In what ways might AI affect the future – and our understanding – of music?

Artificial Intelligence (AI) could be one of the leading inventions of our time and has potential to hugely affect the future of our society, and in particular, music and our understanding of it. The development of digital technology has been a prevalent part of the last 20 years, with recent leaps ahead with the discovery of Artificial Intelligence (AI). This is, essentially, the ability of a computer to think and act humanly, or at least think for itself (Built In, n.d). The birth of this concept is thought to date back to a 1956 Dartmouth Workshop, with seven main aspects, including random creative thought, which is a necessity for creating and processing an art form such as music (McCarthy, Minsky, Rochester and Shannon, 1955). As of today, AI is progressing rapidly and has an increasing use in the world, like self-driving cars, medical help, and of course, the creation and performance of music. In this essay, three aspect of music will be discussed – composition, performance, and listening – and to what extent AI could be used to affect the future of these aspects, and how we can learn from this.

Composition:

To give background to the importance of independent thought (the aim of AI) in the creation of art, Kant believed that "genius is the talent which gives the rule to art" so that "originality must be its primary property" (Kant, 1911, p. 307-308). Therefore, this suggests that the creation of art, or in this case, music, requires understanding of previous rules in order to break them and go beyond them. For example, one could look at Debussy's use of the creation of his own scales in "Nuages" (Alesait, 2018), where he used a combination of whole-tone, pentatonic, acoustic, and octatonic scales around the note B, as well as a lack of functional harmony and cadences (Debussy 'Nuages' from Nocturnes Summary Notes, n.d.). This is "genius", as it is not an imitation of anything pre-existing, and creates new rules for other composers to follow, influencing composers like Schoenberg, through his ideas on non-functional harmony (Tymoczko, 2007). AI can help us learn about these works of "genius" by decoding their rules for future development, like a perfect formula for understanding and replicating a Bach fugue (also what Kant would consider "genius"), but this calls into question to what extent AI could not just think for itself (as the mere ability to think "like a human" does not constitute a genius), but actually dare to break free from convention in a way that could inspire others in the future.

An AI platform called AIVA (AIVA - The AI composing emotional soundtrack music, 2021) calculates patterns in existing classical music such as Mozart, in order to detect rules of harmony, melody, structure, and instrumentation (Zhang, 2018). This essentially generates something which is musically

"perfect" in less than a minute. The user can then adapt this (Aiva, 2019), before downloading it as a finished work. This is based on Kurzweil's (1965) computer algorithms built to mimic existing music patterns. (Sidewinder77, 2007). Currently, AI is used to generate scores for video games, due to the efficiency of arranging, speed of production and cheap costs. It is easy to imagine a future where video games, TV, film, musicals, operas and concerts all use AI soundtracks. However, this is not creative thinking, one of the defining aims of AI, but mere replication. In order to truly compose something new, AI would have to make its own new rules to follow (such as a "genius"). This could be achieved through mathematically tracking the progression of compositions over time. By believing in the Grand Narrative (the idea that all works are part of a continuous history), AI could anticipate the next paradigm shifts in our understanding of harmony, tonality and structure, and create music to represent this. Although this might not count as complete "creative thought" as it is mathematical, formulaic, and based on predictions, this may be the closest that AI could get to true originality, or at least, in our lifetimes.

However, would these compositions be successful in terms of communicating human emotion, or as a way of self-expression? It is impossible to define the purpose of art (although many philosophers and artists throughout history have tried), but it was believed by Sulzer (Guyer, 2020) that music has to contain an expression of sentiments, passions and character. Although AI can far exceed human intelligence, it is still not close to our complex emotional range. Hegel defined the beauty of any art (music) as the "sensuous expression of free spirit" (Houlgate, 2020). If a computer does not have a spirit, it cannot reflect human emotion, experiences, and perspective, and therefore could never replace human composers. For example, Shostakovich's powerful Symphony 12 – "The Year 1917" was a reflection on Lenin (TheWickedNorth, 2012) but undeniably could not have been written without Shostakovich's personal experience of that time. However, maybe by having the option of AI generated music, we will be forced to acknowledge what exactly what we regard as the purpose of music and art.

Performance:

Not only can AI compose new music, but it can also play pre-composed music. This comes from two sides: robots trained to play instruments; and pre-recorded sample sounds that can be used to generate audio of any music.

I first learnt about robots playing instruments when I saw a video of the WF-4RII anthropomorphic model playing "the flight of the bumblebee" on YouTube many years ago (Anders, 2006). The aim of this was to match human flute playing and play this piece "perfectly". This utilised independently

moveable lips, lungs, tongue, arms, fingers, and neck, pre-programmed for this one piece. This is not AI, as it has no ability to think for itself, but it has suggested that given the ability to "think", paired with the technical prowess of a real player, an AI robot could process and perform music with similar expression and musicality to a human. Even though AI has not developed to have true human emotion yet, it could still play with vibrato, rubato and phrasing, as these can be learnt, not just felt. A more recent development of this idea of a robot performance was done by Manchester University in 2016 (Robot Orchestra - School of Arts, Languages and Cultures - The University of Manchester, 2017), where students wrote music which was then played and conducted by "electronic brains" with instruments (Science and Engineering at Manchester, 2017). This was a further step toward today's independent AI, as the robots could play any music given to them instantaneously and have the ability to play live through following a conductor. A robot musician could teach us specific mechanisms needed to play an instrument and we could even have AI instrument teachers (that is, if there was any need for humans to play an instrument anymore!). Although, even if robots can play proficiently, and with "real" musical feeling, from a listening perspective to what extent would humans be able to connect with the robots players? I personally think that part of the beauty of going to watch live musicians is knowing the training and hours required to perform, which would be completely eradicated if performance was just a product of carefully built models and algorithms. Although the future of AI is uncertain, we are fast approaching a very crucial deciding point in how we want AI to progress in replacing humans.

Secondly, the other side of AI producing a performance is through music technology, and in particular, samplers. Samplers can take recordings of existing instruments or sounds, and transform them into new pitches and styles through synths, layering, and reverb. (Russell, n.d) As technology stands currently, the human music producer has to manually manipulate these pre-recorded sounds to suit their preferences, but it is easy to imagine AI taking the place of this producer through its ability to think humanly. In the same way as how software such as Sibelius (Avid.com, n.d) can play scores as an audio file, AI could also do this, replicating the sound of an actual orchestra through sampling. Similarly to before, AI could also apply rubato, phrasing and expression to this. This could negate the need for humans to record music, especially orchestral. Potentially, we could even move away from realistic instrumental sounds towards more technology-generated synthesisers, so that not only would AI be replacing our need for instruments and players, but also so that music would develop as a result. Music technology is a hugely growing field of work right now, and we could learn a lot from collaborating with AI to create new styles, sounds and techniques.

Listening:

The final side of music to be considered is listening. Assuming that AI composition could be true creative thought, and that the performance could be a comparable representation of music, what would this be like for the listener, and would it be an adequate replacement? To answer this, I am going to consider firstly possible future implications and developments of AI, and secondly what this could mean to us and our community.

Firstly, if music was composed by AI, this could create an interesting concept of "disposable music", because as we know, technology develops at such a fast rate, that music would be outdated by the time that it was first premiered, especially if AI is so advanced that it can learn independently. Taking this a step further, it is easy to imagine each person having music composed specifically for them, in a similar manner to the Spotify algorithms (Gershgorn, 2019). This works through technology called BaRT suggesting music based on recent listening. BaRT uses your history, skips, liked songs, and location to stream music (familiar or new) to your taste. AI could do this in a similar manner and use compositional devices (like harmony or tempo) to match your desired mood. After learning the effect of existing music on our emotions, AI would know, for example, that a fast-paced drum beat and a repeated dominant pedal would make you feel more excited. This has potential benefits in therapy and mental health treatment, as music curated to release more dopamine could be targeted specifically at users with depression or anxiety. For this to happen, much more psychological research on how exactly music can impact our mood would need to be done. Furthermore, nuances such as the context (eg being in a group or not) and the time of listening, as well as social and cultural influences would need to be considered regarding the user's environment (Jannach et al., 2018) before AI is fully able to achieve this.

Secondly, if music was personalised as such, it is a possibility that this would affect both culture and memory association, as well as our connection with each other. If everyone had their own curated music, then concerts in the style of "Silent Discos" might take place (Colorado College, 2018), where everyone listens separately while in the same place. This might prohibit us from connecting with each other in the way that we are accustomed to during live music performances. A study was done by Hou et al. (2020) to investigate the inter-brain coherence (synchronisation) between a performer and the listeners. They used near-infrared spectroscopy to compare brain activity between a violinist playing a set of pieces and the participants watching videos of the violinist playing. The results were that the brain activities of participants synchronised to certain degrees with each other and with the

performer, through activation a neurological system called the "frontoparietal mirror neuron system". Activation of this system essentially allows multiple people to share brain movements. This is research that still has to be investigated further as it was one of the first of its kind and had a small sample size, but it may suggest why we feel so connected to others when we listen to live music together. Although no research has been done surrounding "Silent Concerts", my hypothesis would be that we cannot connect in the same way if we are not listening to the same pieces. Therefore, moving to AI-generated personalised music may not be a good step, as connection to others is what makes a community.

Music composed on demand would also mean that it's unlikely to hear the same music twice, and with that, we would lose so much memory attached to music. For example, folk songs, which carry stories of ancestors and history, passed down aurally may no longer have a value in our society. Folk songs bring people together as a community, in the same way that the pop-culture within generations (like trending songs from childhood) connects people through shared experience. The memory of music is thought to be separated into semantic (attached to feeling and importance) and episodic (remembering the situation of its former encounter) systems with two distinctly activated neural networks (Groussard et al., 2009). Neither of these pathways would be activated in this way if we only heard AI-composed music once. This indicates that memory making would be negatively impacted by "disposable music". Therefore, although the prospect of AI curating our listening experience could be beneficial, it may lead to missing out on both a community feeling and an attachment of memories to music.

In conclusion, AI could be incredibly exciting through its implications on how we compose new music, influence paradigm shifts, replicate and develop sounds, and personalise listening experiences. It really could change how we view and experience music, and we could learn from AI's music as much as AI could learn from ours, especially surrounding rules and patterns and how this affects us psychologically. This is the start of a journey that will decide the prevalence of technology in our society, as well as the need for "art", community, and culture. As it stands right now, it is hard to imagine that AI, however advanced, could ever truly replace "real" music and the true creativity needed for a "genius", but I imagine that in even 30 years this could be very different.

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