew from these sounds and places.

5.1 Washington D.C. Protest Soundscape

The sounds of commerce, traffic, and commuting overtake the urban soundscape much of the time. It is these sounds that reverberate and are filtered through the materials and people on and surrounding the city streets. After the 2016 presidential election, the sounds of protestors became ever more present, particularly in the capital city, Washington D.C.

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Washington D.C., founded in 1791, did not have marches or protests until 1894. This first march involved a ragtag group of 10,000 diverse unemployed men and women who made their way across the United States following a populist, Jacob Coxey, and his message of mass infrastructure employment. The protest broke the law at the time, banning protests on the Capitol building's lawn and grounds (GRINSPAN, 2014). Despite his arrest, the march created opportunities for others to occupy the streets and symbolic spaces of the nation's capital, from suffragettes to the Ku Klux Klan to civil rights marches (PARKINSON, 2014, p. 157-158).

The Washington D.C. soundscape is like that of most other medium-sized cities. The spatial architecture of the streetscape differs, as buildings vary in age, height, and materials. Washington has many public buildings, made of marble, stone, glass, and steel, and protests down straight, wide streets reflect and carry the sound. The streetscape differs also in its 'deputization', where the hardened street elements help protect buildings from attack while adding more reflective surfaces (KRIEGER, 2003, p. 66).

While Washington D.C. has a robust Metro subway system, car traffic remains a significant part of its soundscape. When traffic is shut down for protests, the localized city soundscape develops a very wide dynamic range. In between the chanting, exclamations and rhythmic instruments that are accompanying the rhythm of the chant, there can be almost absolute silence, just the shuffling of feet on the street with an occasional conversation between protesters. While there is always some form of amplification, literally and figuratively, on the stage for organizers, politicians, and activists, most of the marching is unamplified. This allows for chants to make their way down the line of protestors, where reflections and reverberations can, at times, throw the timing off.

Counting people at protests or demonstrations is difficult and typically the media and politicians get the numbers wrong. According to countlove.org, a website that counts the protests and demonstrations in the United States since January 20, 2017, there have been almost 20,000 protests with over 12 million attendees in the United States alone through June 2020 (COUNTLOVE, 2020). The individual themes of the protests vary, with civil rights, racial justice, gun control, and immigration leading the way (COUNTLOVE, 2020).

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The largest protests started with the Women's March on Washington in January 2017, the day after Trump's inauguration. Over four million women and men marched in and across the United States and around the world to be part of what is likely the largest single day demonstration in U.S. history, with at least 500,000 in Washington D.C. (CHENOWITH, 2017). In 2017, it is estimated that between 5.9 and 9 million people protested in the U.S., with 74% of the protests against Trump administration policy or issue viewpoint (CROWD COUNTING CONSORTIUM, n.d.). Since the original Women's March, some of the most well attended protests/events in city streets, including Washington D.C. have been the second Women's March with at least 2 million protestors in January 2018, March for Our Lives for gun control with 2.5 to 4 million marchers and walkout participants in March 2018, and 2.5-4.5 million people in June 2018 in different LGBTQ pride events and Families Belong Together protests to stop family separation (CROWD COUNTING CONSORTIUM).

The Citizen Impulse Response Library is as much conceptual as it is physical. The day after the 2016 U.S. presidential election, many of us were shocked with a feeling that remains to this day. While national politics does not affect every citizen immediately and directly, the dismay was felt deeply by many, including myself. I began to read and research, to try to find out how this could have happened, how a country with a supposedly fully democratic system could have elected an unqualified reality television personality into its lead role.

5.2 Creative Process

My research connected terms in audio recording with the 2016 election, starting with the term echo chamber. This is a fertile area of research - combining politics, science, sociology, psychology, communications, audio, and beyond. Living in Baltimore, Maryland less than an hour away from the nation's capital, I had an opportunity to reverse my complacency and attended and recorded as many marches and protests as I could. These ranged from smaller protests with hundreds of people to the Women's March in Washington that, despite claims of 500,000 attendees, seemed to be double that.

While researching, I collected the recordings from multiple protests, from the first Women's March in January 2017 through the third Women's March in January 2019 and

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many of the major protests in between. Overall, I attended and recorded ten protests in Washington D.C., with others in Baltimore and Kansas City, Missouri. I was attending these protests as a concerned citizen as well as an artist and scholar. Reflections of my voice are to be found in some of the impulse response files.

My first work with convolution reverb and non-traditional impulse response files involved using political speeches from one party as the impulse response file for a politician from the other political party, for example, Obama's last speech as president as the IR file for Trump's inauguration speech. This was intriguing and created interesting results from the melding and convolving of sounds. The word convolution originates from the Latin word *convolvere* which means "roll together" (OED, 2018). Convolution is a mathematical term, to combine, but it is also in our vocabulary as entwining (OED, 2018).

The Citizen Impulse Response Library is the entwining or combining of different sounds in different spaces, diverse protestors with voices and emotions in the reflective spaces of government buildings. It is the sonic equivalence of a subject that Teresa Hoskyns writes about, the intertwining of the spaces of democracy and the democracy of space (HOSKYNS, 2014, p. 4). I wanted to make sure to capture the voices rolled together, to record a multitude while being cautious about privacy. The impulse response was recorded and edited in an entirely digital format, but what it was based on was live, at that moment. The convolution was in real time and very human and emotional. No recording or library, or convolution reverb can ever truly capture that.

I cropped out certain sections, looking for transients and rhythm and similar moments across marches. I experimented with using Izotope RX6 denoise software to listen to the "noise" versus the original signal. RX6 can also dereverb and just output the reverb. While ideally, this could have isolated the reflections, because there are so many layers in some of these recordings and the software is not infallible. The denoising and dereverbing process at times created very digital, choppy audio that was not listenable.

In editing the files, I had to decide on beginnings and endings of the impulse responses. Unlike a traditional impulse response file, which uses a handclap, starter pistol, or sweep of frequencies, I had hours of recorded audio from close to a dozen protests. Some of the files ended up involving handclaps, that transient sound that is at times used for more traditional IR recordings. The sound can be comforting and piercing, when part

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of a group, the "sound of membership in a crowd that safeguards one's identity" (GOODALE, 2013, p. 219).

I experimented with and without fadeouts on the files. In a space, the late reflections fade out, as the sound and reflections dissipate and diffuse in the space. A traditional IR file would include this decay to silence.

To hear what the impulse response files sounded like applied to other audio, I experimented with applying impulse response files to other impulse response files, and to other sound files. I used Waves IR-1, that uses convolution reverb and can import any wav file as an IR file. One of the most effective sounds to apply the impulse responses to was a ticking clock[1].

Conclusion

Space and sound are intertwined, their past and their future. When we hear a spatialized sound, we learn and inherently know something about the originating sound and the space in which it is reflected. As we gained control over their interactions, we still found reasons to keep spatialization audible.

While physical echo chambers, of city streets and studios, blend sounds with versions and reflections of themselves, virtual echo chambers are homogenous and dangerous. It is these online echo chambers, where singular and similar opinions are the sole reflection, that have helped to create a strong, consistent, and resonant set of protests in cities in the United States and around the world. These events have continued since the 2016 elections.

The sounds of democracy in action, of diversity, of protests, of city streets, are reflected in and through the glass, steel, and marble buildings. It is possible to capture these sounds and convolve them with others, as one would with a traditional impulse response library. But what does one do with this response library? Most impulse responses are used for other recordings, to recreate spaces, to put the listener in a particular place, real or virtual.

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1 To hear a collage that incorporates the Citizen Impulse Response Library, you can listen on SoundCloud https://soundcloud.com/bad-crow/citizen-impulse-response-lankford-sound-collage (LANKFORD, 2019).

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Upon reflection, the convolving is already happening in real time during protests. The melding of diverse actions and voices in protests in U.S. city streets and beyond is a physical convolution reverb, where government and commerce buildings provide the reflective surfaces, and each of us attributes to that impulse response. Reflections only happen when there are actions. It is therefore up to each of us to be part of a collective response library.

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