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The AI Songwriter:

The Importance of Understanding the Implications of Using Artificial

Intelligence in the Music Industry.

Rachel Meddings

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BA Music

The Liverpool Institute for Performing Arts

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Introduction

A composer finally finishes their latest piece of music and names it 'Genesis: Symphonic Fantasy in A Minor, Op. 21'. As any composer would do, they register the song with the composer's rights society that they are a member of. This is a scenario that happens every day, all around the world. The issue with this example is the composer is named AIVA, an Artificial Intelligence Virtual Artist (Aiva Technologies, 2016).

This essay argues for the importance of considering the ethical implications of the growing use of artificial intelligence within the current music industry in relation to four areas: how crucial it is to understand the way audiences will perceive these advances in technology; whether artificial intelligence can be more efficient at predicting hits than humans; how AI developments could change the songwriting process; whether this will be beneficial or detrimental for songwriters and how the current copyright law supports AI.

Definitions of unfamiliar or contested terms

- o Artificial Intelligence (AI), for this essay, will be fined as "the theory and development of computer systems able to perform tasks normally requiring human intelligence" (Oxford Dictionaries, 2018).

- o Artificial Neural Networks (ANN) are a set of algorithms, modelled loosely on the human brain, that are designed to recognise patterns (Sky Mind, 2019).

- o Deep Neural Networks (DNN) are artificial neural networks with multiple layers between the input and output layers (Sky Mind, 2019).

The rationale for researching this topic is that the subject matter felt relevant and concerning. Firstly, artificial intelligence is only in its infancy but is making strides. It is crucial that both music professionals and music consumers understand the impact this could have on the music they create, listen to and even the way they consume the music. Currently, this technology is not fully developed but when it reaches its potential there could be many ethical and legal implications. Secondly, the development of artificial intelligence and using it to compose music could affect the job prospects of emergent songwriters, like myself; wishing to enter the industry.

Whilst researching this topic, it was clear that the media had presented artificial intelligence as the technology to replace human involvement with music, however this wasn't strictly true. Therefore, the focus of this essay was shifted slightly towards the use of artificial intelligence in the music industry as opposed to strictly focusing on music generated by AI.

The research methods used for this essay primarily stem from desk-based research consisting of reading articles, books, academic papers and studies in the subjects of artificial intelligence and music creation. This also involved establishing the relationships that currently exist and theorising what could exist between the two fields in the future. Alongside the reading, first-hand research was also conducted by utilising many of the artificial intelligence programs to understand how they work.

This essay will draw upon the research conducted and form its own theories, arguments and conclusions to bring this technology and its implications to the forefront of the reader's mind.

There are three essential sources of information that have aided in the research for this paper. Jordan Passman's article 'Music As A Commodity: Songwriting With Artificial Intelligence' was helpful in researching the issues that artificial intelligence songwriting could come across over the next few years, especially regarding licensing, royalties and crediting. Marr's book *Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning To Solve Problems* was especially relevant when focusing on how streaming giant Spotify utilises artificial intelligence to make user specific playlists. Finally, Roger's article 'Why Is AI-Generated Music Still So Bad?' was critical in understanding why, despite hours of research and millions of dollars, artificial intelligence is still not capable of achieving what we want it to.

This paper begins with an outline of Artificial Intelligence, both inside and outside of the music industry, it then focuses on how consumers of music may react to this development in technology. Followed by how artificial intelligence can be used to predict the next music trend and how AI could change how songwriters work. And finally focusing on how copyright law supports AI and the ethical implications this technology could create.

Artificial Intelligence

When focusing on music created by artificial intelligence, it is crucial to examine artificial intelligence's evolving and growing role both within the context of the music industry and outside of this profession. The media often portrays AI as "either the technology to bring about the fourth industrial revolution" (Hellard, 2018) or "the technology that will see humans enslaved by robot overlords" *(ibid.).* Yet, despite the mixed reactions amongst media, there are still many benefits to introducing artificial intelligence into our work lives. There are arguments that using AI will enhance workplace efficiency, eradicate much of human error and extend and expand our creativity (Forbes Technology Council, 2018). However there are also many negatives to counteract the benefits of using AI. Although artificial intelligence could eradicate human error from processes, errors could still remain in the coding. As AI is largely algorithmic, the technology could be coded to have a negative impact on certain demographics and discriminate against certain people (Hellard, 2018). Alongside that issue, the addition of AI to our workplaces could result in a large number of job losses, especially laborious positions such as manufacturing *(ibid.).* As music is a creative and inherently human process it is not predicted to be directly affected by job losses caused by AI; although software is being developed that could change this.

Artificial intelligence has been used in music creation for decades, dating back to 1995 when David Bowie developed Verbasizer, which took "literary source material and randomly reordered the words to create new combinations that could be used as lyrics" (Deahl, 2018). Verbasizer helped Bowie write three albums during that period:

Low, Heroes and *Lodger* (Braga, 2016). A more recent example of an artist utilising AI to create music would be Taryn Southern's album *I AM AI*. When composing her album, Southern used software Amper as a tool as she knew "very, very little about music theory". In 2016 Sony's Flow Machines created a melody in the style of The Beatles which was then given to composer Benoit Carré who developed the song into a fully produced pop song entitled 'Daddy's Car' (Deahl, 2018). Now there is an entire industry being built around the need for AI software that can create music, including Jukedeck, Spotify's Creator Technology Research Lab and Amper (*ibid.*). Most of these modern uses of AI rely on artificial neural networks, Sky Mind's AI Wiki (2019) defines these as:

> a set of algorithms, modelled loosely after the human brain, that are designed to recognise patterns. They interpret sensory data through a kind of machine perception, labelling or clustering raw input. The patterns they recognise are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated.

In the context of music analysis, this means that you feed into software a plethora of songs which it then analyses to find patterns. This could include, but is not limited to, chords, tempo, length and how notes can relate one to another in a sequence. It then learns from all the input data and composes its own melodies. The output from each software type can differ though, as some deliver MIDI data which can then be used in a Digital Audio Workstations, such as Logic Pro X, whilst others deliver audio stems.

Therefore, we know it is possible for Artificial Intelligence to create music, but is it human-like? Rogers (2018) argues in her article 'Why is AI-Generated Music Still So Bad?' that despite certain genres of music being very formulaic it is not as easy as it

seems to create human-like music. "Composing music is actually more complicated that we expect," Hang Chu, a computer science PhD student at the University of Toronto, told Rogers in their interview. "Music is not something where if you throw enough data at it and hope the algorithm can figure it out, it will work" (*ibid.*). However, there are instances where an AI has created the foundations for a song and then a human musician has expanded on that idea to create a fully formed idea. "We asked, 'what are the building blocks to create an entire song?'" Pierre Barreau, the CEO of the aforementioned AIVA Technologies told Rogers (2018) in an interview. "If you consider just melody, you can generate that. Then based on that melody, you can make another model that create instrumental accompaniment for that melody. If you break it down it becomes much easier." This concept has resulted in at least two successful pieces of music being created, the first being devised by AIVA, and was the world's first AI-composed main theme for a video game, *Pixelfield* (Silicon Luxembourg, 2018). The second example would be IBM's Watson which created a trailer for a film after being trained on input data of other movie trailers. Despite AI coming up with several ideas, it was ultimately a human that took the ideas and turned them into the final piece of music (Rogers, 2018).

The quality of existing artificial intelligence music programs are mixed and the ideas and execution are still in their infancy but in the years to come there is little doubt it will become more prominent and begin to reshape the music composition business (Bielenberg, 2018). "The computer can start to do more and more of the groundwork and prep work and even suggest different ideas," says Smith, a fellow at IBM's AI research centre. "But that leap of creative thought, that spark of imagination, still has

to come from a human" (Rogers, 2018). As and when artificial intelligence becomes more influential in the music industry, there will be many issues and questions that we will need to find the answers to, which I will explore in the later sections.

Consumer Reactions

If artificial intelligence became capable of composing human-like songs, would music consumers accept these budding composers? In 2017, Prof. Dr. Fracisco Tigre Moura along with Music Stats conducted a study with 430 participants regarding the perception towards artificial intelligence music. This study also took music awareness into account, for example, music is often present in our lives when it is not the centre of our attention like during a television advertisement or at a nightclub when intoxicated and less consciously aware of surroundings. During these situations we might not notice if the music was adequate or unmemorable, but we would notice if the music was truly awful and usually seek to change this situation. However, there are also instances where music is the forefront of the moment, where we listen to it with the upmost attention and interest, such as concerts, festivals and open mic nights. These are situations where we wouldn't stand for adequate music as the listeners consume the sound as a primary focus and have usually paid money for this experience (Tigre Moura, 2017).

In the Music Stats study, they chose to look at five specific yet different places to consume music, due to their different involvement levels: nightclubs, public spaces and commercials are spaces where the consumption of music is passive, it is not the primary task. Whereas bands and singer/songwriters usually have active listeners as they are choosing to partake in this event and have greater involvement levels. All contexts were measured from one to five with "1 being not acceptable" to "5 being fully acceptable" (*ibid.*) and the results were as follows:
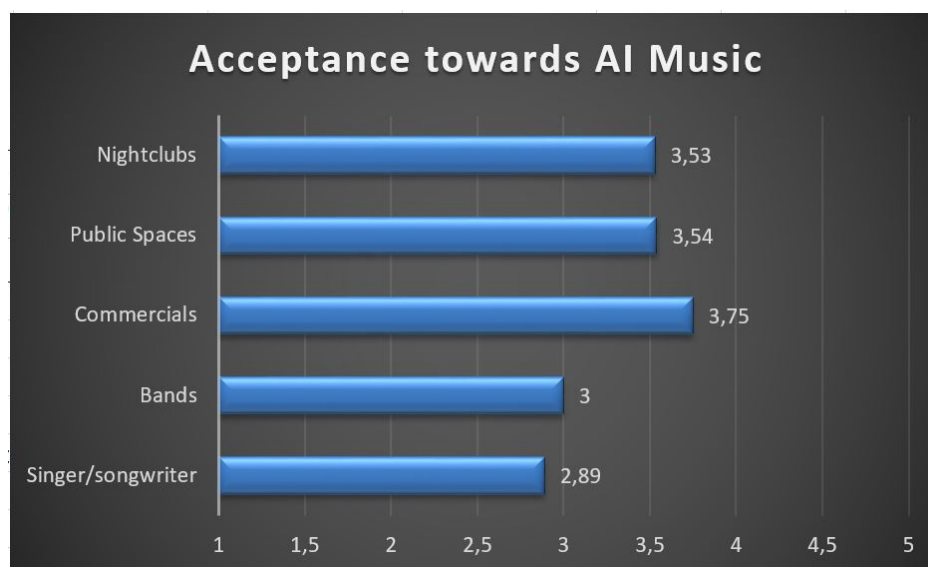

Figure 1 (Music Stats, 2017)

The results shown in Figure One indicate that there is a higher acceptance towards AI generated music in scenarios in which the music is consumed passively, such as nightclubs, public spaces and commercials. Therefore, it is perceived in this study, that it is less acceptable for singer/songwriters and bands to perform songs composed by artificial intelligence. This could begin to question whether acceptance towards AI music is dependent on the scenario and situation or whether genre and authenticity play a crucial role in defining where the use of AI generated music is appropriate.

The Cambridge Dictionary (2019) defines authenticity as "the quality of being real or true". In the context of popular music however, it can be difficult to tell what is real and what the music industry wants you to perceive as true. Frith (2004) suggests that popular music becomes "more valuable the more independent it is of the social forces that organise the pop process in the first place; popular music's value is dependent on something outside of pop, is rooted in the person, the community or subculture." This suggests that to be more successful, the music must be established from some essence of authenticity. This theory also suggests that music genres such as folk are perceived as less acceptable to use AI music, as this is a genre that is based upon honesty and it manages to maintain this because "it is the authentic sound of the past unpolluted by artifice" (Machin, 2010, p.16) and "no matter how predictable it might be in terms of sounds, looks and lyrics, it is associated with tradition and an older form of social organisation" *(ibid.)*. This could begin to show the relationship between acceptance of AI music, authenticity and genre. The singer/songwriter result was the least acceptable for AI music and could be argued as the most authentic way to consume music. The singer/songwriter genre has a strong connection to folk music as it originally began with folk-acoustic traditions (Ruehl, 2018).

It could be argued that Tigre Moura's 2017 study, although it is a good start, is not a clear way to define the acceptance of AI generated music. It seems apparent that this study should have had a greater emphasis on genre, as opposed to a combination of both genre and context. By analysing a variety of genres and consumer's reactions on the use of AI music, it would be easier to correlate why

audiences perceive certain genres as more acceptable and whether this links with authenticity, context and history.

Artificial Intelligence can also be used to gauge consumer reactions outside the music created by AI. Kohn (2018, p.1335) suggests that "the application of artificial intelligence to more finely understand consumer reactions to advertising is on the horizon." To further this, he suggests to "expect your devices to read your facial reactions to an advertisement and learn what kind of music will more likely prompt you to respond favourably" *(ibid.)*. Although this doesn't assist with analysing how consumers will react as more and more artificial intelligence music creation software are writing the songs they listen to, it is crucial to look at how AI is being used in the music industry surrounding this. Though this software is currently being used for advertisement consumer reactions, it is possible that in the future it could also be developed to understand audience perception of AI music for a more in-depth study compared to the results shown in Figure One.

Reilly (2018) predicts that within the next decade between "20% and 30% of the top 40 singles will be written partially or totally with machine-learning software." With Artificial Intelligence music quickly rising to the forefront of music it is crucial, now more than ever, that we understand where and when it is acceptable to use this technology so that there is no risk of alienating audiences or receiving backlash from the music industry.

Future Music Trend Predictions

With the use of artificial intelligence growing in the creation of music, it is clear to see why many companies are also using this new technology to predict which songs will be the most successful. This software is notably being used by Musiio, a new technology company based in Singapore (Nvidia, 2018a). Their software uses deep learning to "identify the best songs for record labels and streaming services" (*ibid.*) and can listen to "30,000 songs a day". This is approximately the same as the number of new songs released every day (*ibid.*). Musiio works by 'listening' to the tracks that are inputted and identifying characteristics and patterns, therefore allowing an ability to predict success from a large volume of music. So far the company has found that "by solving the volume issue in music, and by offering actionable insights, you can increase your 'hit-rate' and ultimately your revenue". This can also be shown by the diagram in Figure Two (*ibid.*).
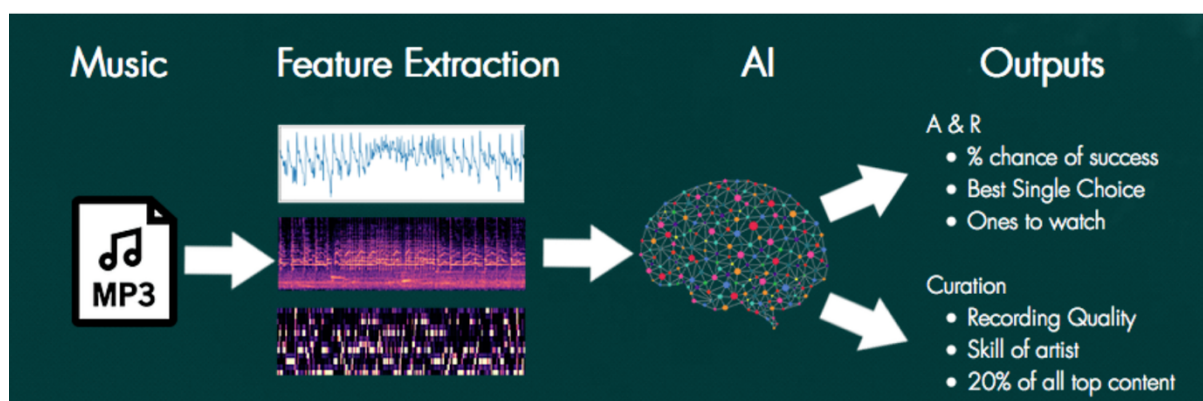

Figure 2 (Nvidia, 2018b)

A team of machine-learning engineers from Bristol have been successful in using this technology to "determine whether a song would be a hit and, within an accuracy of sixty percent, predict whether a song would make it to top five or if it will never

reach above position thirty in the chart" (Brown, 2011a). They have managed to achieve this by claiming to have found the master equation to predicting song popularity, aptly named the Hit Potential Equation:

$$\text{Score} = (w^1 \times f^1) + (w^2 \times f^2) + (w^3 \times f^3) + (w^4 \times f^4), \text{etc.}$$

Figure 3 (Brown, 2011b)

In the equation, shown in Figure Three, the "w" represents "weights", or musical features such as time signature, energy, duration, loudness and tempo. To discover whether the track would be a hit, using deep learning networks, the engineers input the official U.K. top-40 singles charts from the past fifty years to see how crucial these features are to producing a U.K. hit song during all of those years (*ibid.*). The time in which the song was released contributes heavily towards this equation as "musical style doesn't stand still, and the "weights" have to be tweaked to match the era." Once the algorithm has analysed these "weights", the next step is to 'mine' the proposed song for the exact same "features", displayed as "f" in the equation. The correspondence between "w" and "f" is compared to the trends of the time and provides a hit-prediction score (Score A Hit, 2012a). Once a successful song has been analysed it is placed into one of three categories: expected hits, unexpected hits and hidden gems. Here, there is a collection of various songs that fit that category and an explanation as to why they have been placed there. For example, Score A Hit (2012b) named Gnarls Barkley's 'Crazy' as an expected hit, and the reason for it being so successful was the "danceability, low energy and loud signal" of the track.

Not only has Artificial Intelligence been used to predict which songs will climb the charts, but it is also being used by streaming services to predict which songs listeners would like to listen to next. Streaming services initially began to grow when they offered consumers instant access to millions of tracks from one application. To expand upon the streaming empire, Spotify has pushed for listener personalisation which includes consumer products like *Discover Weekly*, a playlist that "pulls in a weekly selection of music tailored to a user" (Russell, 2018). Spotify uses deep neural networks to gather data from listener's preferences and uses that to determine which tracks a consumer might want to listen to next (Marr, 2019). Spotify's algorithms have also taken account sharing into consideration, their A.I. algorithms "ignore drastic, but short-lived changes in listening habits" *(ibid.)*. Increasing the personal aspect of Spotify's listening experience has benefited both their listeners and the company with their subscriber base "growing by 8 million, and share price rising by 25% in the three months following its listing on the New York Stock Exchange in April 2018" *(ibid.)*.

So far, it has been relatively easy to analyse why songs have been successful and to recommend existing songs to consumers, but is it possible for artificial intelligence to predict hit songs before they've become successful? In 2017, HitWizard was announced at the Amsterdam Dance Event Tech conference. This software has been "specifically trained to predict the next big hit to take the music industry by storm" (Mix, 2017). To conduct these predictions HitWizard takes various sound parameters into account; similar to how Musiio analyses hit songs. These factors include BPM, valence and tempo and then "compares them against airplay data

sourced from Dutch radio stations and the local Spotify charts" *(ibid.)*. This allows the Artificial Intelligence to predict the "chances a song has of becoming a hit with an accuracy ratio of approximately 66 percent" *(ibid.)*. Despite having a higher accuracy rate than Musiio, HitWizard is much better at predicting which songs will not succeed and are unlikely to please audiences. It can estimate how unsuccessful the song will be with an "accuracy of 93 percent" *(ibid.)*.

This technology will be largely beneficial to publishers' workflow, enabling them to see the data that can identify popular songs before they've even entered the charts. However, it could be argued that this technology could have a negative effect on the music that reaches the mainstream. With Spotify recommending endless playlists of music to their listeners, it means that consumers never need to look for music. This could result in more people listening to music passively, possibly devaluing the experience of music. It could also change the way we perceive music's rich history: "concentrating only on chill playlists and hits makes us forget about the richness and culture behind a musical era" (Book, 2018). Currently "the album is culturally dead" and has been replaced by streaming services and their playlists. "Half of music consumption on Spotify now occurs within playlists, limiting the potential for artists to use music as a story-telling vehicle" (*ibid.*).

Despite this data being critical in finding what tracks will be most successful, the most accurate way to predict what will be a hit song is still reliant on humans. Republic Record's Patch Culbertson explained to Thompson (2018, p.236-237) that he uses Shazam, an application that allows the user to identify any recorded song

with the press of a button, to decide whether a song would be a hit. Culbertson

focused on one specific location, a small city close to Houston named Victoria,

Texas. If everyone in Victoria purchased ten copies of an album, it still wouldn't go

platinum. Yet, the small city is a "prescient indicator of the music listening habits of

the largest cities in the state" (*ibid.*). Thompson (2018, p.237) states that "most

people listen to the Top 40 radio for fluency: They want to hear songs they already

know." But Culbertson utilised these smaller radio stations to play artist's lesser or

unknown tracks and see whether the song had potential in a larger city. If the song

was picked up on Shazam more than other songs, Culbertson would have the proof

he needed to bring the song to more popular stations, bigger cities and eventually

the rest of the United States (*ibid.*). Although some AIs are correctly predicting chart

toppers up to 66% of the time, this method has proved successful time and time

again for Republic Records and ultimately comes down to human interactions with

music. Despite this method being the most accurate method of discovering whether

a song will become a hit, it could be argued that it is not the most effective.

Culbertson's method is very time consuming compared to HitWizard and Musiio.

With these program you simply input the song and it will determine how much the

song will succeed or fail. Therefore, the sooner a more accurate AI software is

developed the less time consuming this process will become.

Changing the Songwriting Process

Technological developments have always had an impact on the creation of music,

dating back to the creation of the electric guitar, multitrack tape recorders and the

synthesiser (Bawiec, 2018). AI has been used in music creation for decades, dating

back to a 1997 documentary named *Inspirations* which was filmed during the production of David Bowie's 1995 album *Outside* (Braga, 2016). During this documentary, Bowie showcases the aforementioned lyric-writing program named Verbasizer. This program utilises a well-known songwriting technique called the Cut-Up Technique, which involves "taking a finished line of text and cutting it into pieces – usually just one or two words on each piece. The resulting pieces are then rearranged to create a brand new text" (The Hit Formula, 2013), which can then be used to generate creative and different lyrics. Since then, lyric writing software has developed immensely using Artificial Intelligence. Reimagine AI is collaborating with *Google Brain* to develop and create a series of "Artificial Intelligence Music Collaborations Agents" (Reimagine AI, 2017). The first program to be developed is Lyric AI, which is an artificial intelligence assistant intended to aid musicians in devising original lyrics *(ibid.)*.

Computer-generated music is growing fast within the music industry, looking to "disrupt creation, licensing and access for musicians and non-musicians alike" (Passman, 2017). The current market leaders in artificial intelligence composition are Amper, Jukedeck, Sony's Computer Science Laboratory and Google's Magenta. This technology is advancing quickly to the forefront of the music industry, with millions of dollars being invested in the further development of AI music creation *(ibid.)*. Passman (2017) claims the primary reason that composing with artificial intelligence is rising to prominence is because it is "certifiably confirming music as a commodity" and then "ironically placing computers in the driver's seat of the creative process."

Artificial intelligence is currently being used by songwriters and composers mostly as a songwriting tool to assist with creating their music. A prime example of this would be Taryn Southern's album *I AM AI*, which "included a guest artist called Amper" and therefore "creating the first album that was entirely composed and produced by artificial intelligence" (Culey, 2018). Southern is very open about how reliant she is on these artificial intelligence programs, in an interview with Music Ally she talks about the frustrations that led her to working with Amper: "Now I'm able to iterate with the music and give it feedback and parameters and edit as many times as I need. It still feels like it's mine in a sense" (Music Ally, 2018). Southern also commented on the remarks that using artificial intelligence to compose music is 'cheating' saying: "Yes, we are totally cheating. If music is concretely defined as this one process that everyone must adhere to in order to get to some sort of end goal, then, yes, I'm cheating. I am leading the way for all the cheaters!" But: "The music creation process can't be so narrowly defined" (*ibid.*).

Currently, the market for low-budget music, that is often consumed passively, is large and growing. The rise of content creation on platforms like YouTube and Instagram provide more opportunities for creatives but also spreads their budgets thin. Consumers are now "watching one billion hours of YouTube content every single day" and not all content creators can afford to buy royalty free music to accompany their videos (Passman, 2017). When content creators are purchasing music, it might not have anything to do with the art or content, it's all about creating a watching experience for their audience (*ibid.*). Passman (2017) states his opinion on the matter as: "We're in a world where music can be a commodity and both buyers

and sellers are happy about it. If AI music companies can offer enough volume at the right price point, I think they will thrive, but custom original music companies will never be replaced."

AI songwriting programs make it simple, even for beginners, to write a song. Different AIs specialise in different aspects of songwriting, Amadeus Code is an "artificial intelligence powered songwriting assistant" that focuses on writing chord progressions, think of it as a "paint by numbers, for songwriting" (McCourt, 2019). Google's Melody Maker, which is a division of the Chrome Music Lab, is capable of composing melodies that allow more freedom than Amadeus Code, but still doesn't require any formal music education to understand how to use it (*ibid.*). Lyric writing can also be achieved with artificial intelligence, Song Lyrics Generator can devise lyrics in a genre or emulate the style of an artist. Google Poetics is a site that generates lines of incomplete poetry, simply enter a word or phrase and let the algorithm do the rest. It's a "creative way of coming up with unusual song lyrics for you pop masterpiece" (*ibid.*). To compose every element of a song, one would need to use several pieces of software to even come close. For software to create a song on its own, artificial general intelligence (AGI) would need to be developed, which is currently in the early stages of research and development. Artificial general intelligence is the "representation of generalised human cognitive abilities in software so that, faced with an unfamiliar task, the AI system could find a solution. An AGI system could perform any task that a human is capable of" (Rouse, 2019). Therefore, it is crucial to remember that these AI tools are "designed to be

songwriting assistants, not instant hit factories. The target market here is struggling songwriters, bereft of ideas and in need of a creative spark" (McCourt, 2019).

Copyright Law and Ethical Implications

In the previous section, 'Changing the Songwriting Process', the idea of artificial intelligence composing low-budget music for content creators was raised. The music created for this purpose also contains copyright infringement and licensing implications. Licensing and using music is complex and definitely not a "one-size-fits-all scenario" (Passman, 2017). To secure a proper music license requires many "legal and logistical nuances, […] especially with the growing number of platforms for media and the constant evolution of content distribution" (*ibid.*). A prime example of the benefit of AI generated music would be uploading music to video streaming platform, YouTube. When licensing a song for YouTube, the owner of the copyright would need to "evaluate the terms of use, the length of the term, the territory, if there will be paid media behind it [and] whether there is exclusivity during the term, etc. to determine pricing, and assemble a comprehensive license" (*ibid.*). The use of music generated by software like Amper and Jukedeck, cuts out this entire process and allows content creators to simply buy music generated by AI, which is far cheaper than a similar quality of music created by a human composer.

However, could this process devalue the music that humans create? To even begin to answer this, we must first define what makes music so inherently human and why do we make and listen to music? Mannes (2011) believes that "The elements of music – time, pitch and volume – echo our pulse, our breath, our movement, and our

vocal range. At our emotional core, we experience these elements as joy, sadness, exhilaration and countless other feelings." Yet, a more scientific approach would say that music "can functionally synchronise individuals' internal rhythms and promote feeling of group love through modulation of oxytocin" (Barnes, 2015). This could also link to why humans began to make music and why music is so inherently human, Barnes (2015) furthers these ideas:

> Music may have a comparable evolutionary importance to language. By helping our ancestors connect with one another, strengthen their cognitive faculties and reduce cognitive dissonance, music faculties could have easily proved an extraordinarily beneficial evolutionary adaptation. Even today, it helps us maintain a vital equilibrium in the face the constant stresses we face in our day-to-day lives. There is no question that music is more than just a diversion.

The main aim of artificial intelligence is to replicate how the human brain works, but if abilities originally thought to be uniquely human can be replicated by an algorithm, should we begin to think differently about them? Douglas Eck, a team leader at Google's Magenta, states:

> I think differently about chess now that machines can play it well. But I don't see that chess-playing computers have devalued the game/ People still love to play! And computers have become great tools for learning chess. Furthermore, I think it's interesting to compare and contrast how chess masters approach the game versus how computers solve the problem – visualisation and experience versus brute-force search, for example (Hutson, 2017).

Although this is an interesting perspective focusing on the positive side of machine-learning, it is also crucial to remember that chess is a board game of strategic skill and music is something that currently still requires a creative spark and human input. When a song is composed, typically the "individual or collective who authored the work will exclusively own the work and is referred to as the 'first owner of copyright'

under the 1988 Copyright, Designs and Patents Act", (The UK Copyright Service, 2017) but what happens when the music composed solely or with artificial intelligence? Well, in 2017 AIVA (Artificial Intelligence Virtual Artist) became officially recognised by SACEM, France and Luxembourg's authors' rights society, as a composer (AI Business, 2017). This means that AIVA is the first AI to be given the status of composer, meaning it holds the rights and can receive royalties and credit for the music it composes (Healy, 2018). Although the main issue with artificial intelligence revolves around the ownership and royalty collection, there is also the problem of using music training data to develop the AI. As previously mentioned, artificial intelligence that use deep neural networks require large amounts of training data and AIVA is now "capable of capturing concepts of music theory just by doing this acquisition of existing musical works" (Kaleagasi, 2017). The team at AIVA Technologies decided to focus on training AIVA with classical music, and they explain this with two reasons: "(1) it is the predominant style used in movies, games, commercials and trailer soundtracks, and (2) all of the partitions we use to train AIVA are copyright-expired" (*ibid.*). While the music that AIVA listens to and learns from is copyright expired, this does not mean that the music devised by AIVA is in the public domain as they are registered with SACEM (*ibid.*).

There are other scenarios, however, in which the AI software used is not registered as a composer and so has no copyright claims or right to collect royalties, so who owns the musical works? According to Andres Guadamuz (2017), a lecturer in Intellectual Property Law,

There are two ways in which copyright law can deal with works where human interaction is minimal or non-existent. It can either deny copyright protection for works that have been generated by a computer or it can attribute authorship of such works to the creator of the program.

The United Kingdom's copyright law, section 9 (3) of the Copyright, Designs and Patents Act (CDPA) states: "In the case of a literary, dramatic, musical or artistic work which is computer-generated, the author shall be taken to be the person by whom the arrangement necessary for the creation of the work are undertaken" (*ibid.*). This law appears to work well for the time being but as the use of artificial intelligence grows and develops further the lines between machine and human could begin to blur. The next argument to resolve will be whether "computers should be given the status and rights of people", but that is a whole other debate (*ibid.*).

Conclusion

It can be concluded that artificial intelligence will have a growing role in the music industry as it begins to develop and advance. To determine how acceptable AI generated music will be to the average consumer, more studies will need to be conducted. This will, in turn, help establish a clear correlation and relationship between AI generated music and authenticity and whether genre has a large part to play in what will be perceived as acceptable. Currently, artificial intelligence is not the most accurate way to determine which songs will be successful before they are released, but the most accurate method is also not the most time efficient. Therefore, it would be reasonable to expect a more accurate AI software to be developed in the future.

Furthermore, AI songwriters appear to be the perfect solution to achieving constant success in songwriting, however, currently AI has reached the stage in which they are intended to be used as songwriting tools. The aim of these technologies is purely to assist songwriters when they lack ideas or are faced with writer's block but in the future it is possible they could play a more vital role in the composition of music. Whilst the current UK copyright law seems fitting for artificial intelligence's limited role in creating music, as the technology grows and develops it is vital that we are aware of the potential implications, both ethical and lawful, that artificial intelligence could pose as we move forward. The music industry should be willing to make adjustments as and when this technology develops and the copyright law may need to be updated sooner than we think. Although this paper focuses on different aspects of artificial intelligence use, it is crucial to remember that these are only four areas of focus in an issue that could take years to fully understand.

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