

THE TRANSFORMATION OF THE MUSIC INDUSTRY DUE TO TECHNOLOGICAL
ADVANCEMENTS

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

Yaman Shrestha
Spring, 2021

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

Signature _____ Date _____
Yaman Shrestha 04/27/2021

Approved _____ Date _____
Richard D. Jacques, Department of Engineering and Society

Introduction

What is music? When looking at the definition of music, Oxford's dictionary defines it as a "vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion" (Music: Definition of Music by Oxford Dictionary). When looking back in history, the origin and significance of music can be traced back to the beginning of civilization itself, as it was a form of expression often used in rituals, communication, and personal or communal entertainment (Montagu, 2017). Nevertheless, music has always been paralleled by eras of liberation and creation that has encompassed cultures and generation as a form of expression. However, within the last few hundred years, the advancement of technology has significantly influenced how music has been produced and distributed, which has had a profound impact on the music industry. In fact, it can be easily said that technology is now a crucial instrument in the creation and distribution of music. It has altered how music is composed, transmitted, heard, performed, and preserved. From electric guitars, multitrack recordings, effect pedals, and now personal computers and phones, music is ever evolving to becoming more inclusive, diverse, and accessible. With advancing technology, such as accessible music streaming platforms and editing software, the listener is liberated to explore the complex world of music and produce music himself or herself. Because of this, the music industry has grown to the market potential of \$21 billion dollars (Watson, 2019), reaching an audience of billions. On the other side, technology has also disrupted the music industry, due to the digitalization of music and piracy. This STS Research paper aims to do a thorough analysis of both the positive and negative impacts of technology in the music industry.

Methodology

To address my research questions, I evaluated various scholarly articles, datasets, or books about different technologies in the music field and how it has shaped music within the last few centuries. This required looking at various technological advancements with respect to time and understanding the effect it had on music in that period and how it shaped music later in the future. With this analysis, I aimed to create a clear timeline of the progression of technology in the music industry. In order to understand the current musical experience, data related to music streaming platforms such as Spotify and Apple were used. The analysis of that data will provide a better understanding of trends in music, and potential relationships with emerging technologies in the field. In terms of this research, the main social groups and actors that are affected by my research are artists, producers, and consumers of music. Therefore, this research paper also aims to look at how the advancement of technology affected these social groups through the history of the music industry.

Literature Review

When looking back in history, music was once an art form that could only be heard through live performances. Home consumption of music was often only through physical instruments like a private piano performance. However, with the invention of the phonograph, a sound recording technology by Thomas Edison and Emile Berliner in 1877, a new revolution in the music industry started (Newby, 2017). The phonograph made it possible to record music by etching grooves into tin foil discs, that when played in rotation under a metal needle, created soundwaves that were amplified through a horn-shaped metal speaker (SingularDTV, 2018). The ability to preserve music by recording the performance completely changed the meaning of

music both artistically and socially. By the end of the nineteenth century, companies in the United States and England were manufacturing disk recordings of music, which made music more accessible to people in the comfort of their homes (Kramer) .

The invention of multitrack recording also positively transformed the music recording industry by allowing artists to tweak and perfect their music. Prior to Les Paul's miraculous discovery of multitrack recording in the 1940s (Hilton, 2018), artists could only record a full track at one time. Once multitrack recording became popularly available in the mid-1950s, it revolutionized how music is crafted, granting creative power to the musicians and sound engineers to meticulously experiment, layer sounds, and fine-tune their production (Hilton, 2018). This invention led the music industry to a new age of recording music, which was impossible to do prior to this invention.

Another notable invention that changed the production of music is the effect pedal. Introduced in the 1940s, an effect pedal is an electronic device that can modify the sounds of various musical instruments. Rowe Industries created the first guitar effect pedal in 1941 and later manufactured the first standalone guitar pedal commercially in 1946 (Musicology, 2018). The only two controls of the first guitar pedal were increase and speed (Musicology, 2018). The use of these controls influenced the expression of rock 'n roll and it can be heard in the 1955 hit 'Bo Diddley' (Musicology, 2018). Eventually, the increased accessibility of transistors in the 1960s led to a more affordable and lighter guitar pedal, making it purposeful for stage use. Nowadays, the effect pedal works generally by taking an analog signal from an instrument, which then is converted into a digital signal, which is then modified through audio signal processing. The modified digital signal is then converted back to an analog signal, which is then played through an amplifier. There are a multitude of effects that can be added such as distortion,

overdrive, fuzz, and delay. This invention allowed artists to add another dimension of sounds that were not possible with just physical instruments. This led to the growth of genres such as jazz and rock ‘n roll.

As technology progressed, even the medium in which we listen to this digitized music has transgressed quite a bit in the last century. We have moved gradually from records to cassettes, to CD’s, and now to music streaming services like Spotify. All these changes had a big impact on the commercialization and accessibility of music in the industry. The first invention was the compact cassettes or tapes, which were invented in 1963 by the Dutch company Royal Philips (Kendall, 2018). These cassettes work by first “etching” sound waves magnetically onto the tape. So when you play a cassette, the magnetic tape is run past a head that moves up and down from the charge on the tape (Roemer, 2020). This movement of the receptor, similarly to a vinyl, is translated into electromagnetic waves that are then sent to an output like a speaker (Roemer, 2020). Probably one of the greatest benefits of cassettes is their small size. This and the invention of portable cassette players made music more accessible and portable than ever before, essentially changing how and where we listen to music.

The compact disc or CD was later invented by the conjoined efforts of Sony and Phillip in 1982. To figure out how a CD works you have to look at its surface. A CD’s surface contains one long spiral track of data, which contains flat reflective areas and non-reflective bumps. When a CD drive shines a laser at the surface of the CD, the laser light can detect the reflective and non-reflective areas, which can be read and are converted into a stream of digital information that is then outputted into a speaker (Brain, 2000). CDs were extremely important for the development of the music industry. It was the main release format of music for many decades. The reason is that CDs brought the best format compared to the devices before it. They had

high-quality audio and affordable, compact, transportable, and modifiable features (Kendall, 2018).

Contrary to the popular sentiment of tapes and discs making music more accessible, anti-taping lobbyists believed that home recordings were killing the music industry. In fact, the invention of tapes and CDs initiated a new concept of home modification and brought about a new concern, piracy, which was resisted by most recording artists and producers. After cassette tapes and CDs became popular, the music industry faced its first devastating blow from piracy and eventually in 1989 the DAT Bill, also known as the Digital Audio Tape Bill, restricted how many tapes consumers could purchase along with the attempt to prevent consumers from piracy (Kendall, 2018). On the other side, cassettes and CDs also ushered in the age of Mixtape culture, which allowed amateur creators to record and distribute their own music, which is a concept that allows the rise of artists into the music industry to this day (Kendall, 2018).

In the early '80s, the MP3 was invented and in 1992, the MP3 became mainstream. In 1999, peer-to-peer sharing services (e.g., Napster) created fraudulent copyright infringement (Kendall, 2018). The ease of access to free music from utilizing sharing services compromised the revenue profit of the music industry. Contrary to the negative impacts on revenue profits, platforms such as Napster started the concept of sharing MP3 files that eventually transformed into platforms like iTunes, Spotify, and YouTube.

With the rise of accessible internet and the invention of smartphones, a new concept of listening to music came to popularity: streaming. Streaming music was developed with the aim to listen to and discover new music without having the need to actually download or purchase songs (Kendall, 2018). In addition, streaming made it possible to access music in the palm of our hands with smartphones. By the late 2000's and mid 2010's streaming platforms like Apple

Music and Spotify quickly rose to the market, pushing the music industry into this new market. Streaming platforms, also aimed to make digital music into a sustainable business model for everyone involved, such as the artists and producers, who were often hurt by piracy (Kendall, 2018). By making music very accessible through either ads or a small fee, it encouraged consumers to legally listen to music, while allowing artists to profit in the process.

Analysis and Discussion

Considering the advanced and swift progression of technology, from the phonograph to streaming, the music industry experienced various revelations in how music is created and perceived. Overall, the impact of technology has been mainly beneficial. Some of the positive changes that have resulted from utilizing technology in music are improved production, easier promotion, better distribution, accessibility, and the advancement and emergence of new musical genres. For example, the studio environment, which consisted mainly of physical instruments, a few hundred years ago, has changed completely into a digital environment where digital equipment now dominates the production process (Southern Utah University, 2021). In addition, with the emergence of electronic instruments, such as electric guitars and effect pedals, they have allowed new types of sounds that would have been impossible to create with standard instruments.

With all technology, many limitations and disadvantages arise. In terms of the music industry, one major negative that has risen due to technological advancements is piracy. Due to music being digitized, it could now be read, copied, and transferred between any two computers. Although it made music very accessible, it has also been financially disastrous to artists and producers. In fact, piracy due to digitized music has led to economic losses around 12.5 billion

dollars every year according to the Recording Rights Association of America (Siwek, 2007).

These monumental changes affected most of the music industry despite the measures taken by the music business to prevent the convenient access that consumers had to pirated content.

In fact, the International Federation of the Phonographic Industry (IFPI) in 2018 reported that 38% of consumers acquired their music via copyright infringement methods such as piracy. From all the consumers who obtain music via copyright infringement, 32% acquire it by stream-ripping, 23% by downloading through cyber lockers or P2P (i.e. BitTorrent), and 17% by using a search engine to find illegal files. The results come from a study conducted by IFPI in 2018 with a representative sample of 16 to 64-year-olds in 18 countries that according to IFPI “make up the vast majority of global music consumption” (Wang, 2018).

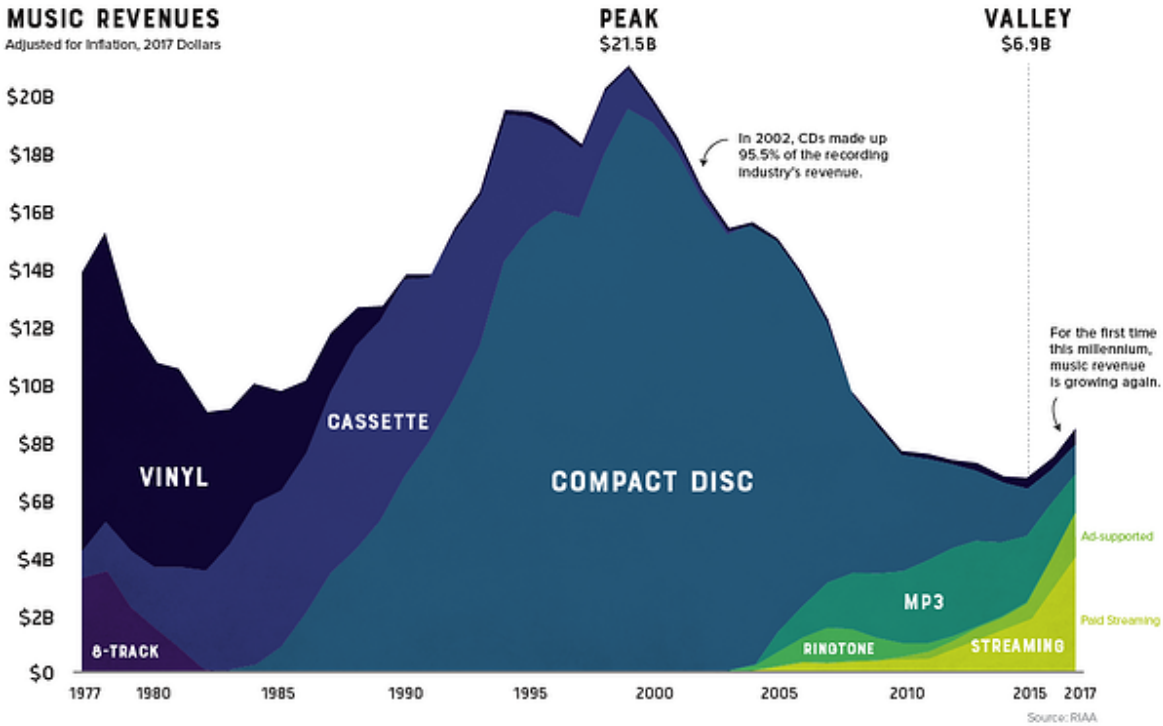


Figure 1: Distribution of Music Revenues based on form of consumption

The graph above from Visual Capitalist shows the music industry sales in the past 40 years. The creation of CD's and cassette tapes matches with the steep increase in music revenue. The highest peak is at \$21.58B, which was the same year Napster, a peer-to-peer file sharing service, was launched. After the use of Napster began to rise, it resulted in a downfall of revenue sales, which eventually led to the shutdown of Napster in 2002. In 2003, the iTunes Music Store was launched by Apple, which correlates with a slight jump in revenue from 2003 to 2004. The music industry faced an all-time low in between 2014-2015 with a total revenue of \$6.98B. After the low point, music revenue increased from 2015-2017 (Routley, 2019). From this data analysis, it is evident that the music industry faced a devastating drop in revenue since the start of the millennium. The era of cassette tapes and compact discs flourished in terms of revenue profits, but issues of piracy protection and taxable goods in the music field discouraged this growth in revenue. As music revenue profits slowly recover, it is important to note the rapid growth of music production, distribution, and consumption that came about after music became mainstream. Digitized music has diversified the methods of consuming music.

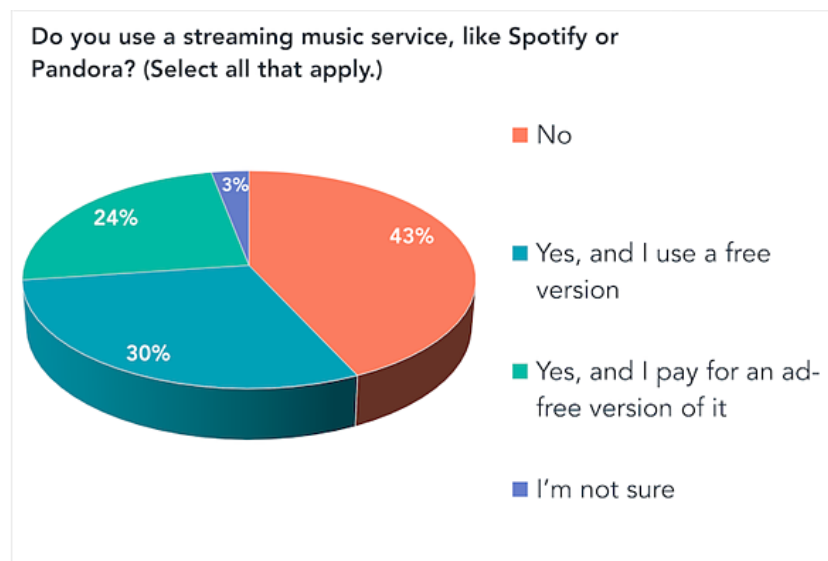


Figure 2: Survey of use of music streaming services conducted by Lucid

In a survey conducted by Lucid, participants were asked if they use streaming services. The data indicates that 54% use music streaming services, while 43% do not use it and 3% are unsure. Amongst those using the music streaming services, 30% use a free version and 24% pay for an ad-free version (Zantal-Wiener, 2019). This analysis parallels the findings from the prior study conducted by Visual Capitalist. Streaming services are currently the most popular method of music consumption with an estimated 54% of the research pool of consumers utilizing it, and it complements the increase in revenue streaming services, both paid and ad-supported, have experienced in the past several years.

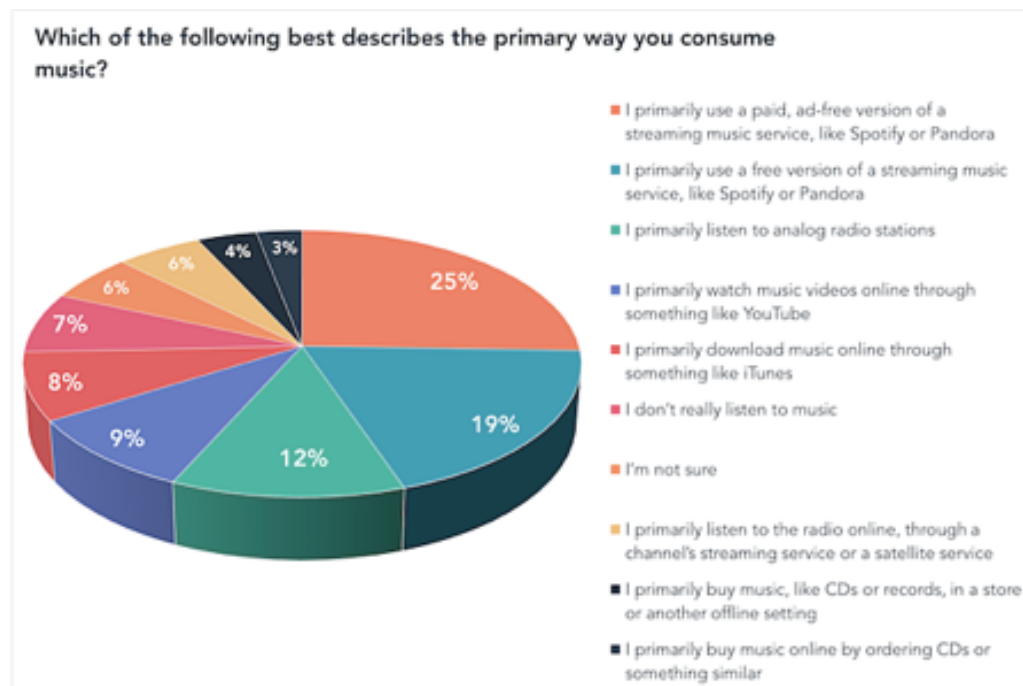


Figure 3: Distribution of Primary ways music is consumed

In a follow-up survey question, participants were asked what their primary ways of consuming music were. Figure 3 depicts the distribution of platforms for listening to music and the color key is sorted from most selected to least. The most popular response at 25% was using a paid, ad-free version of streaming services. 19% use an free version of streaming which

includes ads, 12% listen to analog radio stations, 9% listen through YouTube, and 8% download music online through services such as iTunes (Zantal-Wiener, 2019). It is important to note that amongst all the consumption methods, streaming services make up 44% of the total responses.

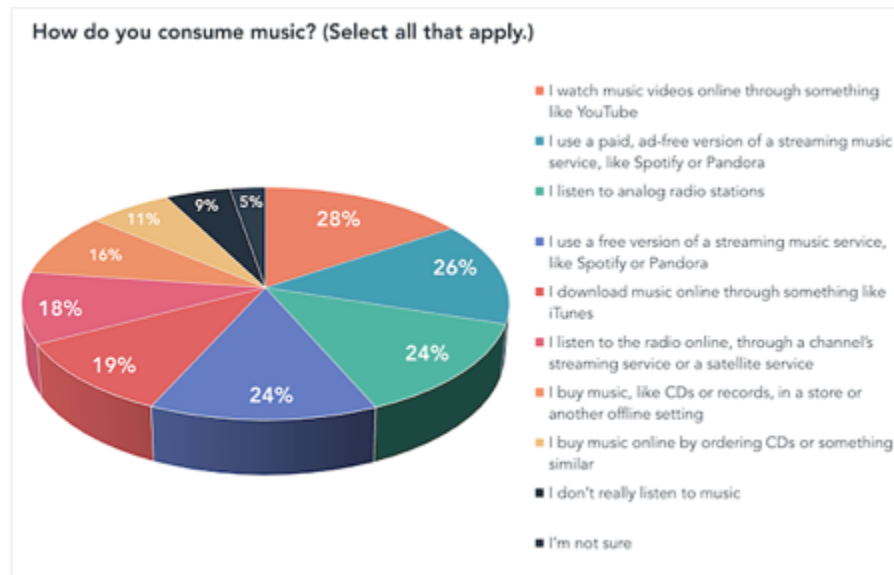


Figure 4: Distribution of ways participant consume music

When the participants were asked to give all the ways they consume music, the results were different. Youtube is the most popular response with 28% of participants selecting this as a primary method of consuming music. 26% use a paid, ad-free version of streaming services, 24% listen to analog radio stations, 24% use a free version of streaming services, 19% download music online through services like iTunes, 18% listen to a radio online, and 16% buy music, such as CDs or records in stores off-line, while 11% buy physical music through online orders (Zantal-Wiener, 2019).

These three surveys highlight that free or options with ads dominate the ways people consume music currently. One possible reasoning for this is that in the current age of the music industry, consumers don't necessarily feel the need to buy music. This is mostly due to the

advances in technology that has made music so accessible for everyday consumers. In the past the only option to consume music was to buy music, whether it's a vinyl, cassette, or CD. However, since music is so accessible on the internet, with various free options easily and readily available to the consumer, it makes it so much less likely for consumers to “buy” music. The music industry is reacting to this change of interest, and are now focusing on utilizing streaming services and ads to distribute music instead of selling physical copies of music. Although this has slowed down revenues, it has helped increase consumer’s exposure to different artists and types of music. In some way or from it has led to the democratization of music in the music industry, which has led to the very diverse pool of music available for consumers to listen to.

Conclusion

Music is something that is ever expanding and technology has been in the forefront of its progression. It has led to a new age of digitized music, which was almost unimaginable a few centuries ago. With it came many benefits for the music industry, such as improved production, easier promotion, better distribution, accessibility, and the advancement and emergence of new musical genres. However, in the same light, many of these technologies have caused harm financially for the industry. However, by analyzing the history of technology and current data in this field, one thing that is very notable is that technology does not wait for the industry to catch up. Instead, it is the job of the industry to catch up with technology and utilize it to make it as beneficial for all parties involved in the industry such as the consumers, artists, producers, and record labels. The current age of music is streaming, which has been in the forefront with the increased global use of the internet. However, the future of the music industry is still very malleable. There has been almost an exponential increase in the utilization of technology,

therefore, it would not be surprising to see the definition of music expand to broader ways. One great example of upcoming technology is AI generated music. Currently, AI is used more as a tool for assisting in music creation, generating ideas that producers or artists turn into tracks. However, with better algorithms and improvement in AI, it is very possible for AI generated music to dominate the music industry. One thing for sure is that music is something that will continue to evolve as society progresses into newer ventures.

References

Brain, M. (2000, April 01). How cds work. Retrieved April 03, 2021, from

<https://electronics.howstuffworks.com/cd.htm>

Hilton, K. (2018, February 14). Les Paul and the invention of multitrack recording.

Retrieved April 01, 2021, from

<https://www.prosoundnetwork.com/international/who-invented-multitrack-recording-les-paul>

Kendall, J. (2018, February 8). From discs TO Digital: The odd history of music formats.

Retrieved April 02, 2021, from

<https://flypaper.soundfly.com/produce/from-discs-to-digital/>

Kramer, J. D. (n.d.). The impact of technology on the musical experience. Retrieved

April 01, 2021, from

https://www.music.org/index.php?option=com_content&view=article&id=2675%3Athe-impact-of-technology-on-the-musical-experience&catid=220&Itemid=3665

Montagu, J. (2017, May 23). How Music and Instruments Began: A Brief Overview of the

Origin and Entire Development of Music, from Its Earliest Stages. Retrieved October 29, 2020, from <https://www.frontiersin.org/articles/10.3389/fsoc.2017.00008/full>

Music: Definition of Music by Oxford Dictionary. (n.d.). Retrieved October 29, 2020, from

<https://www.lexico.com/en/definition/music>

Musicology: A history of the guitar effect pedal. (2018, May 03). Retrieved April 02,

2021, from

<https://mixdownmag.com.au/features/columns/musicology-a-history-of-the-guitar-effect-pedal/>

Newby, K. (2017, December 14). Music Technology: A Timeline. Retrieved October 29, 2020,

from <https://www.wired.com/1997/10/music-technology-a-timeline/>

Roemer, C. (2020, November 19). How do audio CASSETTES WORK? Retrieved April

09, 2021, from <https://legacybox.com/blogs/analog/how-do-audio-cassettes-work>

Routley, N. (2019, March 09). Visualizing 40 years of music industry sales. Retrieved

April 06, 2021, from <https://www.visualcapitalist.com/music-industry-sales/>

SingularDTV. (2018, January 04). 10 technologies that revolutionized the music

industry. Retrieved April 1, 2021, from

<https://medium.com/singulardtv/10-technologies-that-revolutionized-the-music-industry-aa3023ad3132>

Wang, A. X. (2018, October 09). One-Third of the world is still pirating music. Retrieved April

06, 2021, from

<https://www.rollingstone.com/pro/news/streaming-music-piracy-copyright-stealing-7342>

93/

Watson, A. (2019, August 27). Topic: Music in the U.S. Retrieved October 29, 2020, from

<https://www.statista.com/topics/1639/music/>

Zantal-Wiener, A. (2019, December 11). In the Streaming era, How do most users

consume music? Retrieved April 06, 2021, from

<https://blog.hubspot.com/marketing/online-music-listening-preferences>