The Pianist versus the Smart Piano

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With the increasing developments in artificial intelligence (AI), particularly in technologies that use computational creativity, there is a possibility that AI manifested through the smart piano, could replace an actual human pianist in performance. This paper explores the relationship of artificial intelligence and the potential decline in music careers, specifically in the field of classical piano performance. This research describes various recent developments in Computational creativity and the smart piano, as well as identifies attributes of a creative human performance as compared to an AI performance.

"Computational creativity is the study of building software that exhibits behavior that would be deemed creative in humans. […] Computational creativity studies also enable us to understand human creativity and to produce programs for creative people to use. […] Creativity is not some mystical gift that is beyond scientific study but rather something that can be investigated, simulated, and harnessed for the good of society" (López de Mántaras, 2016, p. 1). Since the 1980s, computer software has been able to connect with acoustic pianos and generate automated piano performances (Schubert, Canazza, De Poli, & Roda, 2017). As improvements in computations, algorithms, and technology have been booming in the field of music, piano manufacturing companies have recently been producing their own lines of smart pianos, with more advanced ones being able to exhibit human qualities in performance.

In 2015, the world-famous piano maker Steinway & Sons released its primary line of smart pianos, the Steinway Spirio. This smart piano enables anyone to record and edit in fine detail, including modifications in note velocity and duration, pedal data, and even the deletion or addition of time. The recording could then be accurately reproduced on the piano, by the piano through the AI system (Joita, 2019). Similarly, Yamaha Corporation developed the first-ever AI

piano system that could play any musical piece in the style of late renowned pianist Glenn Gould. Yamaha's Dear Glenn Project AI System was featured in a concert in which the piano system performed on stage at the Ars Electronica Festival, held in Austria. The AI system played pieces that were never performed by Gould, including a live piano duo with a celebrated pianist of today, Francesco Tristano, and another piece with a wind trio (Yamaha, 2019). The performances were warmly received with the sold-out hall erupting into loud applause.

This was not the first-time musicians have played with an AI system. In 2018, Yamaha had already developed the Yamaha AI Music Ensemble System. "The AI Music Ensemble System instantly analyzes a musician's performance in real time, and predicts suitable tempo, timing and dynamics to create a harmonized ensemble." This smart piano could precisely reproduce any pianist's touch on the piano plus interact with other musicians. An experiential installation was also exhibited in Austin in 2018, wherein visual synchronicity was applied through on-screen graphics. The player was able to see and play with the AI Yamaha AI Music Ensemble System. The probability of one musician being able to perform with a whole band of AI instrument systems is now being considered (Wong, 2018). In fact, a study was conducted to examine the reliability and responsiveness of computers as performers (Baird, Blevins, & Zahler, 1993).

"When live performers play music together, they interact with one another as they play, making adjustments in dynamics, in tempo, etc." Through tracking algorithms, computers were able to adjust and interact just like humans do when they perform music together. According to research conducted as early as 1993, "the computer performer responds extremely well when performing with a live performer who plays in a reasonably accurate manner. If the live performer changes tempo, the computer performer will follow and accept the new tempo. This

ability gives a real feeling of interactive ensemble playing." (Baird, Blevins, & Zahler, 1993, p. 7). Since then, technology has only been advancing. In 1993, AI had begun being able to interact with other musicians with tempo changes. In recent years, AI performances have been able to possess attributes of a human performance, including "gesture" (López de Mántaras, 2016).

"One of the main limitations of computer-generated music has been its lack of expressiveness, that is, lack of 'gesture.' Gesture is what musicians call the nuances of performance that are uniquely and subtly interpretive or, in other words, creative" (López de Mántaras, 2016, p. 8). López de Mántaras and his team came up with the five most important expressive parameters in music performance: dynamics, rubato, vibrato, articulation, and attack of the notes. They created SaxEx, which is a case-based reasoning system that analyzes and synthesizes human performances along with the musical score. The system studies the input and is able to reproduce a performance containing the identified expressive properties. Furthermore, the system is able to perform multiple versions of the same piece in varying musical expression by analyzing performance patterns at the phrase-level of various concert artists. "Although limited to monophonic performances, the results are very convincing and demonstrate that case-based reasoning is a very powerful methodology to directly use the knowledge of a human performer that is implicit in her playing examples rather than trying to make this knowledge explicit by means of rules" (López de Mántaras, 2016, p. 9).

In 2016, a similar study was conducted by researchers at the University of Padova and UNSW Australia, this time focusing on piano performances generated by AI via a Disklavier, a type of smart piano. One hundred and seventy-two musicians of various backgrounds rated seven performances of piano music by classical composer Kuhlau, wherein one was played by a human, and six were generated by algorithms, including a 'mechanical' and 'unmusical' one. The

participants rated to what extent each performance was by a human and gave open-ended answers to explain their judgment. Five main themes describing human performances were named as qualitative analysis by the participants: “intuitive, expressive, imperfections, halo (global preference) and empathy” (See Appendix A). The research reveals that AI-generated performances of piano music can be indistinguishable from human performances, and therefore, proving that AI-generated performances can be as creative and human-like (Schubert, Canazza, De Poli, & Roda, 2017).

Schubert, et al. (2017) raise a concern parallel to mine:

> [The] conclusion is presented in a provocative tone to raise an important question about the role of artificial intelligence (AI) in mimicking human pursuits. Like the Deep Blue computer victory over the human player in chess, the current algorithms may make the human per-former redundant. And so an answer is needed to the question of why one would continue to learn to play chess, or play a musical instrument that a robot can play as well if not better? (p. 184)

Although, the group responds to their own question by saying that based on the participants’ open-ended responses, “humans are somehow drawn to seek creative outputs only from humans because they can see the similarities among themselves, and so can marvel even more when one of ‘their own’ excels at something” (Schubert, Canazza, De Poli, & Roda, 2017). López de Mántaras also notes that many may still view these AI creative performances as only apparently creative for two main reasons: “the lack of intentionality and our reluctance to give a place in our society to artificially intelligent agents.” (López de Mántaras, 2016, p. 18).

Currently, AI systems are already able to produce classical piano performances that have creative and human-like properties, including expressivity and nuances. Musicians are also able

to perform chamber music sensitively with a smart piano. One concert featuring performances by a smart piano has already been presented to the public and was well-received. However, it has not yet become a popular practice. At present, people still search for human presence during an artistic performance. On the other hand, for recorded music that can be streamed online or aired on the radio, people may not be able to differentiate performances by a human or AI. These findings still raise an important issue regarding the future of classical musicians pursuing performance careers in their field. Who knows what further developments will arise in the world of AI, as well as the social implications and cultural transformations that result in these technological advancements?

References

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Appendix A

Themes Identified as Reason for Human Performance Rating

Table 5. Themes identified for open-ended responses to why human performance rating was made.

Theme name	Explanation of theme	Sample text coded to this theme	Number of occurrences	
			Non-CPE	CPE
Halo	Global positive comments when human performance	Only a human can play it so well	12	1
Expressive	Reference to musical features or expression or emotion specifically	I can hear different dynamics and emphasis on particular notes	224	85
Imperfections	Reference to error or greater variability expected in human performance, or not in machine performance	There were small imperfections, such as unevenness in chords and pedaling	85	12
Empathy	Feeling the sense of the human player or not	Only a human could get those accents to have the same profound effect on another human	3	1
Intuitive	Judgement made by without further justification, or uncertainty of answer indicated, or intuitive nature of response indicated	I don't know, I just guess by my feeling	438	65
Instrument-Sound	Suggestion or inference that the instrument is only playable by a human (piano) or non-human (e.g. MIDI)	The piano is a physical musical instrument—played by humans	5	2

Note: Counts are collapsed across the seven stimuli. Counts can add up to more than the total number of coded units because sometimes more than one theme was coded for a particular data unit.

Figure A1. Table showing main themes that emerged during research regarding computer versus human piano performances by Schubert, E., Canazza, S., De Poli, G., & Roda, A. (2017). Algorithms can mimic human piano performance: The deep blues of music. Journal of New Music Research, 46(2), 175-186. doi:10.1080/09298215.2016.1264976