Activated Sound

> *Activated Sound* is a pre-show sound installation of user-controlled political songs, resonant pulses, and sine drones. In the spirit of inclusiveness, activism, and peace, it attempts to include the audience in attendance in meaningful and activating music making.

In *Activated Sound* I attempted to engage with all of the issues I had identified as central to my thesis through a piece in a concert situation. I created a musical texture centered on a selection of primarily anti-war political songs. In addition to identifying a topical focus of the piece, I selected the format of an interactive installation, featuring four microphones, the input to which controlled much of the balance and sound of the installation. By presenting an interactive installation as pre-show entertainment for a show in the World Music Hall, I also attempted to engage with the social topography of the performance space, by rearranging the roles of audience members through getting them on stage to make music.

As pre-show entertainment for an evening length series of activist performances, I wanted *Activated Sound* to be empowering and participatory—to draw the audience into the show and make them feel activated and included in a community with similar progressive goals. To this end I wanted the interactive design of the piece be easy to understand yet complex enough to involve audience members in sophisticated, intricate, and fun music making in a political sonic context. The piece was designed, in part through the incorporation of direct interactivity, to counteract the divide between those on stage and those in the seating area, bringing audience members on stage, and involving them in performance.

Four microphones placed around the hall controlled sonic texture of the installation. One of the four microphones, at the left entrance to the auditorium, controlled the playback of a CD of political songs. Two other microphones, in the center of the stage and in the center of the seating, controlled the pitches of a background texture of sine drones. A fourth microphone at the right entrance to the hall controlled the speed and resonant frequency of a pulsing sound that panned actively around the room, providing further textural interest.

The CD, reflecting anti-war sentiment and other leftist political messages, could only be heard when the amplitude coming into the first microphone was relatively soft. Participants speaking into this microphone were rewarded for listening carefully and hopefully engaging more seriously with the installation, but did not get anything out of shouting into the microphone. This prevented louder voices from dominating, neutralizing a potential of imbalance in favor of more obnoxious or more assertive participants.

A set of political songs formed the conceptual centerpiece of the content of *Activated Sound*. Some songs, such as Marvin Gaye's *What's Going On* and Phil Ochs' *I Aint A Marching Anymore*, contained explicitly anti-war lyrics. Other songs, such as *Four Women* by Nina Simone, were included to broaden the political resonance of the set of material. I chose some of the songs myself and also consulted Professor Rob Rosenthal and a friend of mine, Allysia Guy, for suggestions.

The SuperCollider program sampled pitches from the input signals coming through two central microphones when they reached each of three volume thresholds and assigned these pitches to corresponding sine waves, creating a multi-layered

texture out of the multiple rates of activity. For the microphone at the right entrance, louder sounds sped up the frequency of the pulse from about seven times a second up to around twenty times a second. The pulses resonated at pitches obtained by sampling the pitches coming through the microphone.

Activated Sound attempted to encourage audience participation in the creation of an active and dynamic sonic texture. The World Music Hall's lit stage at the base of rows of seating created a social topography that directed audience members to stay seated. I hoped to alter that social topography and allow audience members to take a place on stage amidst anti-war songs and a rich texture of drones and pulses under their control.

I hoped additionally to undermine the potential of the microphones to privilege louder noises. The left-positioned microphone allowed songs to filter through the speakers only when the relatively quiet sounds came through the microphone. Participants shouting into the right-positioned only increased the frequency of the pulses, which played at a steady volume. The volume of the sine drones was also independent of the volume of the input to the two centered microphones. For these programs, louder sounds could trigger more sine drones to latch onto new pitches, but could not increase the volume of the drones.

Additional steps to rearrange the space's social dynamics included the placement of microphones on stage and in the audience. The timing of the installation, designed to bring people up on stage just when they might be expected to find seats, also tried to subvert the line between audience members and performers.

Despite my attempt to bring the audience on stage, only very confident people and individuals who already considered themselves performers or actors took command of the installation. Rather than blur the lines between audience members and performers, *Activated Sound* requiring audience members to speak into microphones in front of a large audience. In asking audience members to stand up, the piece demanded that participants forgo their audience status, losing their seats in the concert hall. The installation encouraged self-identified performers without activating the rest of the audience.

I also learned a great deal from the performance of *Activated Sound* about the social forces surrounding musical shows in concert venues. People's hesitance to engage with the installation by speaking into the four microphones, especially the sine drone microphone in the center of the stage showed me that it takes a great deal of initiative to get up on a lit stage. Even in this informal situation where the majority of audience members were talking to each other and paying little or no attention to the sound installation, very few people felt comfortable enough to use that microphone. I also observed that the desire of audience members to sit down prior to a show is very strong. Understandably, most people chose to secure a good seat, get settled, speak to friends, and read the program over participating in the installation.

In addition to facing discomfort over entering a lit stage area, many people feel uncomfortable speaking into microphones. Even in this installation environment, where input picked up by the microphones was processed through analysis/synthesis to produce entirely different sounds and where the audience's attention was dispersed, the size of the crowd and the associations surrounding a microphone, seemed to

render the task of using the microphones too similar to public speaking for most audience members to be comfortable. People were not entirely comfortable interacting with the system as the logic governing the processing of their sounds was too opaque.

Some interactive measures were more apparent to audience members. The relationship of the resonant pulses to the microphone controlling their parameters was transparent despite its complexity. The audience members favored more apparent processing. Participants easily realized the relationship between their voice and the resonant pulses and enjoyed playing with the sound program. Those who first used the installation by trying out that microphone moved on to other microphones and had more patience for those more opaque interactive schemes.

The other two interactive modules were less successful. The sine drones were difficult to locate spatially, making their responsiveness difficult to tune prior to the installation, and difficult to understand or even activate while at the microphones. In the loud, full concert hall, and with active pulses and loud sine drones in the musical texture, it was also difficult for participants to understand what the recording-playback microphone was controlling. Since the CD was only audible while a participant made relatively quiet sounds, many people attempted to speak into the microphone, did not have any successful interaction, and gave up.

The complicated texture and complicated nature of the interactivity in *Activated Sound* provided few incentives to participate in the piece. Instead the piece was very demanding of audience members, asking them to speak into a microphone in front of an audience, giving up their audience status to perform. I learned that I

needed to weigh the effect of prominently placed microphones against high pressure on audience members. I also found that a dense sonic texture with too many inputs controlling sound characteristics could create a confusingly broad focus to interactivity. I also learned that people's willingness to participate in an interactive installation depended on the balance of incentives and risks involved in doing so. *Activated Sound*, in requiring people to leave their seats prior to a show, get on stage, and perform in order to interact with a beautiful but complicated and opaque sonic texture, required a lot of confidence on the part of audience members.

I had hoped to excite and politicize the audience at the show prior to the beginning of the program and engage in consciousness-raising about the continuing war in Afghanistan and the rising push toward war in Iraq through the inclusion of the political songs activated by the first microphone. The infrequent emergence of the songs in the sonic texture due to the complicated interactivity resulted in some loss of the piece's topical significance. I had hoped the interactivity would boost the meaningfulness of the songs but it instead nearly removed them from the installation. By requiring people to play songs they did not recognize without the ability to know what songs would come on next, and also by cutting off songs in the middle of verses, I inadvertently discouraged audience members from participating, and minimized the meaningfulness of the songs. I could have been more successful in increasing the installation's political resonance by preserving the narrative of the music, and including interactivity by giving people choice over which songs they heard. Giving the songs lingering presence in response to attempts at interactivity and placing them

at the core of the sonic texture also could have increased the strength of the piece's political message.

Activated Sound should have focused more explicitly on the political songs, and provided more incentives and fewer obstructions to participation. As a pre-show installation, it faced a difficult task in attempting to encourage audience interactivity, a task only complicated by the opaque processing and dense sonic texture.

Resolution

Performed by members of the Wesleyan New Music Ensemble

Resolution is a series of five short movements, where each performer is provided with a sequence of instructions serving as a framework for improvisation and a pitch set representing each movement's closing sonority, forming the notes of a dominant seventh chord.

The experience of the dominant seventh chord is central to *Resolution*. As the chord in western tonal music theory with the strongest tendency to resolve to the tonic, its inclusion calls up the harmonic memory imprinted on many people by years of exposure to classical and popular western music. By leaving the voice-leading up to the performers, to the audience, and to chance through the interactivity and indeterminacy specified in the score, and by resolving to the dominant, rather than the tonic, *Resolution* facilitates an exploration on the part of the ensemble collectively, and its members and audience members individually, of the ways in which a harmonic doctrine has transformed our hearing. *Resolution* provides a mechanism through which to explore our ability to hear things differently, and to engage critically with our harmonic education.

Members of the New Music Ensemble developed individual and collective guidelines for dealing with the instructions in the scores during the rehearsal process leading up to this performance. Their performance of *Resolution* is an expression of their relationship as an ensemble, their relationship to an audience, a performance space, and a musical language.[2]

[2] This description is taken in modified form from the program notes for the Wesleyan New Music Ensemble 14 December 2002 concert.

I composed *Resolution* for a commission from the Wesleyan New Music Ensemble for pieces exploring the role of a conductor in an ensemble. I chose approach that guideline by focusing on the internal dynamics of the ensemble. I hoped to explore the social relations in the ensemble, as well as the relationship of the ensemble to its audience and performance space. Written for an acoustic ensemble of up to twelve players, the commission also provided me with the new challenge of creating a score to express my compositional intentions. By instructing the instrumentalists to draw on various sound-producing sources in the performance space, I hoped to draw new lines of power and communication, re-writing the social constituting forces in the space through scored interactivity.

The scores for *Resolution* distinguished between different zones of power in a performance situation—the ensemble, audience, and performance space. The scores also notated the proximity of a given instrumentalist to other members of the ensemble—a notational decision that led the ensemble to perform the piece in several physically separated clusters. Interactivity was notated through the inclusion of "Mimic" and "Vary" commands, which instructed the performers to mimic or vary certain features of sounds they observed. At different times, the score asked performers to mimic or vary aspects of sounds emitted by other members of the ensemble, by the audience, or in the performance space. The notation also accommodated specifications of what aspect of a sound to mimic or vary such as its pitch, dynamics, or timbre, and what sound to mimic or vary in the zone of power

specified in the score, a nearby or distant, loud or quiet, or high or low sound, for example.[3]

The "Mimic" and "Vary" instructions allowed the performers to improvise on their connection to sounds from different locations in the space. The notation guided the elaboration of audible connections between different members of the ensemble, their audience, and the Multi Purpose Room in the Campus Center, where the performance was held. Much of the interactive subtlety included in the instrumentalists' scores, however, was lost during performance. The scores were restrictive, requiring sound events to occur in specified order and often precisely controlling what sort of sound a performer could react to and in what manner. The acoustic isolation of the performance space combined with the attentive silence of the audience left the ensemble with little to mimic or alter.

I hoped audience members might realize during the concert that their accidental and intentional activities and sounds could be picked up by members of the ensemble and influence the sound of the music. Had the piece been performed in a noisy space, where instrumentalists could replicate conversations and other audience

[3] See "General Performance Instructions" in *Resolution*, Appendix 1

sounds, this might have produced a more participatory atmosphere, drawing audience members into the performance, though not radically disrupting concert protocol. But my limited and unannounced attempts to include the audience were too subtle to engender any significant response from them. In an untested performance space and in front of a quiet audience without prior experience of the piece, the performance of *Resolution* was striking for its resemblance to the ensemble's performances of other pieces and did not clearly display the social and aural connections in the space.

While rehearsing, however, the lines of power in the ensemble were actually reformed. At each meeting the ensemble reached new decisions about how to delegate authority in determining the pitch content of section endings, how to begin and how to end sections, and what guidelines to keep in mind when improvising beyond those specified in the score. In leaving these matters up to the ensemble, *Resolution* intentionally forced the group to consider its internal structure and ask questions about conducting and decision-making process.[4] In working on *Resolution*, members of the ensemble reported to me that they became more attentive to their own actions and sounds as well as those of others in the group. The terms of the commission requested that the pieces consider the role of the conductor. As the ensemble became more aware collectively of the piece's structure and decision-making process, that obligation was more and more completely fulfilled.

Resolution, due to the complexity of the "Mimic" and "Vary" commands, improved the interactive capacities of the ensemble members as well. *Resolution*

[4] The "Score for Ensemble" encouraged the ensemble to think critically about its group dynamics and collective decision-making process by leaving a variety of questions about performing the piece up to the group. See *Resolution*, Appendix 1

became a favored piece to practice, and an effective tool for building the ensemble members' ability to respond to each other during performances and their listening, and cooperative improvisation skills. Performers were able to ease into increasingly complex interpretations of the interactivity notation, asking increasingly detailed questions about the requirements of the piece and learning to make good collective and individual decisions about realizing the composition.

Artificial Space

First realization performed by	Matt Bauder—Saxophone Jesse Pearlman Karlsberg—Laptop Juliya Salkovskaya—French Horn Heather Wieler—Voice
Second realization performed by	Sarra Ibrahim—Voice Jesse Pearlman Karlsberg—Laptop Heather Wieler—Voice

> Two vocalists improvise while wearing closed headphones. A third performer, also wearing headphones, controls processing of the two voices. The processed versions of the vocalists' sounds return to their headphones and to a pair of speakers. Unable to hear each others voices, but able to hear the processed versions of their collective improvisation, the vocalists inhabit and perform in an artificial space, an aural network of headphones and a computer. By changing the processing, the third performer manipulates the features of this space, altering its sonic and social topography. The audience, able to hear the vocalists both processed and unprocessed, engages with the sonic environment from a different vantage point.[5]

Next, I began examining the effects of different sorts of interactive vocal processing in performance. I noticed that the act of wearing headphones seemed to change my improvisatory behavior along with changes in the sorts of processing. I

[5] This description of the 15 February 2003 performance of *Artificial Space* is taken in modified form from the program notes for my senior recital in the New Music Mini Festival

decided to use headphones to explore the impact of different degrees of isolation on the power dynamics between participants in a sound environment, and on those participants' feelings and behavior in the environment.

A series of preparatory pieces revealed the complexity of participants' relationship to the processing. I decided to focus on performance rather than installation settings to explore the effects of different sound-modifying programs in a more controlled environment. By isolating my inquiry, I hoped to learn more about the social effects of different processing.

By utilizing headphones I also introduced a new space into the physical environments my pieces occupied. I explored the effect of different processing on its power dynamics. This space, overlaid on the physical space in which the installation or performance took place, created an alternative associative sphere with different aural and social features. Through the imposition of this space I could affect the audience's perception of the dynamics of the external location for the piece. Isolation within the artificial space could distract performers from their exterior physical location. By changing the rules governing the artificial space by altering the processing, the dynamics of the artificial space, and through it social hierarchies of the physical performance space became flexible.

I also tried to make interacting in my headphones pieces rewarding. I created aural rewards, writing active, articulated, and aesthetically appealing interactive sound-modifying programs. I also worked a little on creating visual responses to sound data to help participants connect their input to the sound coming through headphones or speakers. Visual responses also added another aesthetic reward for

participating. While developing different sound-modifying programs, I created a series of informal presentations for my thesis meetings, preliminary sketches for a larger scale installation involving a few input signals in the form of laptops, aural outputs in the forms of headphones and speakers, and visual outputs on the monitors of the laptops.

In this hypothetical installation, which I abandoned in favor of performance headphone pieces, one person would control processing of input signals from between two and four stations. Each station would be equipped with a pair of closed headphones and a microphone or laptop computer. In addition, many pairs of "earbuds," tiny headphones that can be inserted into ears would be left around the room. When unused these "earbuds" would serve as speakers—broadcasting quiet twittering samples of the processed input signals.

People walking around in the space could access the sound environment from a variety of entry points with different features. Speaking into a microphone, would allow a participant to fully enter the artificial space by hearing your voice processed through closed headphones. People in these positions would have the additional ability to modify the characteristics of the sound by improvising into the microphones. Wearing closed headphones would, however, separate a person from the physical location of the piece. Engulfed in the artificial space, such a person would be unable to hear unprocessed sounds very clearly.

The individual controlling the processing would also wear headphones, isolated in the artificial space. This individual would have the unique power changeg the rules of the artificial space, re-mapping the interactive relationships between

stations. Without a microphone, however, the person running the processing would be unable to interact directly in the artificial space.

A participant wearing "earbuds," while plugged in to the artificial space, would be unable to interact with the processing. Such a person would also hear a different version of the processed sound, with different equalization due to the frequency response of the "earbuds." The more permeable "earbuds" would also enable listeners to hear the people at the stations voices in the external physical space occupied by the installation. People walking around outside the headphones network would still hear a hint of the processed sound environment emitted from unworn "earbuds." Such participants would have the strongest connection to the physical space of the installation and would hear the people at the stations' unprocessed sounds clearly.

While the multiple-tiered structure of the installation itself created a complex interplay between the social pulls of the artificial and physical spaces, the openness of the installation environment would also impact the social topography. Participants would be free to bring any sonic vocabulary to the input signals. They could sing, speak, or make vocal or body noises of any sort, or even use props or instruments. This unpredictability would increase the potential power of such participants and require that the program be able to accommodate any number of loud or difficult to handle sounds.

Each of the different demonstration pieces featured a distinct mix of sound-modifying programs. The first of these preliminary installations, *Monologue 1*, featured a single input signal with several different types of processing that could be

fine tuned and combined by a performer. A compander filter allowed the processor to change the dynamics of the input signal, limiting, noise gating, compressing, or expanding the signal. The compander could limit and locate the dynamics range of the signal in numerous ways. Other tunings could establish a set of rules guiding a relationship between a user's voice and feedback. *Monologue 1* also featured a delay filter, which played quieter echoes of the signal at regular intervals over the input. Including delay allowed me to explore how participants would react to playback of their own voice. Pitch shift and ring modulation filters altered the frequency content of the input more radically by shifting it or multiplying it by a modifiable pitch. *Monologue 1* also contained a program combining ring modulation with a single echo of the input signal.

Conversation Piece 1, a second informal installation for two microphones, headphones, and speakers, used two-band equalization to control the volume of sounds. Combining low and high pass filters, which cut off frequencies above and below modifiable thresholds, allowed the processor to isolate each of the two input signals to different frequency bands, for example, making one signal high and the other low. *Conversation Piece 1* achieved clarity with its clearly defined range of processing possibilities.

Different types of interactive processing could dramatize social features of the installation environment, or even alter its balance of power. The relationships between users were especially flexible and could be altered simply by assigning different processing to the different input signals.

Compander and equalization filters are audio tools normally used by recording engineers for purely aural functions. Through their incorporation in interactive structures, however, they became imbued with social power. A compander filter has the ability to compress or expand the dynamics range of an input signal, allowing the individual running the processing to give different input signals different dynamics characteristics. The filter could also change the volume of each input signal. A compander filter could be used to create a dynamics hierarchy where some voices were louder or more prominent than others. The particular ability of equalization to

modulate the width of the frequency range audible form an input signal, made it possible to introduce flexible hierarchical relationships between users. Equalization could also isolate the voices of different users by limiting their input signals to different frequency ranges.

Reactions to delay varied from unease, to surprise, reservation, enthusiasm, awkwardness, or creativity. Some participants, when confronted with delay began to improvise in rhythmic counterpoint to the delayed echoes of their signal or attempt to create a sophisticated textural or harmonic sonic environment. Others became quiet, reacting with embarrassment to the sound of their own voice. Delay, in adding layers of input from one signal could also multiply the sonic presence of that signal.

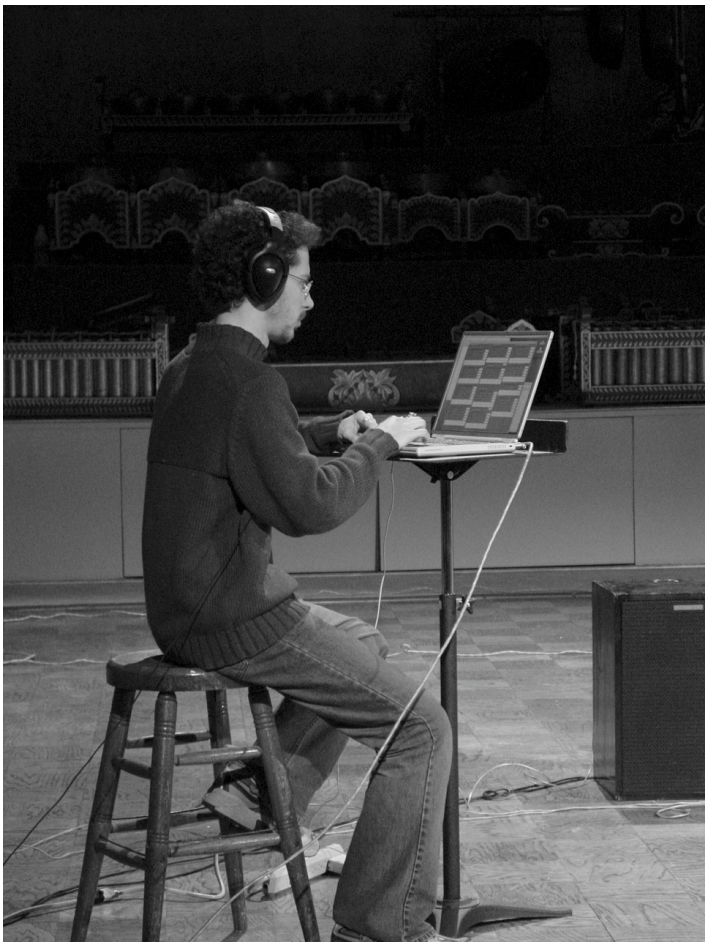
The unusual aural effect of ring modulation could differentiate a channel from others, lending it more prominence. Ring modulation also reduces the intelligibility of words. This complex effect of this filter impacted the social topography of the space in unpredictable ways relating to the personalities of individual users. Pitch shifting could reduce the audibility of words more severely than ring modulation and lend sonic prominence to a channel through introducing a distinct timbre. The implementation of pitch shift I experimented with, in which louder sounds caused the pitch of the input signal to shift upwards, forced participants to fine tune the volume of their voice to a moderate to quiet level in order to keep their voice intelligible near its natural pitch range. Performers could alternate between intelligibility and increased presence by making very subtle changes in their voices.

The third preliminary work, *Duet 1*, also featured two voices, headphones, and speakers, but the sound-modifying programs described above with programs that processed by analysis/synthesis. These programs synthesized sound with parameters based on data from the input signals. The vocal processing in *Duet 1* created entirely new sounds, distinguishing the input to the microphone from the output over the headphones. In this sort of a processing environment the artificial space tended to

impose itself more strongly on the headphone-wearing participants, more directly impacting their improvisations.

Enclosed in an environment with sounds that their input signals clearly controlled, but where no sounds actually resembled their voices, some performers became inattentive or forgetful of their external surroundings. I wanted to test whether the removal of words from the sonic texture would set different limits to how complicated processing could be and remain transparent. I also wanted to explore the degree to which this more abstracted and encompassing artificial space allowed more subtle differences between processing programs to effect interactivity.

For some sound-modifying programs in *Duet 1*, the relationship between the synthesized sounds and the user's voice was easy to grasp. This made users feel more comfortable improvising in the artificial space. One such program synthesized windy-sounding filtered noise that followed the frequency and amplitude of the input signal. Another program played a two-note chord of sine tones with the lower note corresponding to the frequency of the input signal. The interval between the two notes could range from a major to a minor third, enabling the processor to change the rules governing the sound's relationship to the user's voice.



Other patches had room for even more extensive rule changing. A modified version of the resonant pulse sound from *Activated Sound* and an echoing distorted ramp wave that followed the amplitude and frequency of the voice accommodated sophisticated alterations in the interactive relationship between the user and the synthesis program.[6] Users could learn to interact with increasing depth, improvising with a given sound-modifying program over an extended period of time as new functionalities were introduced. Some other programs involving resonant filters were more opaque, and required precise tuning. They tended to respond to narrow amplitude bands and only certain ratio-metrically related frequencies and were otherwise unresponsive. *Duet 1* nonetheless exposed differences between processing by analysis/synthesis programs and other forms of processing. It also displayed the interactive depth of sound-modifying programs with the capacity to change the rules governing the processing.

[6] See "Artificial Space, Second Realization – SuperCollider Code" in Appendix 2 for revised versions of many of these processing by analysis/synthesis programs.

Eliminating the intelligibility of words created a more abstracted context for the social topography of the artificial space and magnified the difference between the sonic environment within and outside the headphones network. Without the ability to talk to each other, users wearing headphones are necessarily engaged on a more specifically sonic level, more self-contained through their inability to use words, but highly interested in exploring the sonic texture. This texture may sound more unfamiliar but its relation to the participants' input is clearly audible due to its utilitzation of the input signals' frequency and amplitude data. The increased disjoint between the unprocessed and processed sounds for participants wearing closed headphones also tends to intensify the immediacy the artificial space constituted by the computer and headphones network in relation to the external physical space.

My work displayed that many features of analysis/synthesis programs could change the distribution of power over a headphones network. Programs that synthesized articulated or sustained sounds and programs with different frequency ranges, dynamics, and even timbres, all evoked different responses from users. Timbre often proved the most distinctive feature of a sound-modifying program, and often exposed dramatic differences in users' improvisatory style. The transparency of a particular sound-modifying program also affected the dynamics of the headphones space.

Combining different-sounding programs and adding or subtracting programs from the processing of a given input signal could also shift the social relationships between participants. Introducing a louder sound or one with a similar timbre could mask sounds from the same or other input signals, subtly changing the features of an

input signal or the relative strength of different voices. Subtracting sounds could alter the balance of power by exposing masked sounds and shifting the balance of sounds with different timbral, or frequency characteristics within the artificial space. Changing the processing of different input signals to introduce greater variety can also change the social relationships between users.

Familiarity of with the processing could make a user more confident and enable a user to engage more deeply with the program. As performers in the second realization for concert performance of *Artificial Space* grew used to the processing I was able to deploy, their behavior in the headphones network grew more sophisticated, varied, and comfortable.

The effect of a person's musical and personal history on their reactions to different processing and on the power dynamics of the installation is more unpredictable. Different individuals frequently reacted to the same processing in divergent ways, as was the case with delay in *Monologue 1*. Exploring social topography in an artificial space filled with synthesized sounds showed me that changes in the dynamics of the space related to processing and personal differences in unpredictable ways.

My desire to explore social topography in headphones environments, crystallized into an interest in performance situations as a way to ensure a more controlled environment, and to work more closely with participants using the input signals. In a performed version of *Artificial Space*, I wanted the tension between the social topographies of the headphones network and performance space to be audible. I hoped to display how processing could affect the dominance of certain performers

and change the social dynamics between members of the ensemble. The context of performance introduced additional features to explore, including the extent to which developing a score for performers, and choosing a specific rehearsal process would help to explicate these concerns.

In rehearsing for the December performance of *Artificial Space*, it became clear that a notated system of interactivity, such as the system used in *Resolution*, was excessively complicated and impeded the players' ability to improvise with each other. After abandoning the *Resolution*-like scored model I had developed in reference to Christian Wolff's *For One, Two, or Three Players*, we decided to try a system of triggers, in which each player could play sounds with certain general characteristics when they heard sounds with certain other characteristics. I hoped this system would create a recognizable relationship between sounds and performers that would alter as the processing changed the likelihood that sounds with relevant characteristics would occur. The trigger system proved too constraining, restricting the performers' ability to improvise and leading to dead ends where no performer was able to make a sound in response to another sound under the system. We next separated the piece into three sections with distinct processing, with the hope that improvising with the processed sounds in the artificial space would expose the social changes induced by altering the processing of the artificial space.

Each section had associated pre-set processing. I was able to modify some parameters of the processing in performance to respond to the performers' improvisations. The first section applied ring modulation and a one second delay to each input signal. The second section used longer delays with different lengths for

different performers. The third section resembled the first, but the ring modulation was partially tuned to frequencies sampled from the input signals.

I could further alter the rules of interactivity by changing the length of the delay, or the static ring modulation frequency in any of the three sections. In the third section, I could also change the degree to which the ring modulation followed the pitch of each input signal. I could also 'limit' any of the three signals at any time, a feature of the compander filter discussed earlier. This enabled me to change the maximum overall volume of different players, and even silence the output from a player. This allowed me to interact as a participant in the piece from a different vantage point and even communicate specific signals such as the end of a section.

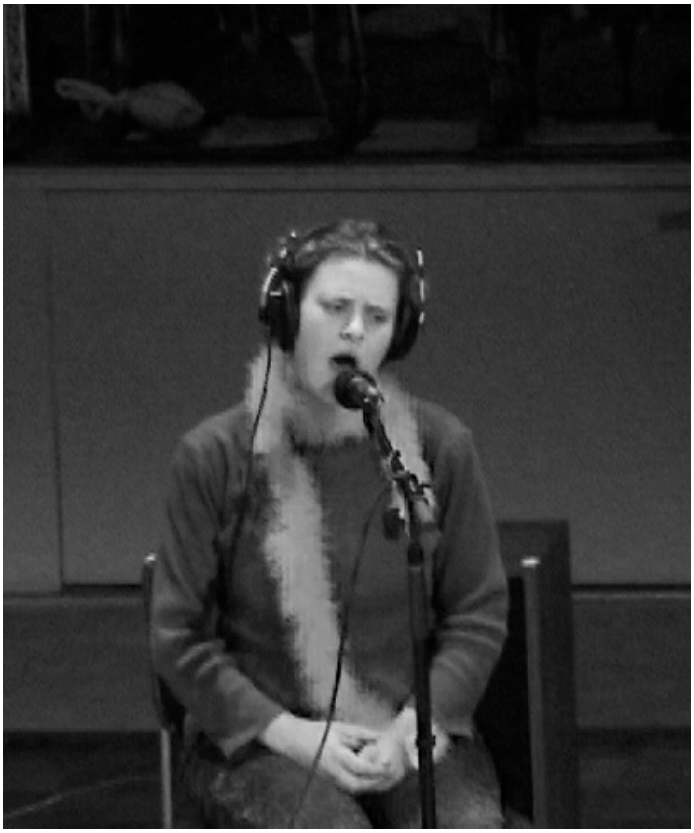
While practicing and during the performance of *Artificial Space*, the ensemble's dynamics changed from section to section. Performers responded acutely to changes in the length of delay or the frequency of the ring modulation of a given signal. Through these responses the piece conveyed the flexibility of the ensemble's social topography even within a section. While some processing changes affected performers' behavior, the performers often seemed as though they were improvising solo or in relation to the other performers unprocessed. The loudness of the two horn players, in particular, meant that the performers could hear each other outside the headphones network. Additionally, the headphones network was only successful after the first two rehearsals. For the first rehearsal, in fact, even the processing for the piece was unfinished. As a result, much of the rehearsal time was spent improvising without any processing. While sectional changes caused audible shifts in the dynamics of the ensemble during performance, the performers seemed insufficiently

engaged in the artificial space, and were unresponsive to a variety of subtle changes in the processing.

For the second performance of *Artificial Space* in my February thesis concert, I hoped to work more on familiarizing the performers with the artificial space, enabling them to interact more subtly with the processing. I decided to place more emphasis on rehearsals. I also wanted all performers, including myself, to spend the rehearsals wearing headphones. I also chose to use interactive processing by analysis/synthesis programs to create a stronger disjoint between the performance or rehearsal space and the headphones space. I hoped that this selection of processing would have more depth than the patches used in the December performance. I also hoped that this disjoint would place the performers more wholly within the artificial space.

Having abandoned the idea of a score, I hoped the rehearsals would help the two vocalists and me to develop a vocabulary in relation to the experience of improvising in the headphones network with different processing. I held rehearsals solo with each performer and conducted the rehearsals entirely within headphones. While rehearsing, we used SuperCollider patches I had written specifically to allow a solo performer and I to speak to each other while rehearsing in headphones. During the rehearsals we alternated between extended improvisation, running through all the processing programs, and discussion about the effects of the processing. The performers developed a musical vocabulary for performance and became more comfortable navigating the artificial space. Since the performers rehearsed separately, this process also enabled each vocalist to develop distinct ways to handle the sound-

modifying programs. The rehearsals also gave the performers an opportunity to request changes in the processing or point out gaps in the program. I reprogrammed the resonant pulse program and added new types of processing in response to these requests to provide the performers with interactive features they wanted. In a final rehearsal before the performance, the three of us rehearsed together, worked out an ending to the piece, and decided upon a loose format for its progression. The solo



rehearsals had introduced the performers to the effects of the processing system. This made it possible to adopt a long form improvisatory approach with the sound processing simply another part of the musical language of the piece.

The experience and familiarity resulting from the rehearsal process rendered audible much more subtle features of the individual performers' relationships to the processing, microphones, each other, and the external space. By the time of the concert both performers were comfortable improvising while wearing headphones and changing the processing resulted in clear yet subtle differences in the way the performers improvised and interacted. We interacted visually by glancing at each

other across the World Music Hall stage, and aurally, by responding to the processed versions of our sounds through the headphones network. Audience members, while unable to contribute aurally to the sonic texture, could hear both the processed and unprocessed sounds. These various interconnections created a multi-textured complex of interactivity in which all participants in the creation and audition of *Artificial Space* interacted from different aural and visual perspectives.

I used delay and a selection of analysis/synthesis programs to process the input signals. The depth of this processing placed the vocalists' focus in the headphones space. The processing brought out highly individual responses, illustrating the different performance styles and personalities of the vocalists. Heather Wieler, one of the two vocalists was particularly responsive to long delay lines. With a substantial background in different polyphonic music traditions, she built complex multi-layered textures, accommodated by the processing patch which allowed me to let an input signal repeat as many as 100 times before decaying. At various points she created a jungle-like texture, a matrix of different laughing sounds, and a complex cluster of sustained tones with timbres drawn from different vocal traditions. Sarra Ibrahim, the other vocalist, particularly liked a processing

patch I wrote at the request of Heather, with the intention of creating a program that responded particularly well to articulated sounds. This patch featured echoing ramp wave blips based on the performers' sounds. Sarra used the repetitive features of the patch to create complex rhythmic patters and also created complex phasing and sloping textures by making sustained sounds of different lengths.[7]

By wearing headphones and improvising more extensively than I had in the first performance of *Artificial Space*, I was less dominant in the social texture of the February performance. Due to an unfortunately short FireWire cable, I was forced to sit much further away from the two performers than I had during rehearsals. While I remained on stage and interacted with the two vocalists visually and aurally, the increased distance did lead to a feeling of greater separation than had been the case during rehearsals. Performing while wearing headphones, however, distributed power more equally than had been the case in the December performance. In the February performance, I improvised with the same sonic environment as the other two performers. By removing sections from the performance, I also had to engage in much more involved improvisation, changing the processing more frequently and more substantially than I had in December. In the first performance, my position outside the artificial space, as a privileged monitor of the processed and unprocessed output of the performers gave me more of a conducting role. Here, while my role differed from the other two performers, I became a member of the ensemble.

[7] For descriptions of these patches and others used in the February performance of *Artificial Space*, see "Artificial Space, Second Realization – SuperCollider Code" in Appendix 2.

The February performance of *Artificial Space* displayed subtlety and wide variability in changes to the social topography and aural experience of the piece. The rehearsal process facilitated the emergence of subtle alterations in the power dynamics between participants. The analysis/synthesis programs, which removed words from the sonic texture, and the variable length delay, also enriched the interactive environment. In *Artificial Space*, processing worked differently with different people, emphasizing the degree to which personality remained an important contingency. Additionally, people altered their behavior and relationships in response to different processing, illustrating the significance of processing changes in changing the social topography of the artificial and performance spaces.

Skating Ice Rink Resonator

> I took figure skating lessons for a number of years as a child. I remember while skating we would listen to music played over speakers mounted on the ceiling of the rink and that the sound would reverberate and echo off the walls and ice, creating a rhythmically complex and cacophonous sonic texture. This piece is designed with the resonance of an ice rink in mind. Two expendable speakers may be skated around the rink by interested onlookers for the duration of the installation, causing the pan, echo, and equalization to shift.[8]

Shortly after the end of winter break, I set up an installation on the Freeman Athletic Center ice hockey rink during a musical event organized there on a Saturday night. In this piece, *Skating Ice Rink Resonator*, a non-interactive SuperCollider synthesis patch sent loud echoing blips through a pair of speakers left on the ice. People at the event were invited to push the speakers around, twirling and shoving

[8] This description is adapted from the comments in the SuperCollider code for *Skating Ice Rink Resonator*. See Appendix 2.