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How has digital technology impacted pop music?

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Final-Year Project – BA Digital Humanities and Information Technology

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Abstract:

My research project will focus on the impact of technology on music, primarily that of digital technology on pop music. The entire history of technology's effect on decades of music is too broad a question to cover in one research project, so I quickly narrowed the topic to highlight the digital age and the broad genre of pop music. The digital aspect made my project more relevant to digital humanities, and pop music is an extremely renowned genre, hence its name.

This research project will be accessible to most casual music fans, while aiming to provide interesting insights to a knowledgeable musician. I am focused on the aesthetic aspects of this question rather than the intricacies of modern software, illustrating what has led artists to pursue the trends we recognise in pop music today.

Declaration of Originality

In signing this declaration, you are conforming, in writing, that the submitted work is entirely your own original work, except where clearly attributed otherwise, and that it has not been submitted partly or wholly for any other educational award.

I hereby declare that:

- this is all my own work, unless clearly indicated otherwise, with full and proper accreditation;
- with respect to my own work: none of it has been submitted at any educational institution contributing in any way to an educational award;
- with respect to another's work: all text, diagrams, code, or ideas, whether verbatim, paraphrased or otherwise modified or adapted, have been duly attributed to the source in a scholarly manner, whether from books, papers, lecture notes or any other student's work, whether published or unpublished, electronically or in print.

Signed: Niamh Domoney

Date: 24/04/2025

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Introduction

This report includes a history of musical sampling and digital audio workstations, their uses in a modern context, and examples of this across a variety of genres spanning decades. Examples of uses of digital technology in music are included to illustrate the impact it has had on pop music. The digital artefact, linked above, includes interactive media to demonstrate the practical aspects of this project.

To correctly depict the history of sampling, one must begin with the work of Pierre Schafer, "the godfather of sampling" (Patrick, 2016). The way tracks are sampled in today's music can be directly traced back to Schafer's experimentation. He was employed by France's public broadcaster Radiodiffusion française (RDF) in 1936 and was later granted permission to experiment with recorded sounds and music technology. Schafer's research at the RDF led him to pioneer the experimental genre of 'musique concrète', which is composed of recorded sounds. He went on to meet Pierre Henry in 1949, who was a classically trained composer. Together they founded the Groupe de Recherche de Musique Concrète, acronymised to GRMC, and later GRM. This was a "studio designed specifically for electroacoustic music" (Patrick, 2016), the first of its kind. These two men would change the music scene forever with their technical and aesthetic innovations.

Schafer reimagined the foundations of music creation, blending composition with science and engineering. He began his compositions in reverse to the traditional manner, beginning with "field recordings of both natural and mechanical sounds" (Patrick, 2016), and then manipulating these with his studio technologies. Music was no longer tied to instruments and their players; it was created through this process of recording and editing. Schafer's music is not an easy listen, even in a modern context, but abstract thinking is required for innovation. It being an uncomfortable listen to this

day illustrates how far ahead of his time Schafer was, and the degree to which he could create in unconventional ways truly shows how much of a pioneer he was.

This link leads to an excerpt from the BCC documentary "The New Sound of Music", originally released in 1979. Michael Rodd, the presenter of this documentary, demonstrates the physical cutting and rearranging of recording tape, editing what was recorded and rerecording something new. Rodd demonstrates this by playing a tape backwards to rerecord the reversed sound, which requires him to pull the tape backwards through the recording machine. He then physically cuts the tape to splice this reversed note into the original recording and rerecords this all onto one new piece of tape. Many of the sounds recorded in this excerpt are not from instruments, but from objects around the room. Any noise can become music with these tools, from rhythmic tapping to makeshift maracas. This sort of innovation creates completely new sounds that were unattainable beforehand, following on from Pierre Schafer's work with Pierre Henry and GRM.

A digital audio workstation, or DAW, is a device or software used for recording, editing, and producing audio files. DAWs as we know them today came into use around the turn of the millennium and have only become more accessible in the last two decades and are massively influential on today's music. The first attempt at a DAW occurred in 1975 and was titled Soundstream. It allowed input from a tape recorder and had software to edit the tracks, integrating both analogue and digital technology. (Fagnoni, 2019) The first digitally recorded music releases during the early 70s were often live recordings of classical and jazz pieces. By the end of the 70s, digital multitrack technology was starting to be used in recording studios.

1989 saw the release of Digidesign's Mac product called Sound Tools. This was a computer-based DAW that contained "both a software component and a hardware audio interface" (Levine, 2019) that enabled the user to edit their tracks digitally, without

physical splicing analogue tape. Digidesign then iterated on this product in 1991 with Pro Tools which could hold four tracks. In 2000 Nuendo was released by Steinberg and was initially intended to be used in broadcasting and post-production but has instead become popular for producing audio for virtual reality and video games (Levine, 2019).

DAWs often implement a 'piano roll' thought a MIDI, Musical Instrument Digital Interface, to sequence notes together (Lavoie, 2021). Sequencing is the arrangement of musical notes together, just how an analogue piano roll would sequence notes on an automated piano. In a digital audio workstation, a piano roll refers to "virtual grid representing time on the horizontal axis and MIDI notes on the vertical axis" (Lavoie, 2021). This link illustrates a similar concept in an understandable manner as it can seem quite complicated. This technology is the basis of most DAWs, the user can change the length and pitch of a note by dragging the bar to be longer or shorter, and higher or lower on the screen. Technology like this doesn't require any prior musical knowledge, it isn't necessary to be able to read sheet music or play an instrument in order to sequence notes.

DAW technology has become increasingly accessible and has mostly superseded its analogue counterparts, improving steadily since the turn of the millennium. Its growth can be partially attributed to the popularisation of all digital technologies, and it has only grown in popularity. Now, GarageBand comes automatically installed on every Mac, iPhone, and iPad, and is completely free. Paid versions of DAWs will always be 'better', but for a beginner or an amateur a tool like GarageBand has everything necessary to create a song. Many DAW users are not professionals and use resources online to learn how to use the technology, purely for recreational purposes. Fagnoni (2019) states that the rise of social media interestingly seems to mirror the popularisation of these tools. This has led to the "rise of the self-taught producer", an individual who can teach themselves to produce music and do so from their own laptop. One can achieve commercial success without any formal training due to their

use of DAW technology, meaning a career in music is a feasible option for significantly more people than before the proliferation of digital technologies.

Literature Review

Capturing Sound by Mark Katz (2010) has been cited close to 2000 times and is referenced in many of the works cited in this report, showing this book is undoubtedly renowned in the field and very relevant to the topic of this project. Though it is not freely available in full online, many excerpts are accessible. Katz (2010) describes the effect of the phonograph and recording practices on the structure and length of tracks, referring to the "roughly three-minute limit of a ten-inch, 78-rpm record side." He explains that this was initially common among classical composers but directly led to the three-minute Pop song we hear today. Katz is acutely aware of the interconnections of different aspects of technology with music, individuals, and society. Since this is the revised edition published in 2010, of an original published in 2004, he acknowledges the changes in this field over the 2000s that were not included in the original. This includes the beginnings of YouTube and streaming services, and he states that the bibliography of the revised edition contains nearly an additional hundred books published since 2004. Capturing Sound is almost an encyclopaedia of knowledge that is valuable to any researchers in the discipline.

Thompson (2016) discusses the impacts of the accessibility of music on our relationship with it in his article for the Smithsonian magazine. Music is freer than ever, so people can easily listen to a wide variety of artists making starkly different music to one another. On the other hand, many argue that music is too available, and this makes it matter less to us. The payouts from streaming services and modern record labels are miniscule, especially in comparison to what radio and CD royalties used to be. Thompson then compares these current debates with the upheaval caused by the invention of the phonograph in the 19th century. He quotes 'Capturing Sound', saying that the three minute Pop song is "basically an invention of the phonograph" (Katz,

2010). Though the phonograph is an analogue device, its impact is carried on into modern music and is mirrored by digital technologies. The beginning of recording has an equally significant effect on the music industry and music consumption as the beginning of streaming. This article contains a lot of information relevant to the digital age even though its title does not indicate that, further illustrating how linked we are to our past.

David Harrison's (2010) master's thesis is titled 'Music by Numbers: The Impacts of Music Technologies on Pop', which resembles the research question of this report. In the preface, Harrison mentions students of his displaying current rock guitar trends without knowing the name of the action, simply replicating what they see. This aligns with the goals of this project, an aim to provide the language to explain common trends in music. One can often identify that there are common threads in a genre of music, without the understanding reasoning behind it and lacking the terminology to express this observation. He mentions the integral connection between music and technology in their association with Pop culture, a unique observation not found prior research, and discusses the autonomy of musicians in a digital world.

Harrison also included surveys and interviews in his research to gather his own quantitative data, the details of which are found in the appendices of his thesis. This inclusion is particularly interesting as it illustrates the opinions and thoughts of non-academics, which is a perspective not always included in this type of writing. This perspective elevates the research and adds distinctive material to the field. This paper was also published in 2010, so includes memorable references to My Space's impact on music consumption, a valuable insight into how trends and social media rapidly changes in such a short space of time.

"Recording sound matters less and less, and distributing it matters more and more." (Jones, 2000) This is true of the digital age as the tools to record music are now so

widely available, many people can create music and release it. Distributing your music correctly to an engaged audience is what matters more in the digital age. This article discusses distance and performance, and how digital technology can help us overcome physical distance in terms of music. Also, the anonymity that the internet provides removes any potential biases one may have about the creator of the music one listens to. Jones notes that the inclusion of CD drives in personal computers, and later high-quality speakers, sparked change in the music listening habits of the average individual. The connection of these computers to the internet created even more change, as any music available online was available to those with internet access. A consequence of this was artists' albums selling significantly less, even as they grew in popularity.

The iPod was a hugely influential invention, but it had a specific impact on the consumption of music. “At the start of 2007, the iPod alone made-up half of Apple’s business.” (Forde, 2021). Forde covered predecessors of the iPod, namely the personal Jukebox, and MP3 players. He also touches on how iTunes created a platform for people to rip CDs to their Mac computers, which was followed by the launch of a retail service with the iTunes store. Apple’s domination of music is referenced in this article, which leads me to research the rise and subsequent domination of Spotify as the most used streaming service over the last decade. The technology we use to listen to music is far more prolific than any DAW among non-musicians, and often among musicians themselves. The iPod is technology that lies on the line between the digital and the musical worlds, tying the two together.

Filippo Fagnoni’s (2019) master’s report titled ‘Digital Audio Workstations—The Infrastructure of Music Production’ is also hugely applicable to this project. DAWs are massively influential on today’s music, and the recent publishing date aids this modernity. A DAW refers to a device or software used for recording, editing, and producing audio files. He also refers to MIDIs, or Musical Instrument Digital Interface, a

term used for tools such as synthesizers, samplers, and computers in general. Fagnoni describes how DAWs as we know them today came into use around the turn of the millennium and have only become more accessible in the last two decades. GarageBand comes automatically installed on every Mac, iPhone, and iPad, and is completely free. Paid versions of DAWs will always be 'better', but for a beginner or an amateur a tool like GarageBand has everything necessary to create a song. Fagnoni states that the rise of social media interestingly seems to mirror the popularisation of these tools. This has led to the "rise of the self-taught producer", an individual who can teach themselves to produce music and do so from their own laptop.

In a 2019 interview with Dani Deahl for 'The Verge', Charli XCX shares her insightful perspective as a successful individual inside the music industry. She released about of her album tracks as singles before the album's release, an unorthodox method when compared to the era of album cycles from the 1960s to the mid-2000s. This era was defined by the methods of distribution, physical records and CDs. The digital age does not hold artists to this structure, but many adhere to it regardless. The luxury of releasing what you want, when you want, is afforded to artists by streaming services. This article recognises that Charli XCX has built a career outside of the traditional structure and finds her popularity because of that. Everything moves at a higher speed in the digital age, and artists must respond to shortening attention spans. It is integral to include first hand experiences from artists in this research project as they offer unique insights and are fascinating. Many musicians are very transparent in the making of their music on social media and in interviews, illuminating a different perspective than that of a music scholar.

Methodology

While deciding on my research question, it became clear that the best digital artefact for my final year project would be an interactive website. I investigated a variety of platforms I could use and eliminated them for different reasons. Squarespace would

provide professional graphics and overall aesthetics, but the level of which on offer is not required for my project and is behind a paywall. “Hosting Ireland” also charges a fee and is not very easy to navigate and understand. Hostinger utilises a significant amount of generative AI in the creation process, which is not necessary for this project.

I ultimately settled on a Wordpress site, commonly used for blogs. I had a site already, so had plenty of prior experience and a registered domain name. Wordpress hosts a website for free, and so was an excellent option for this purpose. Through my previous use of this service I knew I would be able to select a static home page, and a menu that would link to the other content pages. I edited the status of any old posts to private in order to keep the domain name I had, which was my full name. This was the most appropriate as it is very accessible to those interested in my project. Wordpress can host multiple domains under one account, but the original name I had was the most suited to my final year project.

I firstly created a page with the title of my research project and included an introductory paragraph. The artefact required integrated media, so I attempted to embed an image, a YouTube video, and a Soundcloud link. Images and YouTube videos were easy to integrate in Wordpress, as it offers specific buttons for each when adding new content. Integrating a Soundcloud file required more investigation but clicking share on Soundcloud itself allowed me to copy HTML code, which I knew I could embed into the Wordpress site. This did take some trial and error as the embedded link was aligned to the left as opposed to the body text, which was aligned to the centre. In the end I had to go into the display settings of the block of code to ‘justify’ it to the centre. Once this was finalised in a satisfactory way, I confidently selected Wordpress as the platform for my digital artefact.

I began adding content pages by writing blog posts, creating an interactive website. It is possible to insert a ‘carousel’ of images, similar to a slideshow, but I opted to include each image separately. This is more accessible as each image is its full size, and all are available without needing to scroll through to find the referenced images. I linked a full

video of all the songs I referenced for the full context of my research, though listening to the entirety of each is not necessary to understand the report. This allows the reader to listen to snippets from different parts of the songs, with users oftentimes gravitating towards the intros and choruses. The interview with Damon Albarn is almost an hour long, but the clip I referenced is played at the very beginning of the interview and so does not require any time stamps or scrubbing through.

Wordpress automatically lists your most recent posts as the website's homepage, which was not ideal for the website I wished to create. I made an introductory post, which included my research question, an introductory paragraph, and a description of the website. I then was able to make this page a static home page, so the link to my artefact will now display this page first. A navigation menu was required to access the other pages, which I added to the top right corner of the page. In the process of organising this I created two dropdown menus, one for sampling and one for digital audio workstations. Underneath each are the links to similar pages, grouped together by topic. I also included a link to the home and conclusion pages, for easy navigation. The title 'Niamh Domoney' in the top left corner of the site also links to the static home page, but I found this to be insufficiently clear. It is not obviously a link until the user hovers their mouse over it, and even still all that changes is the cursor. It is important that users can easily manage the site without difficulty, and so I added a much clearer link that is in line with the entire navigation menu.

The analysis of the use of digital tools for this project simply required listening to tracks that had cited use of specific relevant technologies and recognising those impacts. This includes identifying a sample in its original context and then repurposed in a different song and understanding what changes have been made. Oftetimes the pitch or tempo of a sample has been altered, but to notice this one must listen to the original and sampled versions in succession, paying attention to different aspects on each listen. Identifying the use of DAW or MIDI technology is not as simple, but one can assume modern songs implement DAW technologies in the processes and would only clarify if

this is explicitly not the case. This involves finding interviews with the artists, but even more importantly with their producers.

Analysis and Reflection

The invention of the gramophone made music accessible to those with the necessary wealth, requiring others to visit their wealthier neighbours' homes in order to listen to music. Vinyl record players increased how available music was, with records often costing under €10 during their initial rise in popularity. These prices have risen significantly in the interim years, which can be partially attributed to the overwhelming accessibility of digital music. Once individuals could purchase a cassette tape to play on their own in their car, this was truly when the individuality of music consumption began. One could curate their music taste while commuting to work or listening to a Walkman during their grocery shop. The Walkman was then superseded by the MP3 player, introducing digital technology to the average music listener. Physical forms of recorded music are considered a commodity once again, as all trends are cyclical.

"Whether it's the synthesizer sounds of the 80s, cross-genre MP3 mashups of the 90s, or the Popularization of autotune in the 2000s, technology has always been a driving force behind hip-hop music." (National Museum of African American History and Culture, n.d.) Modern sampling began in the Hip-Hop genre, and the origins of both the genre and the practice are linked. Sampling is an integral cornerstone of the Hip-Hop genre, it's unlikely one would exist without the other. In its beginnings, artists would use record players to alter recordings by moving the record as it spins on a turntable. In the 2000s, Auto-Tune was popularised as an aesthetic decision, deliberately altering vocals to sound electronic. Trends like this bleed in the Pop world in later years, with mainstream artists opting for a similarly electronic sound. An early example of this is Cher's 1998 song 'Believe'.

Hip-Hop and Pop music are intertwined, as all genres are, especially in the modern world. The list of impacts on Hip-Hop in the quote above strongly resembles the same in Pop music as it often follows the trends of other genres, particularly Hip-Hop. The article I quoted, notably published by the National Museum of African American History and Culture, details the use of MIDI technology, turntables, boomboxes, and CD players in Hip-Hop music, and how they were so influential. The same can be said of Pop music, though often slightly later as Hip-Hop tends to be on the forefront of what is new in music and culture. Pop is frequently a collage of other genres, whatever reaches the mainstream. This means that the original use of many technologies was not in the Pop music genre, rather somewhere more experimental and niche.

The Winstons, a soul and funk group, released a song titled “Amen, Brother” in 1969. A seven second drum break in the middle of the song became a popular sample and is now one of the most recycled snippets in music history. According to whosampled.com, this drum solo has been sampled over 6700 times. It’s evident that an incredible number of musicians have been inspired by this short sample alone. “It’s not just a mere drum solo; it’s a heartbeat, a pulse that resonates through the corridors of music history.” (Macnish, 2023)

Below is a chronological list of ten songs that use this sample, covering a variety of genres over the span of decades. This eclectic mix of music illustrates the versatility of this specific sample, but also how diverse musicians can make completely different songs from a seven second drum solo.

1. Salt-N-Pepa are an all-female hip-hop group from New York City. They were the first major act to use the Amen break in 1986 on their song ‘I Desire’, which introduced it to the rap scene (Brown, 2020). They used the sample to produce a minimal beat that is consistent throughout the song, staying true to the original track.

2. ‘Straight Outta Compton’ by N.W.A. is the opening and title track of their 1989 debut album. This song popularised the use of the Amen break in Hip-Hop music. They use a slowed version of the sample, driving the beat forward with added percussion.

3. Oasis are renowned for their use of physical instruments, but their song ‘D’You Know What I Mean’ samples the Amen break in an indirect way. According to a Rolling Stone interview with Noel Gallagher, the sample used in this track is actually ‘Straight Outta Compton’. This creates a chain of samples as Oasis didn’t use the drum solo alone, instead combining it with other elements of the N.W.A. song.

4. Aphex Twin uses the Amen break on his track Girl/Boy Song, released in 1996. Aphex Twin’s music is often described as experimental, demonstrating the versatility of both this particular beat and samples as a whole. This song creates something completely new from the original sample, making it almost unrecognisable.

5. In 1997, David Bowie sampled Amen, Brother on his track ‘Little Wonder’. He refers to each of Snow White’s seven dwarves in this song, along with a series of similar names he made up for the purpose of this recording. Bowie evidently drew inspiration from an eclectic mix of sources while writing this track for his 21st album, with the Amen break as the basis of its memorable beat.

6. Slipknot’s use of this iconic break in their 1999 song ‘Eyeless’ again shows the versatility of the drum break, as it seamlessly blends into the distorted vocals familiar to fans of metal music. It has a slower tempo than ‘Amen, Brother’, but seems to utilise a sped-up version of the sample. Regardless, Slipknot’s style of music creates an unprecedented level of energy.

7. ‘Pigs’ by Tyler, The Creator shows how the Amen break is still used in modern hip-hop music, illustrating its timeless nature. This track uses a slowed version of the break, creating a lazy, yet steady beat.

8. This sample is even used in video game soundtracks, with Toby Fox implementing it into his 2015 game Undertale. The track is titled ‘Your Best Nightmare’ and plays during the final battle of one storyline the player can choose. In this context it creates a villainous and sinister atmosphere, often changing the song’s style to fit with the gameplay.
9. The final song on 100 gecs 2019 debut album, 1000 gecs, is titled ‘gec 2 Ü’ and implements the Amen Break into its electronic beat. If a seven second drum solo from the 60s can be incorporated into a ‘hyperpop’ track, it is evident that sampling can be completely transformative.
10. Lastly, Linkin Park sampled the Amen Break on their track ‘Massive’. Officially released in 2023, this song was originally recorded during the creation of their 2003 album Meteora. (Jenkins, 2023) The late release of this track once again draws attention to how timeless this sample is, fueling its unending popularity.

Terms like ‘cutting’ and ‘splicing’ that are used in digital sampling today originate from the first practices of sampling. The physical cutting of tape had evolved into cutting tracks in a digital audio workstation, a much simpler process that allows for user error. Splicing now refers to joining to digital recordings together, but it used to refer to connecting to pieces of recording tape. Similarly to any digital software nowadays, musicians have the luxury of an undo button when a mistake is made. Cutting at track incorrectly can be fixed with the click of one arrow pointing left but it used to completely derail an entire recording session. Digital technology allows the user to copy and paste recordings, creating unlimited backups rather than one individual strand of tape.

Many major artists use DAWs for their song production, this is entirely commonplace in the modern world. What is more unusual is the use of a free DAW such as GarageBand, or turning a drum loop, that is freely available to the public, into a massive pop song. That being said, record producer “The Dream” and collaborator “Tricky” Stewart did exactly this on Rihanna’s 2007 track ‘Umbrella’. “*Umbrella* won a Grammy, sold millions

of copies, reached #1 on the *Billboard* Hot 100, earned a spot on *Rolling Stone*'s "500 Greatest Songs of All Time", and made Rihanna a household name. And it all started with the royalty-free, "Vintage Funk Kit 03" GarageBand drum loop." (Sorcinelli, 2019)

The fact that this drum loop is so distinct makes the listener inclined to believe it is wholly original for Rihanna's song. This is simply not the case, and it almost couldn't be more accessible. GarageBand is realistically the most prolific DAW as it comes preinstalled on all Apple products free of charge. Inspiration can come from anywhere, similar to how Pierre Schafer would record sounds from the world around him to create music. Advanced tools are beneficial to many, and can provide new and exciting creative paths, but are not necessarily required. It is evident that if a song as iconic as 'Umbrella' can utilise free DAW technology, the software being provided is at a very high standard.

Gorillaz have a similar story to this, as told in the beginning of Zane Lowe's interview with Damon Albarn for Apple Music (2023). Though this doesn't illustrate DAW usage, it simply had to be included in this project. Albarn demonstrates how the entire beat for the Gorillaz song 'Clint Eastwood' is the preset on an Omnichord, an electronic music instrument. He shows at the beginning of the video below that the push of one button plays a beat almost identical to the finished song. The use of this sample is so blatant and simple it feels like it's breaking a rule, but this is occasionally the nature of sampling. Albarn does not mention any payment of royalties, which is often the more complicated element of sampling music. It is possible that Gorillaz would be required to pay the company which sold this specific Omnichord, the composer of the preset, or perhaps it was freely available with no licensing cost.

Released in 2011, Lana Del Rey's 'Video Games' also used DAWs in its production process. This track was written by Del Rey and Justin Parker and was arranged and produced by Daniel Omelio and Brandon Lowry as their production duo 'Robopop'. The

duo's involvement in the track included use of "Cubase, Pro Tools, Ableton Live, IK's Miroslav Philharmonik Orchestra and various dance music sample CDs" (Tingen, 2012). The beginning of the track was Lowry creating the piano part in Steinberg's Cubase 6. He implemented MIDI (Musical Instrument Digital Interface) technology to use a piano roll, without the need for a physical piano. The effects on this piano track create an otherworldly echo, which is the basis of the track's dream-like qualities.

The piano part was then exported into Pro Tools to record the vocals. The song sits in the lower register of the female voice, with Lowry crediting the DAW technology for its added richness and depth (Tingen, 2012). He also deemed Melodyne unnecessary for pitch correction as the vocals simply did not require any tonal improvement. The vocals and piano were then exported to Abelton Live for additional embellishments. Some electronic elements were added to contrast with the stripped-back feel of the vocals and piano, and to replicate the sounds of a video game. Lowry states in this interview that "you don't need the craziest setup to produce records that are successful" (Tingen, 2012). 'Video Games' kick-started Lana Del Rey's career and solidified her sound, all made possible with modern DAW technology.

Before the use of Digital Audio Workstations (DAWs), musicians needed to have access to recording equipment to immortalise their work, which has always been incredibly costly. Just one day in a recording studio can cost hundreds of euros which is a price the overwhelming majority of casual musicians simply cannot pay. Free DAWs like GarageBand allow musicians to explore the recording process without any commitment. More professional tools, such as Logic Pro and Ableton Live, require either a one-time payment or operate a subscription model, but are much cheaper than a physical recording studio. The proliferation of music creation and consumption can be directly attributed to digital technology. The fact that musicians can essentially make high quality music on their own eliminates the necessity of a third party, often a record label, allowing artists to deal directly with their audience (Peters, 2016). Its evident that digital technology has had changed our whole world, and this is also true of pop music.

Conclusion

The main outcomes of digital technology's impact on music are

- aesthetic changes as a direct result of digital technology
- blurred lines between playing and composing
- accessibility, for both the creator and consumer

Digital technology has impacted pop music in a variety of aesthetic ways, from pitch correction and autotune, to sampling and software. Pitch correction is simple to explain as it essentially alters the pitch of a note to be more 'in tune', which is relative to the piece of music. This technology means that fewer takes are required to get a 'perfect' sound as is can be edited afterwards. This means that vocalists and instrumentalists need to be less skilled to record music without any tuning issues, broadening who can play professional sounding music.

Autotune is often confused with pitch correction as they both change the pitch of a note, more commonly vocals. With the advancement of digital technologies, pitch correction is very often completely undetectable. When used for its intended purpose it slightly pitches the note up or down, making minimal changes. Autotune is a deliberate effect, making a vocal line sound electronic while retaining its melody. This is an aesthetic choice often used by artists throughout their live performances as well as studio recordings. Autotune is often used by hip-hop and R&B artists, and these genres have massive amounts of influence on pop music. Artists such as Billie Eilish, Bon Iver, and Charli XCX all have made use of electronic vocals in their respective works, with Charli XCX only singing live through and autotuned microphone. The willing embrace of this electronic sound across genres illustrates its popularity, and its proliferation within pop music specifically.

Digital Audio Workstations have moulded pop music into what it is today. Without DAWs, the difficulties of recording music physically would still be prevalent, creating

music higher costs both monetarily and time required. A musician would either need to own their own recording studio or pay for time in one, which is simply inaccessible to the majority of musicians. DAWs allow individuals to create music in their own home, on their own time.

DAWs also blur the lines between player and composer. It is no longer necessary to be able to play an instrument to sequence notes together in GarageBand on an iPhone, the only skill required is the ability to navigate digital technology. When one can press keys on a laptop keyboard to input music into a DAW, it becomes very difficult to define what is and is not an instrument. This in turn clouds the difference between player and composer, and both are occurring simultaneously.

The most crucial answer to the question of how digital technology has impacted pop music, is accessibility. Now, more than ever before, the creation and consumption of music is so widely available due to digital technology. Smart phones alone are responsible for a significant amount of this popularity as DAWs can be downloaded to mobile devices, and music streaming services are a staple on almost every phone. Both musicians and music fans can engage with their respective hobbies for the price of a smartphone or laptop, a necessity for many in today's world. It has never been as easy to freely create music, and it is not nearly as challenging as it once was. Digital technology is much more forgiving than its physical counterparts, allowing users to 'undo' mistakes, copy and paste elements, and save multiple copies as backup.

The accessibility of music creation directly impacts its proliferation as consumable media due to the sheer increase in volume of music created. The statics about the Amen break are enough to illustrate this, with thousands of songs sharing one sample. Music used to need to be printed physically with copies purchased by those interested, but now almost every song ever written is freely available online. Many see their Spotify Premium as a non-negotiable, but the free plan allows access to almost its entire

library, though it is interrupted with frequent advertisements. Though the advertisements are irritating, this level of access was unthinkable before digital technology. The advancements and innovation that have been made were unimaginable only decades ago. That is the level to which digital technology has changed pop music,

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