

# TOWARDS THE USE OF TECHNOLOGY IN DIVESTING MUSICAL AGENCY

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in partial fulfillment of the requirements for completion of the  
Evidence and Inquiry certificate and the  
Polymathic Scholars honors program in the College of Natural Sciences at  
The University of Texas at Austin

Spring 2019

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## Acknowledgements

This paper would have not been possible without the support of many incredible people all across the campus of the University of Texas at Austin. First, I would like to thank my thesis advisor, Dr. Nina Young. Her support, guidance, recommendations, and incredible enthusiasm allowed me to grow and become more confident in my skills as a scholar and artist. Next, I would like to directly thank those who were willing to discuss their art with me as I embarked on this project. Their discussions shaped the course of this document, and their pieces brought joy and excitement to my life. Additionally, I would like to thank my many colleagues at the Butler School of Music who broadened my horizons and encouraged me every day. I would also like to thank Dr. Rebecca Wilcox. Her direction, suggestions, and incredible institutional knowledge ensured that the writing experience was pleasant, productive, and as smooth as possible for all parties involved. Lastly, I would like to thank my colleagues in the Polymathic Scholars Honors Program. Their help and support through this process has been immeasurable.

# Abstract

Composers over the centuries have used the technologies available to them to influence their creative practice. As technology has evolved, so too has the composers' ability to precisely express which sounds they desire and how those sounds should be implemented in performance. Such specificity on the part of composers was criticized by proponents of the "Open Form" work in the 1950s and 60s, including John Cage, Morton Feldman, and others. Since this movement, the democratization of personal computers, mobile phones, and smart devices has drastically changed the musical environment and enabled a variety of new avenues for composers and musicians to explore. In this thesis, I examine the different technologies used by contemporary composers and the extent to which they encourage centralization or distribution of musical agency. Mobile devices enable experiences such as personalized music and geographic-specific audio, and custom instruments, both physical and software-based, bring opportunities and limitations to the works they create. Through an analysis of artists' works and the technologies used in their realization — with pieces ranging from Lejaren Hiller's *Illiac Suite* to Laurie Anderson's *Landfall* — I outline a set of technical paradigms that enable composers to divest agency to performers, listeners, and the environment. From specific techniques to broader approaches, such a collection of characteristics serves as a guide for current and future creative practitioners looking to make technologically based collaborative, interactive, and interdisciplinary works.

# Chapter 1. Introduction

Music is often described as a dialogue between three entities: the composer, the performer, and the listener. The history of Western Classical Music is, in many ways, the history of the composer taking compositional agency for themselves away from these other groups. From the earliest notes used to inscribe the melody of Gregorian chant, to the mass distribution of sheet music, to the computerized playback of recordings, many developments in music technology have been aimed at empowering the composer to more precisely articulate what they intend to say, and in doing so, take interpretive liberty away from the performer and listener. Indeed, Varèse, in his writings describing an evolutionary trajectory for the future of electronic music, called for machines that could exactly replicate the sounds indicated by a composer on a score, allowing “it [to] reach the listener unadulterated by interpretation.” (Varèse, 1939) Such a machine would give the composer absolute power over the performer and eliminate them from this dialogue in western art music that has existed for centuries.

While the trend to concentrate power upstream has been the predominant function of technology in music, the purpose of this thesis is to examine other uses of technology, primarily those aimed at redistributing power away from an all-powerful composer. I analyze how the trends towards divesting musical agency may be categorized, with examples reaching well beyond the traditional mid-twentieth century definition of the “open” work. I first outline the major repositories of musical agency that many composers initially divested to, then examine how the introduction of new technology shifts these approaches to either exemplify the trends already present and add more elaborate interfaces between the agents and the resulting musical experience.

Looking to the future, I argue that the direction of technology’s influence over music should be to increase the ability for composers and curators to share power with performers and listeners,

rather than to continue increasing direct control over the audio they create. By additionally pulling from the field of music perception, I posit that the avenue of future development with the greatest possible impact will be that which allows for greater divestment. Consequently, I will focus primarily on technologies that shift this to the most extreme extent possible, ultimately examining those targeted at giving agency to the listener.

## Chapter 2. Existing Movements to Divest Agency

Movements aimed at divesting musical agency — the ability to control an experience for an audience member — from the composer to other forces have been at the very heart of many core movements of twentieth century music. When composers look to divest agency, they often give creative license to the performer, incorporate aspects of the environment, or cede control to other artists involved in realizing the piece. This expands the number of parties in the conventional trifecta of “Composer to Performer to Audience” to include the environment, interpreters, and other art practitioners working towards the same experience. Today, these multimedia works span several musical traditions, reaching from the avant-garde with composers such as John Cage and Morton Feldman, to Jazz and Bluegrass inspired artists including John Zorn and Anthony Braxton. All of these works aim to expand the variability, dynamic expression, and experiential opportunities to be had with a work. These pieces “offer themselves, not as finite works which prescribe specific repetition along given structural coordinates, but as ‘open’ works, which are brought to their conclusion by the performer at the same time as he experiences them on an aesthetic plane.” (Umberto Eco, 1959)

The opposite of this trend to divest agency would be efforts of the total serialists and advocates of new complexity. Such movements, championed by the likes of Karlheinz Stockhausen, Brian Ferneyhough, and Pierre Boulez, aim for the concentration of agency in a single role: the composer. Their aim to control every parameter of the music being performed manifests itself in the form of complex notation and compositional systems, and by extensive use of electronic playback of highly sculpted audio.

While paradigms to divest musical agency abound in the music of the mid twentieth century, many had their roots planted centuries prior in music history. Mozart’s *Musikalisches Würfelspiel* (*Musical Dice Games*) from 1792 gave his performers a chance to compose their own waltzes. The



tradition of empowering a soloist to compose or improvise their own cadenza for a concerto gives the performer a great deal of artistic agency. Much of medieval and renaissance literature is full of musical games, puzzle cannons, and other works that show a proclivity to invite thinkers and musicians to have a hand in creating the pieces they perform. These ideas around randomness, dice throwing, and chance would get reintroduced in the geographically centered works of Hildegard Westerkamp and the environmental listening practices of Pauline Oliveros, as they shift agency to the environment. The practice of creating graphic scores, or otherwise indeterminate notation mechanism is part of a trend to shift agency to the performer, reminiscent of previous traditions of live improvisation and virtuosic showcases. The San Francisco Tape Music Center's emphasis on collaborative immersive events was one of the earlier broad recognitions that divested agency to other creative forces to yield a more comprehensive and immersive multimedia experience. At their core, all of these pieces questioned the central principle of a composer as master orchestrator, and all worked to define movements that would later be expanded upon greatly influenced by technological advances.

## **2.1 - Existing Musical Trends to Shift Agency to the Environment**

The most notable composer for divesting his compositional authority to other sources is John Cage. From his famous "silent" piece *4:33* (1952), to his *Aria* (1958) utilizing graphic notation, to his *Sonatas and Interludes* (1946-1948) for prepared piano, most of Cage's works encourage the acceptance of all sounds into the folds of music. Just as Cage looked to include non-traditional sounds in his music, so too did he search for non-traditional compositional forces. In his most well-known work, Cage instructs the performer to sit *tacit* (silently, not playing) for three movements whose total duration adds up to four minutes and thirty-three seconds. During this duration, the sounds of the hall, the audience, and the larger environment all form the content of the piece.

During performances, this often means listening to HVAC systems hum, audience members coughing, and birds or insects outside if it is amiable weather. By making these sounds the content of the piece, Cage decrees that the environment shall have direct agency over the musical content of the piece.

Another artist who posits that there is great intrinsic value in the sounds of the environmental is Pauline Oliveros. Her practice of *Deep Listening* aims to encourage a listener to comprehend as much sonic information as possible from their surroundings. Her work establishes several different forms of listening, including “focused listening”, “open, global, and receptive listening”, “inclusive listening” and “exclusive listening”, among others (Baker, 2003) The application of these ideas is that one can develop their listening ability by actively practicing exercises that hone these skills. Such activities focus on listening to a whole or portion of the soundscape. As the sounds that are present drastically change from session to session, the environment has a monumental impact on the overall experience of the exercises.

Other more modern pieces also place an emphasis on the environment. *Inuksuit* (2009) by John Luther Adams has been hailed as “the ultimate environmental piece” (Tommasini, 2012). This work takes place spread out over a large outdoor area that the audience is invited to wander. The performers, over the course of a full hour, play music that responds to and is emboldened by the environment in which it sits. The piece, scored for between nine and ninety-nine percussionists, is ultimately mediated by the environment in which the work is placed, and in doing so, Adams cedes a great deal of musical agency to this force. Gusts of wind, birds, insects, water features, and other people inhabiting the space all are expected contributions that the environment adds to the composition.

Other sonic art objects that place specific emphasis on the environment include the modern-day audio tour and soundwalk. Many audio tours incorporate a shift of agency to the environment

and how the audience moves about within it, as they must account for anticipated aspects of the environment in every decision they must make. For example, in *Embodied Ways of Listening: Oral History, Genocide and the Audio Tour* (High, 2013), High outlines how the geography and anticipated sonic landscape affected the design and composition of the audio tour they produced. Incorporating aspects like anticipated traffic noise, known rest points, and other features of the geography, the physicality of the location they were producing the work for was forefront of their mind when producing the experience.

When divestment to the environment is pushed further, one arrives at Hildegard Westerkamp's practice of *Soundwalking*. This practice calls for the listener to curate their environmental sounds by seeking out particular sonic experiences in their surroundings. Similar to the ideas championed by Cage, Westerkamp's works call for the inclusion of all sounds as music and encourages the practitioner to move around spaces in order to curate these sounds. The pieces that result from this practice would often appear as a short set of instructions, instructing the listener to consider "which is the quietest sound of your body?" and then "Lead your ears away from your own sounds and listen to the sounds nearby." The resulting experience is one that can highly tailored to be meditative, educational, or contemplative, but always highly dependent on the soundscape one is inhabiting.

While the soundscape of environmental noises is certainly sufficient for music, many composers began to question how to bring the seemingly random quality it affects into a more traditional musical paradigm. Such a harness would allow the environment to act however it might and allow a performer to then interpret the actions on musical instruments. Such an interface would take the environment as input and create a musical experience as the output, with the performer acting as the go-between to dutifully to realize the composition. John Cage once again pioneered these interactions as he began incorporating the *I-Ching* as a random number generator in his

compositional process, introducing chance into his *Music of Changes* (1951). This incorporation of randomness was later incorporated in performance, as Cage, instead of performing the *I-Ching* himself, directed his performers on how to use the device. This resulted in pieces such as *Child of Tree* (1975) where the duration, form, order, and content of the piece is variable. This act of using the *I-Ching* results in the environment, or random determinants, exercising its compositional agency through the interface Cage has designed for it. It should be noted that, while the performer is instructed on how to use the *I-Ching*, they do not have any more control over the result of the *I-Ching* than you would over the results of a dice roll. They simply perform the actions called for by the instructions and score, then create the resulting piece.

Though Cage is often credited with introducing the strain of chance music that has become aleatory in the modern musical lexicon, his work might be better classified as a reinvention. Mozart and Haydn both beat him to the punch two centuries earlier in small sets of musical games that were popular in Europe in the late eighteenth century. These composers designed the dice games by writing out hundreds of pre-composed modular components, each section one measure in length. The player would then roll dice several times to select which measures would be used in any given performance of the piece. These light pieces were, however, not considered serious music and instead treated as mere novelty games or jokes that would allow someone to compose the music “without understanding anything about music or composition.” (Mozart, 1792, translated) Indeed, as they were designed to be able to function with interchangeable parts, these pieces are algorithmic in nature and provided blueprints of how a composer might allow for variation on a form, a concept that would be revitalized by algorithmic composers almost two centuries later.

Another notable mid twentieth century piece that incorporates chance processes is Pierre Boulez’s *Third Sonata for Piano* (1955-1957). Unlike most of Boulez’s other works, the third sonata for piano calls for a very typical chance process: The performer is to shuffle the pages of the score,

arranging them in to a random order before beginning the performance. Unlike most of Boulez's other works that call for very stringent rhythmic, pitch, and structural content, this piece creates a considerable amount of variety in the results that may be achieved.

Many of these works call on actions by the performer to begin initiating the chance processes that give rise to the variability present in these works. However, just as in Cage's *4:33*, where the performer has no control over the environmental noises and conditions that will define the sonic content of the music, in pieces involving shuffling paper and dice rolling, the performer has just as little control as when they are to sit at the piano bench and wait for four and a half minutes.

Another approach to incorporating the environment into musical compositions calls for an entirely different approach to time, that of permanent Installation/Sculpture Art. Here, the art object becomes part of the permanent physical and sonic landscape. Dan Corson's *Sonic Bloom* (2013) is one such playful installation that interacts purposefully with the grounds surrounding the Pacific Science Center in Seattle, Washington. The installation takes the form of several building-sized flowers that the participant is to walk or run through. Motion sensors detect movement in the vicinity of the flowers and activate "blooms", wavelike orchestral crescendos, as one passes by. Such a piece is heavily shaped by its surrounding environment both physically and sonically, as well as in its interface with the participants. Physically, the bulbous flowers share similar architectural features to the Space Needle, which they silhouette against when viewed from the pedestrian path below. The audio fits in with existing noise levels, as the bass-heavy recordings clearly project outside of normal conversation-level frequencies. Lastly, in interface, Corson relies greatly upon his location to provide varied demographics to form the overall audio shape. Adults who move slowly through the sculpture activate it in a markedly different style than the younger kids who run through it while

exploring the nearby Science Center. These influences combine together, the environment having a formative impact on the sculpture, and the sculpture leaving a lasting sonic and physical impression on the landscape.

Together, these very different musical works are united by the composers' actions to relinquish control of important compositional components, letting them be decided by environmental factors instead of by the composer. Following this principle, these pieces from Cage, Westerkamp, Corson, and others form a collection of works spanning many decades where the composers have placed the environment, a distinctly non-human force, in control of salient compositional aspects. The wild amount of variability involved in many of these pieces is frequently a hallmark of these works. However, as a result, they can often appear to lack traditional musical aesthetics. While adding layers of indirection and interface was identified as a viable approach to begin working towards this end, a desire for a strong traditional musical results, combined with the proclivity for composers to divest agency to other sources, lead many composers to instead divest agency to a source that could apply extensive musical training and aesthetic principles directly to the art.

## **2.2 - Existing Musical Trends to Shift Agency to the Performer**

Another prominent trend among western art music composers producing "Open" works in the middle of the twentieth century was a shift of musical agency to performers. These pieces give large amounts of decision-making responsibility to the performer, towards various musical ends. By inventing a multitude of less specific score notation systems, these composers enable the performers of their works to make meaningful choices that had been slowly eroded in the performance of traditional cannon works.

As the performer begins to take on a more influential role in music production, I would like to make a distinction between the role of a performer and an interpreter. Performers are the ones to physically produce the music at the time of performance, whereas interpreters work in advance to decide what choices should be made for a given performance. In the case of a solo performance, the standard practice is for the performer to execute their own interpretations of a piece of music. This is often not the case with large ensembles, symphonies, or other groups that have a conductor or follow the lead of an artistic director. In such cases, the leader of the group takes on the role of primary interpreter, and the performers fill a somewhat subordinate and supportive role. Such a split between interpreters and performers has been long recognized, as our nomenclature of “composer-performer”, “singer-songwriter”, and, in French, “Interprète”, all speak to the need to specify these artists do something more than simply perform. In most of the repertoire surrounding the Open Work, practitioners are active in reclaiming musical agency through more meaningful interpretive roles. David Tutor famously would spend hours interpreting scores, obsessing over and measuring the exact ratios between lines drawn on a page to determine the relative lengths of notes. (Ross, 2007) Similarly with large ensembles in pieces like Philip Glass’ *Two Pages* (1968) and Reich’s *Music for 18 musicians* (1974-1976), the composers find opportunities to give decision making power to the musicians performing the pieces, sometimes with the aid of a traditional conductor, but more often without.

The proclivity to give choice and decision making to the performer is one that was originally the accepted norm rather than a tactic of the avant-garde tactic. John Dowland (1563 - 1626) and William Byrd (1538 - 1623) both wrote works of this style, including puzzle canons and palindromic motets. These works called for the performers to each read the same lines of music, but some in unconventional ways, such as starting from different places in the score, or reading backwards from different ends of the staff. Such works were written to challenge the mind and skills of a talented

musician, and often made great mental demands of the performer well beyond simply singing the notes on the page.

This thread was revived in the twentieth century with the emergence of several pieces that place more extreme compositional demands on the performers of the work than simply performing back the specified sounds. One such category of pieces that gives a large amount of agency to the performer are those similar to *Intermission 6* (1953) by Morton Feldman and *Klavierstück XI* (1952) by Stockhausen. These pieces both involve giving the performer pages of music containing staves with musical fragments that the performer is to move between freely. (See Figure 1 for a score sample) This has the effect of defining a color pallet or building blocks from which the composer is to assemble a piece. Feldman worked in small fragments and did not address many overall rhythmic concerns, leaving that as an additional parameter for the performer/interpreter to fill. Stockhausen's execution of this principle however worked with larger segments that included lengthy highly defined rhythmic patterns, with instructions for tempo markings, dynamics, and articulations. By specifying such parameters, the only variables he left "open" in this open work are the order of the individual sections and the total duration. These open aspects still allow the work to be highly adaptable as the performer can determine the length, form, pacing, and structure of the piece. Forming almost a guided improvisation, these pieces can be shaped by the performer into whatever structure is necessary. As an "Intermission", Feldman's piece in particular was intended to be variable in length to fit the varying duration of an intermission<sup>1</sup>, and could be performed by one or two pianos, indicating that the available performing forces should be utilized. These pieces leave the

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<sup>1</sup> Another work that is highly variable in length is Philip Glass' *Mad Rush*, which was commissioned to be played as program music before the arrival of the Dalai Lama. As the Dalai Lama's schedule was unknown, the work needed to be of an indefinite length. (Glass, 2008)



performer/interpreter with a great deal of musical agency as they are enabled to dictate the length, content, and form of the work.

Another composer that worked to expand agency for the composer was La Monte Young who, in his short collection titled *Compositions 1960*, dealt with everything from authorship to performer's choice to open works to graphic scores. *Number 7*, the most famous of the set, is also the most "traditionally" open, in that it calls upon the performer to decide several important aspects of the work. By specifying only two notes, B and F#, and the instructions "to be held for a long time", Young leaves open to the performer the choices of which instruments should be played, which shape the notes should have (if any), and perhaps most importantly, the overall length of the pieces. Other pieces, such as *Number 13*, calls authorship into question and enables performer choice, as the score simply instructs them to "...prepare any composition and then perform it as well as he can." (Young, 1960) Here, the performer is clearly given a much wider amount of agency to determine the audience's listening experience, as they can fill this void left by *Number 13* with any composition, performed at the highest skill level possible. Such a high concentration of agency in the performer is rarely seen elsewhere, as in the work they have almost total control over what sonic experience is given.

Young's *Compositions 1960: Number 9* is a graphic score. It contains a single line and the instructions "the enclosed score is right side up when the line is horizontal and slightly above center". While Young's work is an extreme example, such ambiguous directions and markings are commonly seen in graphic score notation.

Anthony Braxton, on his graphic scores, explained that "one should be able to actually see as well as hear [the piece]." These scores, often colorful, visually appealing, and only optionally containing anything resembling traditional sheet music often work to express either the emotion, performance style, or spectral movement of the desired sounds. One such work, *Composition No. 108*

(1984) consists entirely of waving lines meant to evoke the general shape of the music. (See Figure 2 for a score sample) More generally, pieces that utilize graphic scores often omit instructions pertaining to overall length, structure, or instrumentation, so each realization varies drastically from performance to performance. Such decisions, left up to the performer to realize, reflect the agency that the composers divest when inventing and utilizing such purposefully ambiguous and versatile notation.

While graphic scores tended to throw out most of the indications found in traditional music scores, several elements of the variability they introduce worked their way into standard sheet music notation. These practices all aim at expanding the amount of choice the performer has in interpreting the piece. Among these ideas are notation tools that generally get classified under the wide umbrella of “extended technique” and include everything from tone clusters to box notation to open instrumentation to notated improvisational practices. As these markings became standardized, they began to become more frequently seen in large ensemble literature.

The main tool that composer’s such as Philip Glass, Terry Riley, and Leo Brouwer employed was the use of “Box Notation” or, under different names, indications to the performer that they are to repeat a specific section of music until instructed or internally compelled to do otherwise. Glass’ piece *Two Pages* is named after such a technique, as he comments on the new notation system that allows him to fit twenty minutes of music on to a mere two pages. Integral for this to function is the instruction that each section is to be repeated a variable number of times. The net result is that the performer is left up to their own devices to determine the relative lengths of sections in the piece.

Another example of this practice can be found in Leo Brouwer’s *Etude XX* (1983), which calls for the guitarist to repeat in a very similar fashion an undulating drone-type pattern. He is able to use this device to create an ethereal and unmeasured atmosphere. By including box notation with no indication of desired number of repetitions, performers who are capable of playing the patterns

extremely fast may do so several more times than a beginner who may play the patterns for the same duration, but fewer times. By utilizing this technique, Brower makes the piece instructive and educational, as in the spirit of an Etude, yielding agency to the performer.

Riley's infamous *In C* is composed of simply fifty-three fragments, arranged on the page in a scattered manner not unlike Feldman's scores. However, by specifying an ordering and giving extensive directions, Riley "tames" the unordered building blocks of Feldman's approach to instead create a piece that is reliably between twenty and fifty minutes long and shifts from C major to G major to F minor from start to finish. While the overall structure and length of the piece are recommended, the intricacies of the specific number and types of instrument, the exact texture at any given spot, the octaves each pitch is played in, and many other musical characteristics are all left open for the performing forces to decide.

This agency given to the performer the expense of being notated on the physical score is perhaps best scene in the works of Steve Reich and Julius Eastman. In several of their pieces, specifically Reich's *Piano Phase* (1967) and *Music for 18 musicians* (1976), as well as Eastman's *Stay On It* (1973), the most salient portions of the work are not notated in the score and commonly only relayed by another who has previously performed the work.

In *Piano Phase*, the core effect of the piece is a phasing phenomenon that involves two performers, initially performing the same rhythm, slowly getting out of phase with each other and allowing one to play slightly ahead or behind. As this process continues and the pair grow more and more out of sync, incredibly complex rhythms start appearing that are highlighted by the pianists. For the most salient and novel aspect of the piece, the phasing, there is little notation that the composer gives other than how to start the phase and where to finish it. (See Figure 3 for a score sample)

Similarly, in *Music for 18 Musicians*, Reich places an even greater emphasis on the performer, as the piece did not have, and some may argue still does not have, an adequate score to describe the original performance practice. Notes at the beginning of the published score allude to this, as they indicate that, for all of the early performances, the ensemble performed only with small scraps of scores, much akin to the fragments provided in box notation, and had instructions to simply wait for a cue from the metallophone player. (Reich, 1976) In these cases, an incredible amount of musical decision making is left to the performer, as they take on the role of interpreter, performer, as well as, in the case of *Music for 18 Musicians*, audible conductors.

This challenge is exemplified in Eastman's *Stay On It*. The piece consists of several scenes in which the ensemble alternates between group unison and a guided improvisation. The piece then relies on performers to coordinate among themselves how to transition between playing sections of guided improvisation and playing unified tutti passages. In such a piece, agency is shared in a different dispersal, as the musicians are left to both improvise, as in *In C*, and coordinate, as in *Music for 18 Musicians*. Together, the agency Eastman provides the participants with pushes them from simply performing the work to a role that calls for very strong interpreting ability.

Eastman's works drew extensively from the popular tradition, and the improvisation skills he relied on his performers having often were developed in the context of a jazz education. Jazz, and to a similar extent American Bluegrass, both have a strong tradition of improvisation permeating their cultures. From jam-circles to the concert stage, improvised virtuosic solos are a critical part of this music and reflect a different paradigm in distribution of musical agency. It is no surprise then that at the intersection of Jazz and Western Art Music are many composers-performers who bring this decidedly non-western paradigm with them when they begin to produce art music.

One such jazz-inspired practitioner of western art music is John Zorn. His most influential work, *Cobra* (1984), exists as a set of rules, cue cards, and collective memory, rather than anything

physical resembling a score. The piece is open instrumentation and the performers follow a conductor who acts in the role of band leader. The improvisation practice designed for *Cobra* can give rise to an enormously wide variety of resulting pieces, and there exists several ensembles who dedicate themselves to only performing this piece. This work is as successful as it is because Zorn divides musical agency in a very insightful manner. Zorn, as the original composer, provides only the ruleset and a few example realizations. The implementation is then reimagined by every performing ensemble and led by a passionate and informed band leader. This division enables performers who are interested but not yet ready to make the education investment required of other pieces, i.e., learning how to interpret a graphic score, etc., to approach this improvisatory work under the guidance of another musician who leads the learning process. Initially, they can control much of the compositional agency as they help the new member adjust, but as the performer grows more skilled, they are encouraged to take a larger role in the shaping of the musical form and content. One such mechanism that explicitly enables this is the “Birthday hat” rule, in which an ensemble member may don a conical party-hat if they intend to take an extended solo around or with the rest of the group. Rules such as these give rise to an engaging and rewarding musical experience for the performers, who are then empowered to create powerful music for listeners to consume.

All of these pieces examine ways that musical agency is divested from the composer to the performer. By utilizing new written score techniques, engaging with intentional ambiguities, and encouraging guided improvisation, these composers searched for ways to enable the performers of their works to have a greater deal of control over numerous salient aspects of the music. While this trend was by no means the norm, it has become the largest and most effectively integrated tradition of the agency-distributing movements to stem from the mid twentieth century.

### 2.3 - Existing Musical Trends to Shift Agency to Other Creatives

The current focus on musical performance as an interdisciplinary art in our modern musical culture was most notably championed by Richard Wagner, who wrote music in aid of his search for *Gesamtkunstwerk*, or a “Total Work of Art”. He asserted in 1849 that opera was the truest form of art, as it represented a culmination of all of mankind’s efforts in the artistic realm as it incorporated theater, poetry, dance, music, architecture, and costume, lighting, and set design. While this emphasis on opera in modern day music circles has not yet fallen out of fashion, the concept of an immersive form of total artwork has been appropriated by many groups since Wagner made his first pronouncement.

The San Francisco Tape Music Center, founded in 1961 by Pauline Oliveros, pioneered many interdisciplinary themes that would propel the opera tradition into video-opera and eventually the multimedia work. Sharing a building with the choreographer Anna Halprin, the composers of the San Francisco Tape Music Center were active in collaborating not just with dancers, but also with theatres, film makers, and projection artists. Such works included *The Bath* (1966), a ballet choreographed by Halprin and scored by Oliveros, and *Desert Ambulance* (1964) for tape, accordion, and visuals, composed by Ramon Sender, performed by Oliveros, and with projection art by Tony Martin. (Bernstein, 2008) These works highlight the interdisciplinary nature of the multi-media medium, and the collaboration that took place. Such pieces do not stand on their own without all of the components, a result of the composer divesting critical amounts of agency to other artists working towards the same creative end.

Laurie Anderson’s Grammy winning piece *Landfall* (2014) additionally works towards this ideal of an interdisciplinary artwork. The multimedia composition employs several creatives working in tandem to create the immersive experience. The music for the work is scored for string quartet, a role filled by the Kronos String Quartet, as well as a combination of Anderson’s own live

electronics, voice-overs, and electric violin. In addition to these components, Anderson additionally contributes her own projection design in tandem with the lighting designers present at the facility. She considers the lighting design in this manner an integral part of the live experience, so much so that in the Artist Talk-back following the premiere of the work, the individuals invited to speak included the Kronos Quartet, herself, as well as the Texas Performing Arts' lead lighting and sound designers. This heightened recognition of the parties necessary to make an effective immersive experience reflect the agency that she distributed to ensure the work is effective, immersive, and truly interdisciplinary.

Another creative force that has an incredible amount of agency that is not often recognized is the music teacher. The instructor has an ultimate charge to educate and guide pupils through the standard repertoire of the instrument, and with this comes the choice of deciding what to prioritize in such a “standard repertoire”. In doing so, they mediate the conversation between the performer and the composer. While music for educational purposes is nearly as old as our earliest recorded music<sup>2</sup>, one recent development that focuses explicitly on this creative agent is the curriculum developed by Austin Classical Guitar (ACG). In assembling works for classroom use, they found a common need for ensemble pieces that may be performed by guitarists of drastically differing skill levels. Having sections of optional or replacement music for less skilled performers is not a new phenomenon, as ossia measures and optional flourishes and ornamentations have often historically been understood to only be included only if the musician's technical skill is up to the task. However, the scale at which ACG has implemented these modular components makes for drastic changes in the overall piece, yielding results that vary a great deal from performance to performance depending on the different skill levels of the guitarists involved. This agency given to the educator serves to

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<sup>2</sup> The “Guidonian hand”, a mnemonic device for helping teach singers, dates from medieval times.

recognize the purpose of the piece: not to glorify the composer, but more simply to educate and instruct the performer.

However, not all collaborations in music necessarily divest agency. Throughout history composers have needed to work with other participants in the music business to allow their works to be brought into the world. Composers have worked with copyists and music publishers for as long as the latter have been in existence. These participants, while ultimately influencing the final product, sometimes in profound ways, often do not change the direction of musical impetus, and, as their work is almost always verified by the composer before being exposed to the world, it is still the composer who maintains compositional agency. I consider the work of studio technicians, producers, and audio engineers in very a similar manner. They aim to help further the composer's original compositional agency rather than to introduce their own. In this way, the conventional<sup>3</sup> relationship between composer and studio technician or music copyist is not one of divesting agency, but rather an essential, productive, and collaborative effort to realize the composer's personal musical vision. As a result, these relationships are fundamentally different from the others are discussed in this section.

## **2.4 - Alternatively: Existing Trends Focused On Centralizing Agency.**

While there was a push among many groups towards making music more inclusive and art generally more interdisciplinary, these were by no means uncontested assertions. Many composers work tirelessly towards asserting total control over the art that they produced. Trends such as total serialism indicated that there might not be much room for traditional interpretation left in music, and within the realm of new complexity, composers placed such extraordinary demands on the

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<sup>3</sup> While the improvisors and composers at the San Francisco Tape Music Center may be considered studio technicians, they do not have the conventional relationship with composers that is being addressed here.



performers that, to the uninitiated, they seem to be attempting super-human tasks. With the advent of machinery capable of producing and reproducing audio, the possibility to transmit directly from composer to listener became a reality; a reality that if followed to its conclusion, could mean the end of live music performance.

The trends that led to total serialism and continued the general stream of centralizing agency began in earnest with twelve-tone serialism. Arnold Schoenberg is credited with inventing and popularizing the twelve-tone process, and the Second Viennese School that rallied around him had an outsized impact on the subsequent music in the twentieth century. The twelve-tone technique, which involved the use of ‘rows’ of all twelve chromatic pitches, ensured there would be no clear tonal center to the resulting music<sup>4</sup>. (Ross, 2007) In this way, the twelve-tone system became the algorithm to which all pitch material adhered. The performers were required to specifically adhere to the rules set forth by the composer, and little to no variation was allowed.

As twelve-tone technique created “order” among pitches, total serialism brought such rigor to many other parameters of music. Olivier Messiaen was the first to unite the twelve-tone system with applicable parallels to pitch duration, articulation, and volume. The most commonly recognized first such work, "Mode de valeurs et d'intensités" from *Quatre études de rythme*, or *Four Rhythmic Études*, combined together these parameters in a highly controlling manner, such that every note had a uniquely specified dynamic and articulation marking. This specificity results in pieces that place extreme demands on the performers but leave precious little up for interpretation.

The demanding nature of these pieces is further exacerbated in the works of Brian Ferneyhough. One of the British-American members of the “New Complexity” movement, Ferneyhough’s works are renowned for being challenging to listen to and even more challenging to

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<sup>4</sup> While Alban Berg utilized carefully specialized tone rows to give fleeting appearances of tonality, the vast majority of the twelve-tone music was decidedly atonal.

perform. (Whittall, 2012) By filling the score with a litany of information, articulations, descriptions, and instructions, Ferneyhough sews complexity “...between composer and score, score and performance, and performance and reception.” (Duncan, 2010) This work ultimately expresses a desire for exact manipulation and control at the very edge of what humans are capable of playing.

Such exact and precise control over sonic output was, however, already achieved in the electronic music medium many years prior. The piece *Riverrun* (1986) by Barry Truax makes use of granular synthesis techniques to specify tiny and exact segments of the harmonic spectrum to together form a larger exploration of audio sculpting. The piece includes several highly precise spectral bands moving in counterpoint to one another, rhythmic degradations and restorations, and choreographed pitch emergence and obstruction. Such a work would be impossible to realize with human performers, as the demands placed on the performers would be so extraordinary as to make the work unplayable.

The ability to precisely capture and control recorded audio additionally enabled composers who wanted to use the sounds of the environment but without the inherent variability that works by Westerkamp would introduce stemming from the tradition of *Musique concrète*. The practice of Acoustic Ecology approaches this same source material as *Soundwalking*, however, as exemplified in R. Murray Schafer’s *Entrance to the Harbour* (1973), exhibits a curatorial approach. While the sounds that one hears come directly<sup>5</sup> from the environment, they are arranged and condensed to be presented in a decidedly composed manner. This is reflective of the goals of the World Soundscape Project, which aims to record and preserve soundscapes to be experienced by the public, as well as to educate communities about noise pollution and other activist driven preservation approaches.

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<sup>5</sup> These sounds come directly from the environment after being recorded by a specifically selected microphone, processed and mastered by an audio engineer, and then further altered through reproduction and distribution until eventually being filtered one last time through the speakers on our playback device.

This desire to be action oriented and disseminatable thus precludes a Westerkamp-like approach, as they recognize that the sound they want to present is not the same one that will always be there.

World Soundscape Project recordings are ultimately designed to evoke the soundscape they are portraying and develop an appreciation for the soundscape in nature itself. This is at odds with the likes of Francisco Lopez who, in his work *La Selva* (1998), aims to have the listener appreciate the sounds of the jungle as independent of any other sensory experience, including visual or textual representations of the animals or natural forces creating the sounds that are found on the record. In the work, consisting of seventy minutes of recordings from a Caribbean rainforest, Lopez focuses specifically on the qualities of the audio itself, and worked towards mastering the audio he captured in highly specific ways to encourage the listener to hear what he intended to direct them to.

This trend to control, centralize, and manipulate every detail in music eventually permeated some pieces that were previously touted as open works, retrieving agency from other entities and giving it back to the composer. In such pieces, the original intention was to create an open form work that could be realized with greater agency placed on the players or the environment, but in practice became pragmatically fixed. Two such works are John Adams' *Shaker Loops* (1978, 1983) and John Cage's *William's Mix*. In the Adams' piece, the score as it was first published called for an open form, with each member of the ensemble repeating a short fragment, and then moving from one to the next in a manner similar to Riley's *In C*. However, Adams was not satisfied with the realization of this piece, and later redacted the score. The re-released version from 1983 has a specific realization of this work, as he has gone through and notated exactly which specific entrances, exits, and phrasing he wants to occur in which specific locations. Such a traditional score takes much of the agency and improvisatory work away from performers as they now can approach the piece in a traditional manner.

A John Cage piece that met a similar fate was *William's Mix* (1953). While no score was ever redacted, the piece was notoriously challenging to produce, and comprised of 193 pages of score, instruction, and *I-Ching* directions. Because of this intense investment required, it was not premiered and recorded until 1958. Since then, due to the work necessary to reproduce the piece, the recording has, in many instances stood in for a live rendition of the work. Such actions unfortunately ensure that the great dynamic range of possibilities the piece can manifest are ultimately reduced to a single concrete version. This pervasiveness of a single recording thus brings into question the spirit of the piece, as the most common experience of a listener is not that of a performance, but rather listening to the documentation of a performance<sup>6</sup>. This collapse of diversity, agency, and opportunity in to a single rendition centralizes agency into a single entity: the curator. For most works, this ends up being the composer, who thus decides which recordings to distribute and promote, and thus selects from among all the possibilities, a single controlled, verified, accepted, and predictable output to stand in for the entire opportunity-space the work otherwise inhabits.

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<sup>6</sup> It is true that this issue is not unique to experimental music. Your favorite recording of Beethoven's Fifth Symphony suffers from exactly the same challenges; it is documentation of a performance that, if played again, would inevitably be different in some manner. The distinction is that the content of the piece may drastically change each time it is performed.

## Chapter 3. Impact of Technology

Different paradigms of compositional agency defined many of the artistic movements in the mid twentieth century. The open work looked to performers to complete realizations, graphic scores required interpreters, and *4:33* invited the environment into the conversation. These movements all had at their core a dissatisfaction with the composer-centric approach of musical decision making and aim to instead divest that agency to performers, the environment, or other artists working in different mediums. After the widespread adoption of the personal computer and smartphone, these practices were forced to examine their choices in the context of this new technology. These advances led to the developments of custom instruments, context-aware mixing, and emergent properties of the computers themselves, all expanding on divestment of agency to the performer, environment, and other creative forces. However, the distributed nature of such computing created a new avenue for musical agency that has only just recently begun to be explored: the divestment of musical choice to the listener.

### 3.1 - Proven Technology for Composers to Divest Agency to Performers

In many works where the composer aims to divest agency to the performer, the composer focuses on giving choices, options, and modularity to the fingertips of the performer. They are then empowered to decide upon salient features of the piece later, either at time of realization or slightly before. Generally, technology in these situations simply functions as an instrument, and the traditional techniques to divest agency to performers, including box notation, score ambiguity, and guided improvisations, may be employed. The instruments that technology enables very greatly, with the new developments focusing on either digitizing, democratizing, and economizing existing analog instruments, samplers, and effects, or on novel interfaces to create original invented instruments.

The democratization efforts focus on the recreation, distribution, and application of previously established technologies. For example, older works such as Reich's *It's Gonna Rain* (1965) pioneered at the San Francisco Tape Music Center showed the utility and artistic merit of technology such as looping devices, EQ, and other tape recording and modification techniques. However, at the time of these undertakings, this technique was prohibitively expensive, such that all innovation in this area was centered around a few institutions that housed the tape machines. More recently, works such as Bruce Pennycook's *Interiorities* utilize<sup>7</sup> programming languages such as Max/MSP to design loopers, granular synthesizers, EQ effects, and samplers. By implementing very well-known effects, Pennycook enables approachability, as other performers can easily transfer knowledge of similar physical devices to the computer interface he provides for them. Additionally, by using familiar interfaces such as the laptop computer, industry standard Max/MSP objects, and midi keyboards, Pennycook further reinforces the accessibility of his works. For example, a performer that would previously have used sliders to set levels for different frequency bands in an equalizer could now do so using a mouse on a computer screen, with little training necessary to transfer this expertise.

More adventurous electronic instruments include those pioneered and used in the pieces like Michel Waisvisz's *The Hands* (1984), Pamela Z's *Breathing* (2013) and Laetitia Sonami's *Magnetic Memories* (2016). In each of these pieces, the composer designed an entirely new interface for the performer to interact with. While these pieces all allow for a greater variety of tailor-made expression pallets, they also require a great deal of investment on the part of the performer. In many of these cases, an instrument must be mastered specifically for the performance of a single piece. Whereas

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<sup>7</sup> While this piece is listed here as an excellent example of technology specifically enabling new performance practices for live electronic music performance, the work would fit equally well in Chapter 2.3, Existing Musical Trends to Shift Agency to Other Creatives, as the planning and execution was done as an extended collaboration among Bruce Pennycook, Dana Reason (Piano) and Sven Ortel, (Images/Projection).

traditional instruments such as the violin or flute have years and years of repertoire for the skilled musician to perform in return for their investment in learning the instrument, the performer who takes up Waisvisz's *Hands*, glove-like devices that report to a computer very granular gesture recognition to generate audio, has only one short piece to perform in exchange for their training.

These two approaches of implementing traditional effects in modular ways and designing electronic instruments come together in laptop orchestras. These groups, such as PLOrk (Princeton Laptop Orchestra) and SLOrk (Stanford Laptop Orchestra) generally consist of between five and twenty performers who perform electronic laptop music in an orchestral idiom. The performers each have their instrument, which in the simplest case consists of a laptop, software, and speaker. Just as a traditional orchestra has strings, brass, winds, and percussion, so too do many laptop orchestras have specialized instrument groups. These differences may be physical, such as giving subwoofers to some performers to make a specialized "basses" section, or ephemeral, such as distributing different code to different performers to change their instruments responses.

While in function and make-up these groups may be similar, one of the key differences between a traditional orchestra and a laptop orchestra is the possibility of control. Laptop orchestras offer a golden key to conductors: As all the computers can be connected to a single network, a conductor has the opportunity to correct, automate, and perfect everything that is not perfect about a performance. However, this very quickly renders the human performer obsolete as their performance is automated away by a conductor intent on precision. Thus, by the very act of having human performers in the orchestra, the group makes the active decision that the results will be imperfect, variable, and marked distinctly by the people who created it. Because of this, the very nature of laptop orchestras encourages composers to divest musical agency to the performing members of the group.

A very different model for giving agency to the performer can be found in Monte Taylor's piece *FEME VizcayaSC* (2018). This work is for fixed media electronics without an on-stage performer. However, the piece is designed to be re-rendered for every performance and can be customized not only with site-specific speaker specifications and variable overall durations, but also with different samples provided by the "performer". This role is often filled by the curator for a given concert. The piece originally makes use of sound samples recorded in a construction zone, but a subsequent rendering makes use of human vocal reproductions of the original sounds. The agency here is found split between the performer supplying the source material and the composer who orchestrates how those given clips will be assembled and modified in to the final musical product.

Common across all of these pieces however is a unifying spirit of technology enabling the performer to express their musical impetus and training in non-traditional ways. These methodologies, ranging from new physical and electronic instruments to curatorial challenges, all work together to challenge the traditional role of the performer as solely an interpreter of a work and become more generally critical to its manifestation. Thus, as the composer divests agency to performer, the technology available to them enables the performers to do more with every opportunity given.

### **3.2 - Proven Technology for Composers to Divest Agency to the Environment**

In order to adapt a single piece for use in multiple highly distinct environments, modular components are integral to allowing the work to fit the new space it comes to inhabit. These components allow for a composer to specify a work with many aspects still yet to be finalized. By allowing the missing pieces to be completed later, the composer can allow the environment the space will be filling to play a role in how the piece will ultimately be delivered.



Multi-channel audio has been pervasive to electronic music since well before the technology became widely adapted by the western art music. The first multi-channel audio system was presented in 1881 by Clément Ader, and development in technology and promotion of standards since that time have led to many advancements being popularized, including stereo, 5.1 surround sound, and 7.1 surround sound, among others. These formats provide the listener with multiple audio sources so that the composer or audio producer may choose which sounds come out of which speakers. By utilizing powerful sound-localization equations, a technician can give the illusion over a multichannel system that a given signal is coming from a spot other than where the five or seven speakers are in the space. Additionally, by specifying a speaker channel as a subwoofer, the sound designer recognizes that different speaker hardware can achieve the most resounding effect if the audio signals sent to particular machines are different to match their physical construction. Such context-sensitive mixing is a cornerstone of professional studio-quality mixing practice utilized today.

One of the most prominent examples of modularity to allow for variable remixing is the IRCAM SPAT objects from Max/MSP's audio specialization suite. With such a tool, the piece's performer<sup>8</sup> may specify speaker layout, and the computer, when playing back the piece, will automatically calculate the relative intensities of each sound that should be coming from each given speaker. This enables a composer to create a single piece of music and have it interpreted through many different environments. Other software that approaches this problem includes Panoramix, a standalone piece of specialization software which enables a composer to spatialize a work to a specific speaker setup or audio environment in post-production.

By performing their works through speakers and technology that differs from location to location, many of the composers who write electronic music must contend with ceding some of this

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<sup>8</sup> The performer in this case is often the curator who has encoded information about the speaker system in the space.

musical agency to the environment. Such a work played back on thirty-two speaker sound dome would yield a drastically different experience than when performed through a pair of headphones.

### **3.3 - Proven Technology for Composers to Create Emergence**

For as long as computers have been accessible, musicians have been utilizing them for artistic ends. As early as the 1950s computers have been playing back melodies like “God Save the Queen”, and the first recognized computer composed string quartet was completed in 1957. Today, as computation has become cheap and accessible, many trends have become dominant forces in how composers and artists utilize computers to enable music generation. Randomness and abstraction, both concepts that predate computers, are made much more powerful in computational settings. Their application in composition aids in the divesting of agency as these tools give rise to emergent properties. These tools thus begin to take on a life of their own in the eyes of the listener and performers, allowing for the computer to be a repository and source of musical truth and decision making.

Random Number Generators (or RNGs) have been core to all computer-generated music. In much the same manner as Mozart looked to dice to select individual measures of his miniature waltzes, so too did Hiller look to the ILLIAC’s (Illinois Automatic Computer) RNG to choose melodic, rhythmic, and harmonic content for the string quartet. The “computer” itself here is given musical agency, although it chooses among the provided options in a random fashion. However, every program utilizing true randomness is almost always constrained. Truly randomized output of a computer (if applied directly to the Digital to Analog Converter) is white noise, and every action by composers to limit this tempers the agency they give to the computer. The extent to which randomness is allowed to prevail is very important, as, with too many constraints placed by the composer, a randomized algorithm could “randomly output the C Major scale every time.”

(Pinkston, 2017) The challenge of creating emergence, or the appearance of a life-like decision maker contained within the computer, is the challenge of creating layers of abstraction between the randomness and the final output to give the appearance of intelligent design.

One example of this is John Cage's work *HPSCHD* (1969), a piece for between one and seven live harpsichord players, and up to fifty-two computer-generated audio channels. The piece made use of the computer's random number generator, but instead of directly working with the output, the randomness was abstracted in to the subprogram *ICHING*, which allowed Cage to apply his *I-Ching* processes within the context of the computer program. This additional layer allowed for Cage to model the computer's use of the *I-Ching* in a very similar manner to his own, thus allowing for the computer to simulate Cage's own actions of throwing coins. As the piece calls for over 18,000 applications of the *I-Ching*, Cage would have had to throw 54,000 coins and record their results to perform this piece without the computer. While many people will happily roll 32 dice for a short waltz from Mozart, few would willingly sign up for the much larger task the computer tackles in Cage's work.

This process of abstraction over randomness has been further elaborated on with works produced by David Cope's *Emi* (Experiments in Musical Intelligence), where randomness is highly constrained within the "rules" of traditional counterpoint and style. Such works rely on extensive "Expert systems" style of coding, where at each stage of the composition, random number generators are used to choose between certain options. The resulting pieces can thus only sound like the options laid out by the composer, and much of the development and compositional work takes the form limiting or expanding the opportunity-space that the computer chooses among when making the output.

Taken to an extreme, layers of abstraction between the RNG and the actual output can be obtusely thick. Techniques like genetic algorithms and deep-learning neural-nets make use of RNGs

at many orders of magnitude greater than their counterpart expert systems, to varying results. When applied to music, there are often so many random numbers generated that even the developers who created the program are not able to explain how individual choices were made. Choices such as “Why is there a ‘D’ rather than an ‘E’ on beat three”, while explainable in an expert systems model (“the RNG chose a value greater than .9, so that means play a ‘D’.”) would be next to impossible to answer for a genetic algorithm, as many thousands of RNG utilizations would have been made to select that one particular note in the context of the entire program’s output. This issue of explainability, while problematic in other applications of Artificial Intelligence<sup>9</sup>, is a boon to the generative-music application. Such an inability to explain plays in to the human reaction to ability to anthropomorphize and assign intelligence to complex patterns we are unable to decipher. This gives rise to emergence, or the perception of an intelligence force to which we can give agency in musical decision making.

### **3.4 - Emergence: Applications and Conflicts**

Musical applications of machines exhibiting emergence vary as much as their creators. Often, they are treated much like the Mozart *Dice Games*, in which the resulting pieces of music are regarded as oddities, non-serious music, or sources of amusement rather than serious attempts at artistic expression. In cases where they are taken more seriously, such as George Lewis’ *Voyager*, they can be allowed to shine as an equal player in the composition and creation process. Lewis’ software, written between 1985 and 1987, is an improvising computer program that responds to the input of another performer, thus aiming to have the same interface as another human performer. It listens to the cumulative sound created by the group as a whole, to the other players, and to itself, when making

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<sup>9</sup> Explainability is imperative for work surrounding medicine, judicial proceedings, self driving cars, and other applications where human safety or wellbeing is directly impacted as a result. (Lipton, 2016)

decisions on what sounds to produce. The software undergoes complex decision-making processes, which gives rise to emergence as it is given agency by the performers and composer.

However, not all applications are given the agency Lewis' works are. The issues of curation and collapse of opportunity-space that plagued *William's Mix* once again have the opportunity to rear their head, although at a much greater price and often with less justification. This is due to three considerations that technology as a source of agency introduces into the mix. Trust, curation bias, and opportunity-space size are all factors that, while present in various forms prior to the widespread adoption of computers, become exacerbated by extreme compute power. The issue of trust, or actual distribution of agency, is often called into question when a single output is selected to stand in for the entire opportunity space. As an example, Huawei made a splash in media headlines in February of 2019, by, in their own words:

*...embracing the power of Artificial Intelligence to complete Schubert's famously unfinished Symphony No. 8. It has remained uncompleted for nearly 200 years, so we set our AI the task of finishing the most iconic and intriguing unfinished symphonies of all.*

Such bold claims would be incredibly powerful if true, as they would be in possession of a technology capable of emergent properties as it completed the unfinished symphony in a variety of different, interesting ways. Unfortunately, that is not the case, as closer inspection reveals that their AI produced only melodies, and that Lucas Cantor was commissioned to complete the tasks of melody selection, orchestration, thematic/tonal development, and generating overall form. Such a derivation of trust certainly stands to pollute the waters and thus make it more challenging to those who give all of those tasks to the machine to receive the recognition they deserve.

The first compositional task Cantor is faced with, that of melody selection, also serves to highlight the problem of curation bias. As per the infinite monkey theorem<sup>10</sup>, with enough trials even a randomized melody generator could generate the lyrical Schubert-ian melodies that are found in completed movements. By not revealing many aspects of the creation process, we are left to wonder if Cantor used the output of the program every time, or if he had to sort through hundreds of inadequate melodies before settling on the ones that he would utilize in the final product.

The final challenge of opportunity-space size is highlighted by this task as well. If different melodies were chosen, how different would the results have been? We have no way of knowing, as extensive human intervention was involved. These perhaps misleading examples by Huawei serve to limit the actual agency of the computer and the technology employed. The net result is unfortunately a piece that is groundbreaking only in its use of a particular compositional aid, rather than in a more grand and complete technological application.

This is in counterpoint to other composers, such as Omar Peracha, and his piece *GANKyoku* (2019). His work, generated by an adversarial neural network, addresses all of these issues, as his distribution of the work and discussion of his artistic process attest. Peracha has taken steps to build trust in his programs by sharing his process in a presentation at the International Computer Music Conference and addresses the issues of curation bias by acknowledging the final presented work is a collection of three favored selections, chosen out of thirty generated output scores. Lastly, Peracha demonstrates the opportunity-space represented by his network by showing us that the three varying pieces are all output from the same code and parameters, thus demonstrating the decisions possible and agency provided to the neural network. In this way, Peracha has produced a single distributable output that still demonstrates the vitality and agency awarded to the technology involved.

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<sup>10</sup> French mathematician Emile Borel proposed that, given enough time, monkeys randomly striking keys on a typewriter would reproduce the complete works of Shakespeare.

These starkly different approaches speak to the differing amount of agency the artists are prone to yielding to the emergent features of the technology they have at their disposal. Lewis, Peracha, and Cantor are utilizing tools at different stages of development and utilizing them at different positions in their artistic processes. By examining their creative process, it is clear that Lewis and Peracha are interested in divesting meaningful amounts of agency to the emergent technology, whereas Cantor is utilizing it as only a smaller tool in his overall compositional framework. The technology in both of these cases has properties of emergence, but only in one is it given agency.

## Chapter 4. Steps to Music Personalization

Musical literacy is a necessary prerequisite to holding an informed conversation about musical agency. It is not surprising then that, of the traditional three parties involved in music creation - the composer, the performer, and the listener, it is the last of these that has been least vocal in advocating for changes to the power dynamic exhibited within the music being performed. Every piece discussed so far has been the result of some informed contemplation or discussion as to the role the performer should have in the production of the music. Now, however, we will begin to look at pieces that offer to cede their structure, content, and all other salient features to the control of the listener who consumes it. In these works, technology serves to fill the gap between the listener's musical knowledge or ability, and that required by the piece, thus allowing them to converse with it on an even playing field. I argue that, unlike many of the previously discussed categories works, these pieces require technology not only to bring the listener in to the circle, but to be distributed and made accessible in a meaningful and economically viable fashion. Additionally, in making necessarily unique musical experiences, new opportunities present themselves to specialize the sonic experience at the most basic level possible.

### 4.1 - Music Perception

The goal of an artistic practice is often to produce a creative work that engages with the audiences' experiences and expectations, and then knowingly violates, challenges, or expands them in some meaningful way. This is of course a challenge as individuals all have differing past experiences, influences, cultural heritage, and sources to draw from when observing art. These divergent experiences result in our individual differences in appreciation of art, and such differences may preclude any claims towards universality in music. However, with an understanding of what impact these differences have on our perception of music, it may be possible to create a generalized



structure that would be filled and personalized so that a single piece may have the same intended effect on multiple participants.

While it can be taken at face value that different people like different music, a greater understanding of what drives these differences can prove useful for illuminating why a particular song might be highly impactful and moving to one person, but completely lost on another. Mas-Herrero, in his paper “Individual Differences in Music Reward Experiences”, outlines a “Big 5” style personality exam for music, which demonstrates five dimensions through which an audience member may vary in their approach to music. The five factors - Musical Seeking, Emotion Evocation, Mood Regulation, Social Reward, and Sensory-Motor - vary from listener to listener and can be used broadly to inform the sort of music to which a listener responds. For instance, someone scoring high on “Musical Seeking” might have a powerful emotional reaction to a song that has little resemblance to one they have heard before, but someone on the other end of the spectrum with a similar musical background would have little appreciation for it. (Mas-Herrero, 2012) Even with very broad strokes, these are data points that may be taken into consideration when creating personalized music to begin to shape music differently for different listeners.

Further complicating the matter are cultural differences that surround us and shape our listening habits starting at very young ages. Stephanie M. Stalinski has shown in her work on developmental music cognition that babies are more sensitive to wrong notes in non-native cultures than adults. (Stalinski, 2012) This understanding, that as we learn one musical system we lose our perceptiveness to others, additionally makes clear the proposition that in order for a composition to be comprehended by multiple diverse listeners, the piece should be different for each listener to accommodate the fact that they do not speak the same musical language.

## 4.2 - Proven Technology for Composers to Divest Agency to Listeners

Most of the technologies and developments towards giving listeners musical agency have been incredibly diverse and varied. The most successful of these take advantage of an interface that humans are already familiar with and repurposes it to control various aspects of music. This allows the listener to interact with a system they are familiar with and enables the listener to gain an intuition of this new instrument and gain a “mastery” of it within a couple of seconds. While these interfaces may be physical, as in the *Gemini 6B* (2019) by Mickey Delp, or Douglas Laustsen’s installation *Wires* (2019), many of them are software based. Mobile phone applications, web apps, and geographically oriented music all allow for the creators to produce and distribute audio experiences in mass in ways physical interfaces severely limit.

*Gemini 6B* is an installation project by Mickey Delp that aims make “Music for the People”. Delp, who specializes in building custom instruments and synthesizers, made use of arcade-like dials, buttons, and joysticks in creating the installation. The input mechanisms are housed in a large six-sided arcade-like console which is stylized with the aesthetic of science fiction starship control boards, from which the work gets its name. By using the arcade-game interactions and appearance, Delp enabled participants to approach and be automatically invited to control the musical experience. In a presentation on his artistic process, Delp explained how iterations on the device aimed at improving the approachability and playability of the instrument. Such developments introduced after user-testing included adding a “touch-reaction” concept - the idea that every user interaction should be paired with an immediate audible change. (Delp, 2019) By taking such measures, Delp actively works to ensure that his experiences are as approachable and interactive as possibly.

The installation *Wires* by Douglas Laustsen similarly works to empower the listener to make meaningful decisions about the audio content they experience. The piece takes the form of a musical

choose-your-own-adventure book set and examines ways that humans are connected to each other in often unnoticed ways. When the participant enters the space, Book 1 is sitting out. After starting the audio and reading a few paragraphs, you are directed to choose between a few books to open next. As each book is opened and activated, its sounds are added to the sonic texture. The experience is typically under fifteen minutes in length, but content can vary greatly from one rendition to the next. As the audio from all books that have been activated is cumulative, the result at the end of the experience is a collection of books that are “awake”, activated, and contributing their sounds to an overall sonic sculpture. Each participant’s final collection is unique, and this results in each listener having a different aural experience that they personally shaped.

While these two artists work with physical media to build their interfaces for listeners to interact with, other players have been making similar developments with software. The weav.io mobile app is a commercial application that begins to break down the standard approach to music distribution. This running app, which matches the tempo of the song to the pace of your running, allows the listener to determine not only the speed of the material being played, but also the content, as the song is rendered and mixed live as you run. This then allows the music producers to specify different content to play when you run different speeds, and thus places the listener in a performative role. The jogger, acting as both listener and performer, is encouraged to run at a steady (often fast) pace, as the music rewards this behavior, not unlike applause might greet a particularly virtuosic solo. This is one of the first widespread commercialized applications that enable divested agency to the listener.

A more established approach for allowing listener agency over an audio experience is the use of location as an interface. Similar to Hildegard Westerkamp’s practice of *Soundwalking*, these pieces all encourage physical movement around a venue, area, or city. However, instead of appreciating the sounds already present in these locations, these pieces provide augmenting audio components that

sit over top the ambient noises. The following examples, of John D Moeller's *First Vision* (2017), my own work with Songitude, Steve Parker's *Sound Atlas* (2015), and the app Detour, all explore this interface at different scales, ranging from just a few meters to an entire city.

One of smallest of these location-sensitive works is also the only one that can be realized without the listener providing their own mobile device. In John D. Moeller's paper "Multichannel Works for Nonstationary Audiences", he outlines his artistic work *First Vision*. The piece makes use of 96 tablet computers each connected to a small speaker spread out in a grid in the performance space. Not unlike John Luther Adams' *Inuksuit*, the piece is intended for stationary sound sources and mobile audience members who, as they move, create a live mix for themselves comprised most heavily of the sound sources near them. In this way, the listener has agency through an interface controlling the mix of the piece. This listener-audio interface, consisting of interacting via movement, is very natural for this scale, as the total work can be easily walked by a participant, and all of sounds produced as part of the work attenuate naturally as you move closer or further away.

While the familiarity of these interfaces begins to be less reliable as scale increases, the same basic intuition persists. My own work on this field, the Songitude platform, allows for composers to construct and distribute pieces spreading out over large walkable areas by providing the augmenting audio through the listeners' smartphones. This is done by mapping the listener's GPS location to a mix of loops, effects, and other audio files. Unlike Moeller's piece, which functioned as both a temporary installation and a performance event, pieces on Songitude and other online platforms are persistent through time as permanent installations and always accessible via the internet.

Furthermore, sounds are able to cover a much larger area than is possible with a multichannel setup, as the software can map a certain audio file to be played evenly across an area several miles wide, a physical impossibility without personal speakers. As the pieces on Songitude exist independent of an event in the real world, they can last for as long or as short as the listener desires and can be of any

order and proportion that can correspond to via a physical path. This thus gives the listener a much larger degree of agency as they determine many parameters of the experience, from overall length to relative structure to individual mix and content.

Steve Parker's *Sound Atlas* (2019) works towards a similar concept as Songitude, but at a much larger scale production. Parker's works aim to be a "personalized radio station that realizes a composition in real time, based on your GPS coordinates." (Parker, 2019). Through a cell phone app, the work aims to be accessible to all those who utilize the common highways in a community and provide them with another perspective on their drives and daily commutes.

Apps like Detour and Just Ahead, while not in the art music world, commercialize the interface of location mapped to audio experience. These applications are a medium to enable self-guided audio tours for participants, allowing listeners to explore a city at their own leisure, seeing as much or as little of the area that is convenient for them. Such low demands placed on the listener allows the works to be accessible to those who might otherwise not be familiar with the city or the language, or have time constraints, or be impeded by other factors that are normally necessary prerequisites to embarking on tours requiring a great deal of mobility.

All of the pieces examined in this section explore the role of an active user making choices in the production their audio experience. Whether this is through arcade-like buttons, choose your own adventure books, or moving around on a map, these pieces all give the audience an active and participatory role in the creation of the music. This participation is most effectively achieved when interfaces the user is already familiar with are adapted to musical ends, thus allowing a transfer of experience and an invitation of familiarity when enabled to create their own sonic experience.

### 4.3 - Passive Personalization

Active choice for listeners is a powerful tool that enables participants to take an active and participatory role in their musical experience. However, such works, though inviting and familiar, still require the listener to accept the invitation and partake in the musical experience, and the pieces often fall flat without such involvement. This challenge is one that players in industry have long been adept at solving, but from a very different angle: ads. Google, Facebook, Amazon, and many others have perfected the art of passive personalization and content curation. When combined with data on individual music perception and applied to algorithmic music generators such as Amper and AIVA, I believe the resulting personalized content has the possibility to revolutionize how we listen to and experience music.

The most prominent of industries that thrive off of ad revenue, companies such as Facebook, Google, and Amazon, all rely on user profiles to generate specific content based off a myriad of data points unique to you and your interaction with the service. From basics like age and gender, to more complex traits such as political or religious affiliations, these profiles contain most of the salient outward-facing aspects of your personality, including your likes and dislikes, both explicitly and as judged by how long you observe particular content. While this data is monetized by serving you with the ad you are most statistically likely to click on, it is also routinely utilized in other applications such as searching and ranking the content in your news feed, friend lists, and other areas. Companies like Spotify further have much of the data necessary to determine your musical personality, such as your inclination to be “Music Seeking” or to utilize music for “Sensory-Motor” ends, as per Mas-Herrero’s work on individual music reward. When combined with data off of a listener’s smart phone, the data profile expands to include location, heart rate, gait (if walking), and when paired with a calendar application, current activity. Such large profiles should thus be available for use by an application that could utilize the parameters to passively generate custom music.

The industry leading algorithmic music generators are, coincidentally, also utilized primarily by the ad industry. These tools can take in a variety of data points, such as duration, desired mood/affectation, genre, and tempo, and can synthesize them into a unique piece of audio on the fly without any need for post-generation manipulation or curation by a human. While intended to be a low-cost solution for jingle-writing and unique background music for commercials, such technology could also be considered as more serious art music. A composer working with such a toolbox would be able to map a huge variety of inputs about the user to an equally large number of parameters about the resulting music.

There is little work currently to my knowledge in this field. While there are a few startups who have developed the necessary algorithmically oriented composition components, none of them have successfully paired their tools with datasets that enable mass automated personalized music. Such an advance would thoroughly change society's expectation of music, sonic environments, and their own tailored listening experience.

## Chapter 5. Conclusion

When John Cage declared the environment a worthy candidate as a source for compositional truth, the music community had to contend with a new force subtly infiltrating in every work they performed and mediating every interaction they had. The reminder that composers, performers, and listeners all exist within an environment proved to be a powerful statement that, once made, could not be shut out. Now, just as pervasive as the context of the environment, the power and accessibility of computation has reared its head. A capable and mysterious repository of musical agency, this technology serves to inform and direct every interaction among musical participants. Personal computers, smart phones, and other sensors and speakers all began to inform, direct, and mediate our musical experiences. These same advances allowed for musicians to examine their divested agency paradigms, looking to new ways to empower performers, the environment, and technology as a repository itself. Furthermore, just as Cage observed he could delay the usage of the *I-Ching* to create opportunity spaces for his pieces to inhabit, so too have composers begun to recognize the power of the mini supercomputers audiences carry around in their pockets. The highly personal nature of technology has enabled a new force of agency to become available, that of the empowered listener. Such an act of divestment of musical agency is currently working to enable a new personalized music trend that, when paired with psychological underpinnings and big-data paradigms, has an opportunity to permanently alter the expectations that listeners, performers, and composers have of each other.



# Figures

Figure 1 - Score sample of Feldman's *Intermission 6*. Used by permission of the publisher. Notice how order, relative dynamic, pacing, and other parameters of music are left up to the discretion of the performer.

Intermission 6  
(for 1 or 2 Pianos)

Morton Feldman  
(1953)

Composition begins with any sound and proceeds to any other. With a minimum of attack, hold each sound until barely audible. Grace notes are not played too quickly. All sounds are to be

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Figure 2 - Score sample of Braxton's *Composition No. 108*, courtesy of Anthony Braxton and the Tri-Centric Foundation. The realization of the score is left to the discretion of the performer. Braxton's lines and curves are meant to provide a descriptive notation of the music rather than a prescriptive one, allowing the composer to "see" the piece in addition to hear it.

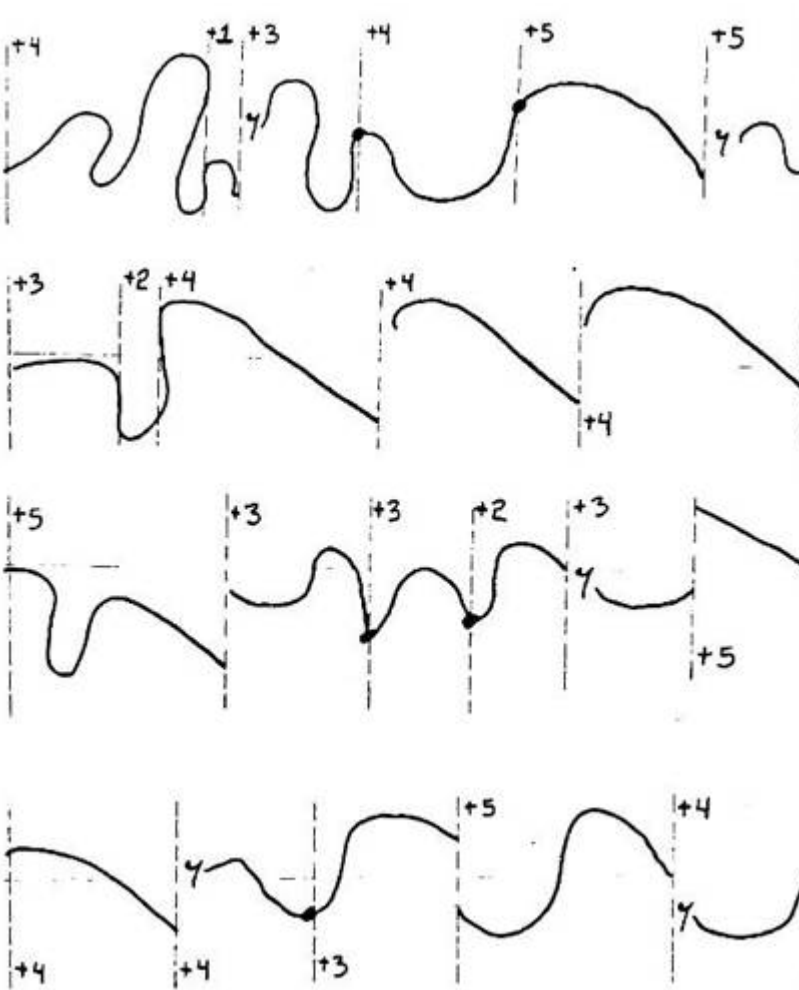


Figure 3 - Score sample of Reich's *Piano Phase*. The phasing, the most salient aspect of the piece from which it gets its name, is only notated as seen in between measures 2 and 3. The score contains only verbal instructions and no direct indication of how long the phase should take, what the rate of phase should be, if the phase should be even throughout or not, or any artistic instructions to the performer.

The image shows a musical score for Steve Reich's "Piano Phase". It consists of two staves, right hand (r.h.) and left hand (l.h.), with various performance instructions and rhythmic markings.

At the top left, there is a tempo marking:  $\text{♩} = \text{ca. } 72$ . Below this, there are three lines of text in English, German, and French: "Repeat each bar approximately number of times written. / Jeder Takt soll approximativ wiederholt werden entsprechend der angegebenen Anzahl. / Répétez chaque mesure à peu près le nombre de fois indiqué."

The score is divided into three sections, each with a number and a range of measures in parentheses:

- Section 1: (x4-8)
- Section 2: (x12-18)
- Section 3: (x16-24)

Performance instructions include:

- mf non legato* (mezzo-forte, non legato)
- fade in* (fade in)
- non legato* (non legato)
- mf* (mezzo-forte)
- hold tempo 1* (hold tempo 1)
- accel very slightly* (accelerate very slightly)
- hold tempo 1* (hold tempo 1)
- f tempo* (forte tempo)
- a.v.s* (ad libitum)

"Piano Phase" By Steve Reich  
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# Listening List

- John Adams, *Shaker Loops* (1978, 1983) Initially distributes agency to (D.A.) performers, then consolidated back
- John Luther Adams, *Inuksuit* (2009) D.A. environment and listeners
- Laurie Anderson, *Landfall* (2014) D.A. other creative forces
- Austin Classical Guitar, Educational Database D.A. educators
- Pierre Boulez, *Third Sonata For Piano* (1957) D.A. environment (shuffle pages)
- Anthony Braxton, *Composition No. 108* (1984) D.A. performer (graphic score)
- Leo Brouwer, *Etude XX* (1983) D.A. performer (box notation)
- John Cage  
    *4:33* (1952) D.A. environment (“silent piece”)  
    *Aria* (1958) D.A. performer (graphic notation)  
    *Music of Changes* (1951) D.A. environment (*I-Ching* in composition)  
    *Child of Tree* (1975) D.A. environment (*I-Ching* in performance)  
    *William's Mix* (1951–1953) collapse versions into single recording  
    *HPSCHD* (1969) D.A. tech, (emergence)
- Huawei, Lucas Cantor, *Schubert unfinished Symphony No. 8* (2019) tech and emergent properties relegated to compositional aid
- Dan Corson, *Sonic Bloom* (2013) D.A. environment
- David Cope, *Emi* (1981-2012) D.A. tech (emergence, expert systems)
- Mickey Delp, *Gemini 6B* (2019) D.A. participants (installation, personalization, approachability)
- John Dowland *Puzzle Canons, palindromic motets*
- Julius Eastman, *Stay On It* (1973) D.A. ensemble
- Morton Feldman, *Intermission 6* (1953) D.A. performer
- Philip Glass, *Two Pages* (1968) D.A. performer / ensemble (box notation)
- Lejaren Hiller, *Illiac Suite* (1957) D.A. tech (emergence)
- Douglas Laustsen, *Wires* (2019) D.A. listener (installation, personalization)
- George Lewis, *Voyager* (1985-7) D.A. tech (as performer)
- John Moeller, *First Vision* (2017) D.A. environment (aided by tech)
- Wolfgang Amadeus Mozart, *Musikalisches Würfelspiel (Musical Dice Games)* (1792) D.A. environment
- Steve Parker, *Sound Atlas* (2015) D.A. listener (location based, tech enabled large scale)
- Omar Peracha, *GANKyouk* (2019) D.A. tech (emergent properties, addresses ethics and proportion of agency divested)
- Bruce Pennycook, *Interiorities* (2018) D.A. performers with tech
- Steve Reich  
    *It's Gonna Rain* (1965) D.A. performer (tech enabled)  
    *Piano Phase* (1967) D.A. performer  
    *Music for 18 musicians* (1974-6) D.A. ensemble
- Terry Riley, *In C* (1968) D.A. ensemble
- Laetitia Sonami, *Magnetic Memories* (2016) D.A. performer (tech enabled instruments)
- Karlheinz Stockhausen, *Klavierstück XI* (1952) D.A. performer
- Monte Taylor, *FEMEVizcayaSC* (2018) D.A. location and curator (tech enabled)
- Barry Truax, *Riverrun* (1986) consolidation/ precise manipulation of exact music
- Michel Waisvisz, *The Hands* (1984) D.A. performer, (tech enabled instruments)
- Hildegrad Westerkamp, *Sound Walking* (essay in 1974) D.A. listener and environment

La Monte Young

*Number 7, Compositions 1960* (1960) D.A. performer ("to be held for a long time")

*Number 13* (1960) D.A. performer (Questions authorship)

*Number 9* (1960) D.A. performer (graphic score)

Pamela Z, *Breathing* (2013) D.A. performer (tech enabled instrument)

John Zorn, *Cobra* (1984) D.A. ensemble (Jazz, game pieces)

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# Biography

Brian Ellis is an Austin based composer, researcher, and guitarist. His musical drive lies in using code to realize his larger compositional vision: that technology should be used toward divesting musical agency from the composer to the environment, the performer, and ultimately, the listener.

Brian is a Music and Computer Science Honors Undergraduate studying at the University of Texas at Austin. He has had works premiered at numerous events, including the Ears Eyes and Feet Concert Series, the Good House Collective's "Time Warp" Concert, the Engineering Chamber Orchestra's Spring Showcase, as well as in numerous student concerts at the University of Texas. He has produced works in collaboration with dancers on numerous occasions, most notably with Unset 2.0, an improvisation and audience co-collaborative dance company. As a performer, Brian is committed to diversifying the repertoire of the Classical Guitar and has performed a solo recital comprised exclusively of minimalist works arranged for the instrument. He performs with a wide range of musicians under the umbrella of the Good House Collective, the New Music Ensemble he co-founded with Christian Clark (Percussion), Nicolas Dominguez (Double Bass), and Zoe Cagan (Flute).

As a Computer Scientist and Computational Biologist, Brian spent two years as a researcher in Dr. Howard Ochman's Microbial Evolution Lab, which is part of the Department of Integrative Biology. Brian's most recent publication is in the Journal Bioinformatics and discusses classifying prokaryotic species based on gene flow.

More information may be found on his website [www.brianellisound.com](http://www.brianellisound.com)