Technology and the Music Industry

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Emily Buckley

Spring 2022

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Joshua Earle, Department of Engineering and Society

Introduction

Some view the worlds of art and technology as disparate, but technological innovations can spark inspiration and creativity, serve as a valuable educational tool, and create new mediums for artists to express themselves. Technology has transformed the way we create and consume music. Music is constantly shifting and evolving, but music has always served as a valuable tool for self-expression, storytelling, and community-building. Due to the significant role music plays in society, music technology analysis can provide valuable insight into the deeply-held values of a period of time and a glimpse into the potential future of music.

The Role of Music in Society

Throughout history, music has impacted societies in a multitude of ways. Music provides an outlet for self-expression. Playing or listening to music can help people process complex emotions and gain clarity. Numerous studies have shown the influential power of music in treating mental illnesses such as depression and schizophrenia (Lin et al., 2011). Listening to positive, upbeat music can increase mood, motivation, and productivity, while slow, calming music can elicit a relaxation response (Saarikallio & Erkkilä, 2007). Many people find meaning through the creation of art. Playing an instrument can be a healthy coping mechanism and a valuable escape from the struggles of daily life. Music demands total concentration and the absence of distraction, promoting a feeling of mindfulness and presence.

Humans are natural storytellers, and music is one of the oldest forms of storytelling. Much of what we know of history is due to oral histories. Stories survive through centuries due to repetitive, memorable music. Songs are a time capsule, capturing the narratives and feelings of the zeitgeist. Lyrics detailing a lived experience, such as mental health issues or racial injustices, can increase empathy and understanding for those who may not experience these struggles. The

significance of entertainment should not be understated. Throughout trying times in history, societies have relied on music and other forms of entertainment to find glimmers of hope and joy.

Music builds community. People sang and danced to celebrate birth, death, weddings, and holidays throughout history. Churches use songs to unite hundreds of voices into one voice. Many religious practices use music to elicit strong emotions and a feeling of connection, healing, and restoration (Laack, 2015). Concerts and music festivals unite people worldwide with varying life experiences but at least one thing in common. Music can cross language barriers to connect with people across the world. Many people advertise their favorite artists and bands as a form of identity. Their taste in music reflects much about their personality, interests, and beliefs. Individuals can find an almost instant deep connection over a shared musical interest.

Music is extremely influential in our world. As technology shifts and evolves, music evolves as well, reflecting and influencing the current culture. Analyzing the impact of technology on music can deepen our understanding of art's impact on the world and the ways in which the available tools influence the end product of creation. By looking back on the evolving relationships between technology and music in the past, we can attempt to make more accurate predictions about how these dynamics will shift in the future.

Methods

I investigated the impact of technology on music through the scope of Actor-Network Theory. Many actors interact in this vast network of music culture. As Actor-Network Theory posits, non-human elements, both physical and conceptual, play just as important a role as human elements in the music industry's shifting network (Latour, 2007). The listener, the instrumentalist, the music producer, technology used to listen to music, platforms on which

music lives, music agents, physical instruments, technology for music creation, and the culture of the time all interact to form the world of music. I analyze these distinct, disparate, but tightly woven, interconnected elements. Each impacts the other in a multitude of ways. I surveyed books, articles, videos, interviews, and podcasts, and I drew from my personal experiences playing music, performing in and attending concerts and music festivals, and listening to music.

Results & Analysis

For thousands of years, songs survived through time without the aid of technology and digital recording devices. The introduction of technology drastically changed the landscape of this art form, and the speed of evolution has only increased. In 1877, the phonograph marked the first sounds to be recorded and played back (Webster, 2002). Microphones, headphones, amplifiers, and tape recorders were developed, advancing music recording capabilities (Webster, 2002). Record players and the Long-Playing (LP) record introduced the idea of the album, allowing a musical idea to span about 50 minutes (Goldmark et al., 1949). Musicians wrote albums designed to be played uninterrupted from beginning to end, with seamless transitions between songs (Goldmark et al., 1949). The longer format of the record allowed jazz artists to experiment with long sections of improvisation (Coker, 1990). The focus of music creation transitioned from live performance to studio recording. With the ability to record and playback music, music could be available on-demand.

With the introduction of radio, people could listen to music in their car. Songs had to be catchy and repetitive to quickly grab a listener's attention. Audiences went from listening to entire records to part of one song, so songs had to function standing alone. Being a radio hit meant rapid success for a musician, so musicians had a strong motive to create radio-friendly music. Repetitive lyrics helped listeners easily memorize and sing along to songs on the radio.

Rhythms and melodies had to be simple enough that the average listener could easily replicate the tune.

Music technology also introduced many new sounds to aid in music creation. In 1919, Luigi Russolo created noise instruments, an early synthesizer, that created industrial and natural sounds, which he used to create unpredictable, complex, unique music (Pinch & Bijsterveld, 2003). The creation of the electric guitar propelled the development of rock and roll, rock, and heavy metal music. Effects pedals altered the sound of an electric instrument through audio signal processing. Electric drums, electric bass, keyboard, and other electric versions of originally acoustic instruments have all expanded the possibilities of sound. The vocoder manipulated speech signals to sound artificial and synthetic (Flanagan & Golden, 1966). The digital sampler presented new approaches to composing music with found sounds or the sounds of everyday objects. Sampled sounds could be repeated, recontextualized, or manipulated. The development of the modern synthesizer provided musicians with more control over timbre, pitch, and dynamics and allowed for even more experimental composition (Pinch & Bijsterveld, 2003). The psychedelic counterculture first embraced the new capabilities of synthesizers and digital music, with progressive rock and pop music following soon after (Pinch & Bijsterveld, 2003).

The invention of the two-channel stereo allowed spatial and depth exploration in music, as well as more natural-sounding music (Theile, 1991). With the introduction of cassette players, the WALKMAN, CD players, mp3 players, and iPods, music listening became more portable and more convenient. Music became a soundtrack to people's lives and background music for everyday activities. The introduction of the mixtape provided a new way for music to be shared. Rappers used this medium to self-produce and independently distribute their music for free to

promote their music. The mixtape provided musicians creative control and autonomy, free of record labels, restrictions, or the threat of copyright infringement.

The creation of the Digital Audio Workstation (DAW) allowed music producers to record, mix, and master audio (Marrington, 2017). New recording techniques that were not possible in live music became available, such as signal processing, multitrack recording, Musical Instrument Digital Interface (MIDI) sequencing, and sound synthesis (Warner, 2003). The user could record MIDI tracks, experiment with effects, and use plugins to add functionality to the DAW. Auto-Tune, a plugin that alters audio pitch, opened up the possibilities for correcting out-of-tune recordings or experimenting with unnatural sounds. GarageBand, an intuitive, user-friendly music-creation application, allowed almost anyone with little musical knowledge to begin making music.

Music now conveniently lives on our phones and the internet. Today's music resides on various platforms such as Spotify, Apple Music, YouTube, Soundcloud, and TikTok. These platforms also shape the direction of music. Music streaming platforms like Spotify and Apple Music encourage artists to create hits that can make it onto curated playlists and top charts. YouTube further expanded the rise of music videos as another form of artistic expression. TikTok has shortened the attention span of an entire generation to only a few seconds. Songs popularized through the app immediately shoot to the top of the charts, forever changing the lives of the artists who create them. A musician who gains popularity on TikTok through a viral sound quickly rises to fame and success. Many musicians write songs intentionally with TikTok viral potential, using sound effects characteristic of other popular songs on the app, or including lyrics that could easily be applied to many different scenarios, inviting TikTok creators to use the sound. Other musicians found an audience through TikTok by regularly posting their music and

covers to the app, similar to the era of YouTube that brought fame to young musicians. Musicians no longer have to be discovered or "planted" by a record label executive. Rather than a few executives dictating the landscape of the music industry, the public determines which artists gain popularity. Fame has become accessible to anybody, no matter their upbringing or socioeconomic status.

Technology Impacting Music Creation

Technology provides new mediums for artists. Previously, only acoustic instruments and voices were available for music creation. As new instruments emerged, music evolved and adapted to these changes. Now, entire songs can be composed using only digitally created sounds. Technology allows artists to use digitally synthesized and digitally-altered sounds. Voices can be autotuned or warped to different frequencies and timbres. The technology available to create music impacts the final product. Pop music and the rise of EDM in recent decades have brought more upbeat, energetic music than ever before. Digital sounds have also led to more experimental music, as musicians can dramatically alter sounds with ease.

The introduction of digitally-produced sounds and autotune raises the question: does the pressure for perfection limit self-expression? When the player piano, a self-playing piano, was first introduced, many musicians strongly opposed its use, believing the mechanical, non-human sound lacked the passion and beauty of imperfection found in human piano players (Pinch & Bijsterveld, 2003). Today's listeners have become accustomed to the quantized pitch-perfect notes to align perfectly with the beat. The ear becomes trained to listen to songs free of mistakes. There is no room for error or human imperfections in a digital age where pictures and videos are regularly digitally altered to remove blemishes and insecurities. Realistic, raw audio recordings without the production we are accustomed to may sound jarring and unpleasant. Does computer-

generated music lessen the emotional impact of a song? Taking away this human element may limit how artists can express themselves. Artists connect with their audience through emotion and relatability, but this could be difficult through an artificial sound scrubbed free of any hints of being created by a human. An artist that chooses to leave in wrong notes or use a first-take that includes some off-pitch or unpleasant tones may not be received well by today's audience.

Conversely, our ears may be vying for these minor inconsistencies, hints of being human, hidden within a song. Sloan Struble, also known by his artist name, Dayglow, admitted he purposefully includes wrong notes, background noise, and rough recordings to help his songs feel more natural and raw (2021). He aims to capture the magic of the first take, where precision and technical skill may not be perfect, but the music's energy and emotion are palpable (Dayglow, 2021). Mac Miller purposefully added the hiss and crackles of a vinyl record to his song Perfecto, potentially implying that the imperfections of life are what truly make life perfect (Cuchna, 2021). Evidently, the technology we use to listen to music, like record players with their flawed but pleasing sound, can have a lasting impact on music creation.

Today's music lives on music streaming platforms, which provide endless choices of music to listeners for free or a cheap price. As music became digital and easier to distribute, artists started getting paid less and less. Most music platforms are free with ads, or a user can pay a small monthly fee to remove ads. An artist earns about $0.004 per stream on Spotify, a massive revenue drop from previous forms of distribution (Marshall, 2015). Profit from songs has to pay employees at the music streaming platform company, the musical artist, their agent, their band, their producer, their lyricist, the artist for the cover art, and any other collaborators. Musicians cannot support themselves by streaming music alone. Most artists rely on merchandise and concert ticket sales as their main sources of revenue. One could argue this has turned the music

industry into more of a commercialized business, less focused on the art of creating music. Failure is not an option when a musician faces the pressure of making enough money to support themselves and the hard-working employees who rely on their success for income. They will be much more likely to create music with the business of music in mind.

With the rise of bedroom pop, a genre defined by young artists gaining popularity through the internet with songs created in their bedrooms, more responsibility and expectations fall on the individual musician. Kevin Parker, known by his stage name Tame Impala, paved the way for the multifaceted musician, writing, recording, and producing all of his music on his own (Pinnock, 2016). Previously, a musician typically excelled at one specific skill, such as singing. Today's musicians must know how to sing, write lyrics, compose melodies, harmonies, and chords, play multiple instruments, produce their music, and advertise themselves to contend with the competition. Inevitably, all of these additional responsibilities take time away from the craft of making good music.

Other Actors in the Music Network

While technology has drastically altered the creation and listening of music, other factors play significant roles in the shifting network of the music industry. The music listener, while not directly involved in the creation process, holds a substantial amount of power and influence in music creation. The audience impacts the musician's artistic choices when they face the pressure to make money and please others. The music industry operates on supply and demand. Pressure to put food on the table, pay rent, and live their desired lifestyle drives musicians to make music that will be more popular. Some want to feed their ego with the numbers rising on music platforms and in concert venues, while others naturally want to please others. Opting to produce crowd-pleasing music may inhibit a musician's creativity and true inner desires. They may shy

away from controversial statements to avoid offending any potential fans. Much of this pressure also comes from their agents. These producers and business executives also care about running a successful business and making money, so they encourage musicians to make the music that will generate the most revenue. Most musicians have to strike a balance between creating music they want to create and creating music that their audience wants to hear. Sometimes the best art is created when letting go of all expectations from others.

According to Actor-Network Theory, even a non-human ambiguous idea, such as a cultural movement, can play a significant role in the network. Political, social, and economic ideas are reflected in music, and music holds the power to influence cultural movements. Music transforms people's moods, opinions, and core beliefs and can rally political and social change. A vocal advocate for the Civil Rights Movement, Bob Dylan captured the soul of revolution and the voice of an entire generation in his music (Brandon et al., 2017). Some artists use their music to spread their political, religious, and spiritual ideas. The Smiths promoted their political ideologies and beliefs about animal rights in their album, "Meat is Murder" (Morrissey, 1985). These artists' efforts toward social movements drove real cultural change. The messages spread through music can spread information to a broad audience and serve as a call to action or rallying cry. With the aid of technology, music can now reach a much wider audience. Messages can be spread much faster and to people around the world. Communities can be built based on shared musical interests, connecting people across political and geographical barriers. Language barriers do not exist in the world of notes and melodies. Music-sharing platforms expose people to music from all around the world.

Conversely, how do musicians impact the technology created? Companies that produce plugins and DAWs create the products that the market demands. Through popularizing certain

sounds, musicians influence the direction of the progression of music technology as others try to emulate them. MIDI sounds have improved quickly, as musicians want access to a wide array of instrumental sounds without the years needed to perfect the craft or the budget required to hire instrumentalists. Musician Jacob Collier more directly influenced the direction of music technology by commissioning Ben Bloomberg to create a unique harmonizer, a keyboard that will produce the sound of his voice pitched to the keys pressed in real-time (Bloomberg, 2020).

Accessibility of Music

How has the progression of technology changed the landscape of music? The racism, sexism, and classism pervasive in our culture have long been apparent in the music industry. Most music education programs focus primarily on European or Western music. Music, especially classical music, has historically been dominated by white, upper-class male musicians. African American musicians make up only 1.8 percent of the top orchestras in America; Latino musicians make up 2.5 percent (Tommasini, 2020). In 2014, only 14.2% of all musicians in symphony orchestras were from non-white backgrounds (Doeser, 2016).

Music technology has been helping and hurting this diversity problem in different ways. On the one hand, the rates of women producers are staggeringly low. The Universities and Colleges Admissions Service surveyed 12 universities in Britain from 2007 to 2011 and found that 90% of music technology degree candidates were male, compared to traditional music degrees consisting of 55% male candidates. (Born & Devine, 2016). An already male-dominated field, the music industry is shutting women out even more with the rise of music production. Many women are discouraged from pursuing this field and face many obstacles to their success once they do.

However, technology in music has helped increase diversity in many other ways. Music production degree programs are often more ethnically diverse than traditional music degree programs (Born & Devine, 2016). The shift away from classical music has opened up room for more people to feel welcome. They may not feel the same discrimination or stereotypes associated with classical music. Also, music education has become more and more accessible. Many free online resources exist for aspiring musicians, such as SmartMusic, musictheory.net, and countless YouTube videos and articles. Podcasts like Song Exploder disseminate information about the music creation process, the music theory behind popular music, and the deeper meanings of top songs (Hirway, 2014-present). There has long been a lack of respect for R&B and hip-hop music and a lack of formal academic writing on these subjects. Many often overlook these songs' deeper meanings and cultural impact. Dissect, another music podcast, works to break down these barriers by diving deeper into the meaning of contemporary music with the kind of long-form analysis previously reserved for classical music (Cuchna, 2016-present).

Traditional instrumental music is not accessible to people who lack hearing, vision, limbs, or fine motor control. Adaptive instruments are an exciting area of research, creating instruments that fit the musician's needs and match their abilities (Chapin, 2020). Other alternative approaches to music creation include Virtual Reality (VR) music, playable fruit (Derrick et al., 2019), paintbrush instruments (Doury & Buttet, 2022), and other applications that challenge our ideas of what is considered an instrument. These projects make the creation of music more accessible to people with varying levels of physical ability.

Music technology makes music creation accessible to people without formal training or technical skill on an acoustic instrument. Sonic Pi provides a coding environment to code music

directly. MAXP/MSP is a coding language for producing music. Google Magenta focuses on using Machine Learning for various artistic and musical projects, including creating a DrumBot, which drums along to a given melody (Dinculescu, 2019), and Tone Transfer, which transforms audio into a different instrument (Hantrakul et al., 2020).

Discussion

Equipped with the knowledge of the impact of technology on music throughout history, we can look ahead to the possible directions music and technology may move toward in the future and how these changes will impact society. Innovations in machine-generated music raise important questions of copyright and ownership. If a software engineer develops machine learning tools and an interface for creating music and a user uses these tools to create a new piece, how much of the ownership falls to the user or the software engineer? How does that shift if the user provides some input as a starting point? As these capabilities advance and become more commonplace, organizations must develop a code of ethics and copyright and ownership policies. Copyright in music has been a long-debated topic, as there is already so much gray area in determining what is copyrightable. Many arrangements of notes are standard in music theory, so it can be hard to draw a line between what may be coincidental and what constitutes intentional copying. New technologies can analyze a piece of music and find similar songs. This capability opens up new possibilities to call ownership and originality into question.

What can humans and computers learn from each other about emotion, art, and music? We are reaching a point where it is possible to collaborate with machine learning algorithms to create original art. Humans can learn from the art a computer creates, just as an algorithm can learn from datasets of human-created art. The idea that a computer could create valuable art threatens the human ego, inciting opposition in many artists and musicians. Humans feel

ownership over emotion and art, fueling the feeling of superiority over other beings. Humility and open-mindedness are necessary to accept that there may be something we can learn from an entity other than ourselves. Many artists may feel threatened by a machine stealing their job, but humans and computers could create new art that transcends previous possibilities if they learned to work together.

What defines music and art? These definitions need to adapt as technology evolves. An algorithm can learn to associate a sad poem with the label of sadness and major chords with a label of happiness. Even if an algorithm cannot feel emotions in the way a human may be able to, neural networks can create complex, interwoven, multi-layered pathways to identify nuanced emotion underlying a piece of art. Just as it could identify these emotions, an algorithm could also create a piece of art reflecting these feelings when prompted. The origin of the art does not detract from its inherent value or potential emotional impact. When observing art created by a human, one never truly knows the artist's true intentions or meaning portrayed in the art. The viewer's experience matters more than the artist's intention. Art is subjective, and what matters most is how it makes the audience feel. Art can inspire, transform, devastate, or comfort. It can elicit responses of joy, fear, fury, or regret. Art has the power to draw out dreams of our future or string out repressed memories. Music can cause someone to reflect inward and reevaluate their life. If a computer-generated piece of art can still elicit these strong responses, the process of creation does not matter. We give meaning to art through our responses to it. One day, computers may be considered musicians. Our current perceptions of artificial intelligence may be limited as we still have a rudimentary understanding of how neural networks function. As our understanding of this technology and its capabilities evolve, our ideas of what constitutes art and what entities constitute an artist may drastically change.

Technology can be a powerful tool in allowing people to express themselves in new ways, influence others, and bring people together. How can we continue to innovate and work towards these goals? Many technological tools improve constantly. MIDI sounds and plugins emulating real instruments have much more room for improvement. Improvements in VR music and accessible instruments help make music more accessible to people who may have barriers preventing them from pursuing traditional instruments. As music technology develops, musicians gain new mediums to aid them in expressing themselves and telling their stories. Music education tools are being refined and improved, providing technology to make learning music possible for more people. Apps can provide feedback to students through machine learning algorithms, which significantly helps students in lower socioeconomic statuses who cannot afford expensive private lessons. Music educators need to reform their teaching to include music from around the world and music technology. Computer-generated art is advancing at a rapid rate. Artificial accompaniment and collaboration with computers all lie in our future, giving a new meaning to human-computer interaction.

References

Bloomberg, B. A. P. (2020). *Making Musical Magic Live* (Doctoral dissertation, Massachusetts Institute of Technology).

Born, G., & Devine, K. (2016). Gender, creativity and education in Digital Musics and Sound Art. *Contemporary Music Review*, *35*(1), 1–20. https://doi.org/10.1080/07494467.2016.1177255

Brandon, S., Maupin, I., & Goodman, M. (2017). Bob Dylan: The prophet of social change in the 1960s. *Media Watch,* 8(3). https://doi.org/10.15655/mw/2017/v8i3/49154

Chapin, C. M. (2020). Adapting instruments, not students: A study of adaptive musical instruments. *Honors Program Theses,* 430.

Coker, J. (1990). *How to Listen to Jazz.* Aebersold.

Cuchna, C. (Host). (2016-present). *Dissect* [Audio podcast]. Spotify Studios.

Cuchna, C. (Host). (2021, October 26). S9E4 - Perfecto by Mac Miller [Audio podcast episode]. In *Dissect.* Spotify Studios.

Dayglow. (2021, August 5). *Dayglow - How I Made "Woah Man"* [Video]. YouTube. https://www.youtube.com/watch?v=Rp_GwRNZrwo

Derrick, M., Paris, N., & Pegula, M. (2019, May 13). *Magenta + Deeplocal + The Flaming Lips = Fruit Genie.* Magenta. Retrieved April 15, 2022, from https://magenta.tensorflow.org/fruitgenie

Dinculescu, M. (2019, December 2). *DrumBot: your real-time ML drummer.* Magenta. Retrieved April 15, 2022, from https://magenta.tensorflow.org/drumbot

Doeser, J. (2016). Racial / Ethnic and Gender Diversity in the Orchestra Field: A report by the League of American Orchestras with research and data analysis by James Doeser, Ph.D. *League of American Orchestras.*

Doury, S., & Buttet, C. (2022, January 6). *Paint with music.* Magenta. Retrieved April 15, 2022, from https://magenta.tensorflow.org/paint-with-music

Flanagan, J. L., & Golden, R. M. (1966). Phase vocoder. *Bell System Technical Journal*, 45(9), 1493-1509.

Goldmark, P. C., Snepvangers, R., & Bachman, W. S. (1949). The Columbia long-playing Microgroove Recording System. *Proceedings of the IRE,* 37(8), 923–927. https://doi.org/10.1109/jrproc.1949.229985

Hantrakul, H., Zada, N., Carney, M., Bowers, M., Li, C., Toh, E., Secor, J., Engel, J. (2020, October 1). *Tone Transfer.* Magenta. Retrieved April 15, 2022 from https://magenta.tensorflow.org/tone-transfer

Harkins, P. (2011). Appropriation, additive approaches and accidents: The sampler as compositional tool and recording dislocation. *IASPM Journal,* 1(2), 1-19.

Hirway, H. (Host). (2014-present). *Song Exploder* [Audio podcast]. Radiotopia.

Laack, I. (2015). Sound, Music and Religion: A Preliminary Cartography of a Transdisciplinary Research Field. *Method & Theory in the Study of Religion,* 27(3), 220-246.

Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oup Oxford.

Lin, S.-T., Yang, P., Lai, C.-Y., Su, Y.-Y., Yeh, Y.-C., Huang, M.-F., & Chen, C.-C. (2011). Mental health implications of music: Insight from Neuroscientific and clinical studies. *Harvard Review of Psychiatry,* 19(1). https://doi.org/10.3109/10673229.2011.549769

Marrington, M. (2017). Composing with the digital audio workstation. *The Singer-Songwriter Handbook,* 77-89.

Marshall, L. (2015). 'Let's keep music special. F—Spotify': on-demand streaming and the controversy over artist royalties. *Creative Industries Journal,* 8(2), 177-189.

Morrissey, S. P. (1985). Meat is Murder [Recorded by The Smiths]. Liverpool & Surrey: Rough Trade, Sire (1984).

Pinch, T., & Bijsterveld, K. (2003). "Should One Applaud?": Breaches and Boundaries in the Reception of New Technology in Music. *Technology and Culture*, *44*(3), 536-559.

Pinnock, T. (2016). Tame Impala. *Uncut*, (227), 102.

Saarikallio, S., & Erkkilä, J. (2007). The role of music in adolescents' mood regulation. *Psychology of Music,* 35(1), 88–109. https://doi.org/10.1177/0305735607068889

Theile, G. (1991, February). On the naturalness of two-channel stereo sound. In *Audio Engineering Society Conference: 9th International Conference: Television Sound Today and Tomorrow.* Audio Engineering Society.

Tommasini, A. (2020). To make orchestras more diverse, end blind auditions. *The New York Times,* 16.

Warner, T. (2003). *Pop Music Technology and Creativity: Trevor Horn and the Digital Revolution* (1st ed.). Routledge. https://doi.org/10.4324/9781351218504

Webster, P. (2002). Historical perspectives on technology and Music. *Music Educators Journal,* 89(1), 38–43. https://doi.org/10.2307/3399883