The Possibilities and Drawbacks of Assistive Technologies in Music and Beyond

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Algorithms are the foundation of assistive technologies, such as artificial intelligence (AI), transforming how we listen to and engage with music. For example, recommendation engines are crucial in music streaming platforms, helping users discover new music based on their preferences and online behaviours. These engines utilise various algorithms and techniques to analyse user data and provide personalised recommendations, enhancing the overall user experience. Schedl (2019) discussed challenges in Music Recommendation Systems. The first challenge is the need for more transparency in current deep learning models, as they struggle to provide meaningful explanations for their recommendations. Schedl suggested that integrating traditional supervised methods could potentially mitigate this issue. The second challenge relates to the need for standardised evaluation metrics, which makes it difficult to compare and assess the performance of different systems. Bias exists in data and in our models, and we need to be aware of different types of biases and the limitations they represent (Wenger, 2023). Considering these challenges is essential when designing algorithms and interfaces for new musical expression platforms. Why did this instrument make that sound? By providing explanations for why specific musical notes or actions are taken, the user learning experience can be significantly enhanced. Users would benefit from understanding the reasoning behind the system's decisions, allowing for a deeper engagement and comprehension of the musical process. Machines will continually acquire new abilities, presenting exciting avenues for individuals interested in exploring their creative inclinations through music composition and performance.

As our lives have become more data-driven and subject to analysis, the potential benefits and drawbacks of AI have sparked discussions and raised concerns among many (Ran, Banes, & Scherer, 2022). Ray Kurzweil mentioned that *Technological Singularity* could happen in our society as early as 2029 in an interview with an MIT AI researcher, Lex Fridman. Also, Yoichi Ochiai, a media artist and researcher at the University of Tsukuba, believes that *Technological Singularity,* especially in media art, will occur as early as 2025 in a PIVOT interview.

The fundamental issue of AI is more than the accuracy or convenience of its ability. It's the concept of "measurement" and "classification" that humans are constantly compared to each other. This measurement involves not only our physical attributes like height, skin colour, and gender but also extends to our thoughts and actions that are often taken into account in the classification design of AI algorithms. Scientists like to measure things. That measured information can be defined as hard knowledge or soft knowledge. The hard knowledge, for example, Newton's laws of motion, represents well-established principles in the field of physics that are difficult to challenge. On the other hand, figures like Freud listened to people's descriptions of dreams and fantasies, aiming to comprehend their mental states and behavioural causes, leading to conclusions that fall under soft knowledge. Soft knowledge sounds vague, but the advanced psychology research results are not as soft as expected. Upon reading Michio Kaku's recent book, "God's Equation," I realised that even hard knowledge might not be as hard as we believe (Kaku, 2022). Could it be possible that science and knowledge exist along a continuum? If true, then the measurement would seem intimately related to knowledge in its myriad forms (Henshaw, Henshaw, & Henshaw, 2006).

The Stanford University report, "Artificial Intelligence and Life in 2030," provides insights into AI's impact on work. According to the report, AI is more likely to replace specific tasks rather than entire jobs in the near future while also creating new jobs. However, predicting the nature of these new jobs is more challenging than anticipating the tasks that may be lost. Employment changes tend to occur gradually, without abrupt transitions, and this trend is expected to continue as AI gradually integrates into the workplace. A spectrum of effects will emerge, ranging from minor task replacements or augmentations to complete job replacements (Stone et al., 2022). For instance, while most of a lawyer's work is not yet automated, AI applications such as legal information extraction and topic modelling have automated certain aspects of the work typically performed by first-year lawyers. In the not-too-distant future, a wide range of professionals, including truck drivers and gardeners, may experience the impact of AI on their jobs (Bown, 2021).

The potential power of artificial intelligence is a subject of concern for many researchers, prompting a call for regulation. Stuart Russel, a prominent researcher and co-author of a leading textbook on the artificial intelligence (Krafft et al., 2020), expressed that unlimited intelligence could be as hazardous as boundless energy, and uncontrolled artificial intelligence could pose risks similar to nuclear weapons.

The challenge is to make sure that this new source of computing power is used for good and not for bad, to increase the well-being of people and for the benefit of humanity, rather than to increase the profit of some business minds.

The big question at hand revolves around the impact of assistive technologies, including AI, on musicians and our cultural landscape. The specific concern is whether AI-driven musical instruments may have any negative consequences. As a developer of such devices, it is my responsibility to question and explore the potential implications, as these instruments can place individuals within a framework of algorithms that may surpass their cognitive comprehension. It is crucial to seek a deeper understanding of any possible ramifications and consequences of integrating these technologies in order to make informed decisions and ensure that the benefits outweigh any drawbacks.

NRICH (2019) introduced the "low threshold, high ceiling" approach to balancing easiness and challenge in learning. Without a challenge, boredom sets in quickly, but if it's too difficult, most people give up (Van Tilburg & Igou, 2012). When designing AI-driven musical instruments, the principle of "low threshold, high ceiling" becomes particularly relevant. The goal is to create an instrument that is easy to pick up and play, allowing people to quickly grasp the basics and begin making music. By having a low threshold, beginners can experience immediate success and enjoyment, which is essential for sustaining their interest and motivation. However, it is equally important to ensure that such instruments offer a high ceiling, meaning that it has the potential for ongoing challenges and growth. As users become more familiar with the instrument and develop their skills, they should have the opportunity to explore deeper layers of complexity and discover new possibilities. This high ceiling encourages continued engagement and provides a sense of progression, inspiring users to invest time and effort into further refining their abilities.

Here are some questions and thoughts:

- **What if the machine assists us in playing musical instruments well without spending much time practising them?**
    - Positive outcomes:
        - Increased accessibility: More people can easily enjoy the experience of playing a musical instrument.

        - Stimulation and excitement: Using assistive technology can create a sense of stimulation and excitement in playing music.
    - Potential drawbacks and thoughts:
        - Loss of the value of practice: While assistive instruments may be easier to play, there is still room for improvement through practice.
        - Loss of the sense of effort: It is important to provide instructions that encourage users to put effort into specific aspects of playing the instrument.
        - Potential for boredom: If the user becomes highly skilled, there is a risk of boredom. Balancing easiness and challenge can help maintain continuous stimulation and excitement.
        - Blurring the line between amateurs and professionals: While amateurs may be able to perform at a professional level, professionals can continue to explore beyond what amateurs may achieve.
- **What if machine assists us in composing music without learning music theory?**
    - Positive outcomes:
        - Increased participation: More people can easily enjoy making music.
        - Enhanced results: Less skilled composers can achieve more significant outcomes.
    - Potential drawbacks and thoughts:
        - Job displacement: Some composers may face decreased work opportunities, but they can learn to incorporate assistive techniques into their creative process.
        - Homogenisation of musical style: To avoid a loss of diversity, more variables can be introduced into algorithms to encourage unique compositions.
- **What if AI suggests specific tracks of music for us to listen to?**
    - Positive outcomes:
        - Improved discovery: Users can easily find music they might enjoy without extensive searching.
    - Potential drawbacks and thoughts:

        - Reduced exploration: Instant recommendations may diminish the inclination for personal exploration and research. Efforts in seeking out music should still be encouraged.
        - Potential manipulation of interest: Careful algorithm design is necessary to ensure users are not overly controlled by machine suggestions. Users should remain aware of their choices and preferences.

- **What if AI judges our musical skills?**
    - Positive outcomes:
        - Independent assessment: Individuals can evaluate their musical skills without relying on a teacher or human interaction.
        - Cost savings: Learning a musical instrument may become more affordable.
        - Consistency in judgment: AI-based assessment can provide more standardized evaluations.
    - Potential drawbacks and thoughts:
        - Impact on music teachers: Some music teachers may experience decreased job opportunities. Teachers can adapt by focusing on aspects AI cannot teach, such as artistic interpretation and creativity.
        - Stereotyped art forms: There may be a period where music becomes more stereotyped due to AI-driven judgment. However, human art will continue to evolve and break boundaries.
        - Overreliance on AI judgment: Caution is required to ensure that human judges do not overly rely on AI when making decisions. Education and understanding AI's capabilities and limitations will aid in its appropriate use.
- **How might these potential drawbacks affect us in the long term?**
        - As we increasingly rely on assistive technologies to perform tasks that previously required substantial effort, there is a risk of losing certain skills and abilities. It is crucial to be aware of and thoughtful about the design and use of assistive technologies. Understanding the trade-offs and taking proactive measures to address potential drawbacks will ensure a balanced and beneficial integration of assistive technologies in the musical landscape and beyond.

While there are both positive and negative speculations about the role of AI, Taishi Fukuyama, the co-founder and COO of Amadeus Code, has suggested that new technologies do not necessarily replace human artists but instead provide new tools and mediums for artistic expression. He compared it to how photography did not replace painting, and 808s or algorithmic composition did not eliminate the need for drummers and composers. Fukuyama added that machine learning systems and algorithms might become a new medium for human expression rather than replacing humans who perform those tasks (Fukuyama, 2019). As of December 2023, it has become increasingly evident to many that the impact of new AI technology is more significant and advancing faster than previously anticipated.

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