Performing in the Assemblage: Virtuosity in AI-Mediated Environments

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Abstract

Using Csikszentmihalyi's Systems Model of Creativity, Deleuze and Guattari's Assemblage Theory, and Rowe's classification of interactive computer music systems, this article explores how AI-mediated environments for real-time, human-machine co-collaboration transform the ontological and political meaning of performance virtuosity from the vantages of the composer, performer, and the audience. The case study analysis and subsequent discussion emphasize the centrality of the human in environments where expertise is distributed throughout a network of technological assemblages. Advocating for inefficient, localized, individuated practices of AI-mediated musicking, this reframing of virtuosity is a response to a post-generative era in which music can be created with unprecedented ease and efficiency.

1 A SOCIO-TECHNICAL UNDERSTANDING OF AI-MEDIATED MUSICAL VIRTUOSITY

Virtuosity is a culturally mutable, conditional quality in music performance, contingent on the developing technologies at a composer's disposal. Emerging technologies stimulate new perceptions of a given instrument's musical affordances and constraints, yielding new paradigms for instrument design, gestural interaction, composition, and performance possibilities (Giotti et al., 2021, Magnusson, 2010, 2019), leading to a refined understanding of virtuosity established through those practices. The 4th Industrial Revolution, with its data-driven technologies and hybrid cybernetic-human systems of interaction and adaptability (Klingenberg et al., 2022), is the latest technological epoch under which composers, performers, and the audience have had to consider the meaning and cultural significance of virtuosity.

AI is as much a technology as it is a technological promise. Surpassing an explanation of a technology's mere functionality, a technological promise is a constructed narrative that provides a potential vision that justifies investing financial and intellectual capital into its continued development (Apreda et al., 2014). More than a techno-optimist attempt to proselytize about far-fetched prognostications, a technological promise must be rooted in the state-of-the-art capacities of a given technology so that future research agendas can be established and socio-technical fields can emerge within existing institutions (Hirsch-Kreinsen, 2024). The modern-day technological promise of AI is premised on the continued development of deep learning and machine learning that further integrates the technology into industrial, commercial, economic, and educational contexts (Krokowski & Hirsch-Kreinsen, 2025). Integrating AI and Machine Learning into the other technologies of the 4th Industrial Revolution—nanotechnology, sensor systems, gestural and facial recognition, haptic and touchless interfaces, robotics, and the Internet of Things, to name a few— create automatized, expert-level IT and analysis systems that greatly enhance productivity in a variety of work-related settings.

The history of AI's technological promise includes grand visions of its problem-solving, assistive capabilities, and generative capacities. However grandiose, this promise has been met with skepticism from creative communities. Generative AI—a subset of AI that can be broadly described through its system-level functionality and algorithmic processes used to produce media in various visual, sonic, and text-based mediums (Ronge, et al., 2025)—has also become a subject of intense scrutiny from musicians and music scholars (see Drury, 2024; Morreale et al., 2025). This apprehension warrants a distinction between two paradigms of AI-enhanced musical tools—AI-driven music platforms such as Suno, Udio, Boomy, or Soundful, and AI-mediated musical environments—not on a technical basis or at the system-level alone, but on their respective potential to reinforce or reframe notions of musical virtuosity. The focus here will be given to the latter's potential to reframe performance virtuosity in AI-mediated environments to realize or interrogate AI's latest technological promises.

Ultimately, this theoretical inquiry seeks a musical response in support of a critical Digital Humanism, which demands AI and other emergent technologies to be human-centered and in support of a techno-structure deliberately designed to produce human-machine cooperation, sustainability, and work towards social good (Hofkirchner & Kreowski, 2023). In a critique of post-humanism, Philospher Erich Prem states that one of Digital Humanism multi-purpose endeavors is to "understand the implications of digital technologies for individuals, societies, and our environment", opposing any claim that humans be in service to technology (2024). Echoing these politics, the centrality and empowerment of the human within AI-mediated performance is situated within Prem's proposed principle that the use and application of technology can be shaped (2024)—in this instance, through creative engagement, analysis, and critique.

1.1 Systems of Creativity

In The Systems Model of Creativity, Csikzentmihaly's definition of creative work is one that cannot be independent of a work's persuasiveness (2014). Recognizing an act as a creative one must, as Margaret Boden has also stated, be recognized as such by those who are observing it (2005). A music performance or work cannot be considered creative in a vacuum or simply due to its existence, but requires an audience to recognize it as having aesthetic value (Boden, 2010). Relatedly, the intersubjectivity of one's domain, subject matter expertise in each field, and an individual's own work greatly influences the recognition of new modes of performance virtuosity. Rather put, the standards of virtuosity are upheld by performers and as a result, recognized by an informed audience. Due to the culturally contingent nature of recognizing virtuosity as the pinnacle of upholding a subjectively understood aesthetic value, the framing of AI-mediated virtuosity will be narrowed here by only examining practices that combine AI (and possibly other technologies of the 4th Industrial Revolution) with musical instruments of the Western Art music tradition. This is not done for exclusionary purposes, but to establish a clear framework for discussing virtuosity that is both retrospective and forward-thinking. This categorization and consideration of virtuosity is specific to the content presented here, and expansions to this framework should (and will) be included in future research.

By adapting The Systems Model of Creativity, it is argued here that virtuosity in AI-mediated environments will be recognized in the following ways:

1. Musicians navigating individually constructed hybrid environments for real-time, human-computer collaboration and interaction.
2. Designing AI-enhanced augmented instruments or virtual performers into a mediated network without alienating the audience.

Spanning theoretical considerations to practical case studies, this article presents a framework for recognizing these two qualities as AI-mediated musical virtuosity through distinct yet contingent modalities: the performer as a real-time mediator and the coder as an instrument designer and composer. The convergence of these two modalities relates to Csikszentmihaly's Systems Model of Creativity along its three components in the following manner:

1. **Domain:** Virtuosity is distributed through various disciplines, modalities, and forms of knowledge that are contemporaneous with the technologies emerging from the 4th Industrial Revolution
2. **Field:** Various experts within those domains determine the quality of a specific musical work or design; most crucially, the audience perceives the excellence and value of a particular real-time performance as a sense-making activity that possesses aesthetic value.
3. **Individual:** The human remains the central focus of the performance, dynamically interacting with the computer, instrument, and other cybernetic elements in real-time.

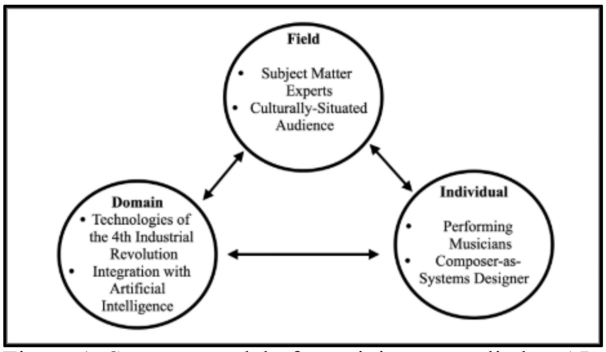

Figure 1: Systems model of creativity, as applied to AI-mediated musical environments

Characterized by a diffusion of agency, this model displaces composition from a fixed object into a networked space for co-creative, collaborative negotiation between the performing musician and fully or semi-autonomous machine. The process of meaning-making is shared between the informedness of both the performer and audience, but it is ultimately the responsibility of the former to convey sense-making through their various domains of expertise, performance aptitude, and creative intent.

The following sections first lay the theoretical groundwork for interpreting virtuosity in AI-mediated environments as a transformation of musical hierarchy and agency, then provide case studies that use AI within a constellation of technologies, disciplines, and domains of expertise.

2 DISTRIBUTING VIRTUOSITY THROUGH THE ASSEMBLAGE

Assemblage Theory, as established in Deleuze and Guattari's *A Thousand Plateaus,* offers an effective conceptual resource for contextualizing the hybrid, fluid, and contingent nature of human-machine reciprocity in AI-mediated musical environments (1987). Complex systems are comprised of a constellation of diverse elements coming together, creating dynamic networks of objects, people, ideas, institutions, and forces. These relational elements do not comprise a static model but are fluidly remapped to create emergent capacities and meaning through their constant reconfiguration. Just as social, cultural, and economic systems are under the influence of these intertwining networks of elements and influencing factors, designing augmented instruments and performing with AI-mediated musical ecosystems are dynamic processes subject to technological innovation, reconfiguration, and supersession.

Considering the responsibilities of the performer and the cultural situatedness of those evaluating them—defined by Pierre Bourdieu as the musical tastes and expectations shaped by one's experience, environment and social strata (Söderman et al., 2015)—virtuosity in Western music canon can be conceptualized as a feedback mechanism for manual musical control in the pursuit of cultural production or reproduction. AI-driven music platforms also rely on the intellectual hierarchy involved in not only past creative and technical efforts, but in the immense technological infrastructure needed to reproduce previous musical forms. AI-mediated musical environments form collaborative, symbiotic ecosystems between the human and the machine, potentially creating new modes of interaction, gestural expression, and sonic outcomes that are untethered to any faithful realization of the past. These ontological fissures not only present opportunities to experiment with alternative ways of performing and human-computer mediation, but each new assemblage represents one of the many possible Deleuzian "lines of flight" (Deleuze & Guattari, 1987) that can depart from the encoded hierarchies within established Western musical canon or AI-driven music platforms.

These lines of flight also present an opportunity to augment the notion of virtuosity currently reinforced by the institutions and hierarchies in Western art music, which privilege the concept and intention of the composer over the execution and interpretation of the performer, as described in Goehr's work-concept model (2007). Presented here is a new form of mediation consisting of two interrelated assemblages:

1. The collection or network of technologies or technological assemblages, hardware, software, and processing algorithms that make up the instrument or interactive systems.
2. The fusion of roles that one person occupies as being the composer, performer, instrument designer, and systems programmer.

AI-mediated musicking raises crucial ontological considerations regarding what constitutes the performance or the composition in these creative spaces, where the machine is generating musical responses or dynamically processing audio data in real-time to establish a non-linear, iterative space of co-creation. As these systems become unique to the individual, musical virtuosity in AI-mediated environments is distributed throughout the specific roles within these shifting assemblages. Reframing performance as the skillful navigation of a networked technological assemblage consisting of material and cybernetic elements presents a challenge to the orthodox view of virtuosity, which is defined as technical mastery in the service of reproducing the formal composition. By shifting the focus of excellence from technical skill on a fixed instrument to a form of distributed creativity, theoretical knowledge, and critical decision-making enacted across a network of technologies, virtuosity becomes a provisional, context-specific quality that emerges from real-time performance.

Comprovisation is a term used to describe the dynamic, context-specific interplay between various elements, contingencies, and structures that play out through improvisation, thereby disrupting the demarcation between compositional authority and deferential performance (Bhagwati, 2013). Comprovisation has particular relevance to the fluidity of meaning-making taking place in AI-mediated musical environments. Improvisational exchange between the human and computer is foregrounded by the haptic, auditory, and visual insights that unfold throughout the duration of a performance. The virtuosos are those who can navigate the technological assemblage, discover its constraints, and leverage its creative affordances to impart musical intent within an emerging performance space that has the potential to seem alienating and nebulous.

3 THE SHIFTING RELATIONS IN AI-MEDIATED MUSICAL VIRTUOSITY

The recursive processes involved in human-machine musicking yield contingently enacted performance decisions, revealing musical intent to the audience. This culturally situated, AI-mediated approach to comprovisation has profound implications on the perception of performance virtuosity from the vantages of the composer, performers and the audience.

This type of experimental musicking can be considered a form of creative-based collaborative research. The perception of performance excellence needs to be triangulated across three distinct categories of qualitative methods, each correlating to the unique vantages of viewing the same complex system. These points of departure can be considered multidisciplinary, interdisciplinary, and transdisciplinary categories of qualitative research evaluation (Dalton et al., 2021).

Alvargonzález (2010) provides useful philosophical perspectives on these three categories of research, which can be distilled to the following:

1. **Interdisciplinarity:** unifying two or more disciplines into another discipline.
2. **Multidisciplinarity:** using knowledge from multiple disciplines within a single domain; to technologize a domain.
3. **Transdisciplinarity:** stepping outside existing disciplines associations to recombine them into a new form.

These definitions are useful for examining the different perspectives of observing the same musical activity within complex interactive computer music systems, especially when juxtaposing them with prior methods of evaluating and perceiving musical virtuosity in Western Art music.

3.1 Composer's Perspective: Interdisciplinarity

The composer of the work is no longer the sole musical genius or the primary, authoritative source of intent. The recognition of virtuosity is inseparable from the compositional process itself and gauged by the performer's adaptability across a complex network of hybrid components, technological disciplines, design choices, and cybernetic agents. From the composer's perspective, virtuosity in performance is a display of interdisciplinary excellence: the performer can deftly synthesize interdependent domains of knowledge to create an iterative, integrated approach to technological mediation that is both relative to the system's design and specific to the individual.

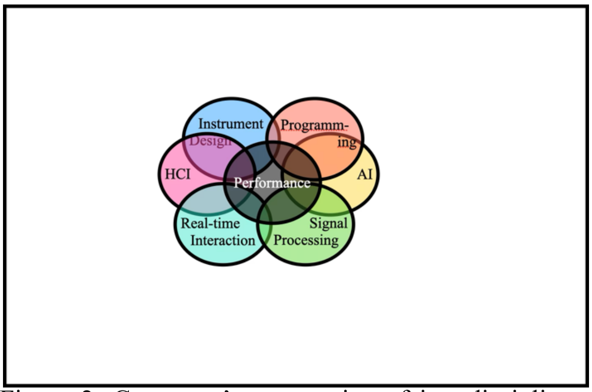

Figure 2: Composer's perspective of interdisciplinary virtuosity

3.2 Performer's Perspective: Multidisciplinarity

A performer recognizes virtuosity in another musician by the way they dexterously combine diverse domains of knowledge and skills into a musical action that is still perceived as a performance. Many of these domains within AI-mediated environments are not inherently connected. A non-exhaustive list of these domains would contain performance techniques specific to a designed, augmented instrument, music theory, digital technologies, signal processing, physical computing, AI/ML, real-time systems, and networked performance. The real-time component to the performance, combined with the indeterminant output of the interactive or generative systems, make this act of mediation nearly always contain some degree of improvisation.

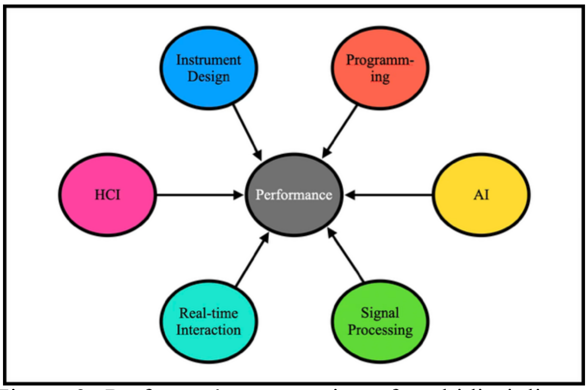

Figure 3: Performer's perspective of multidisciplinary virtuosity

A performer's virtuosity cannot be determined through other performers comparing their attempt at reproducing a fixed composition to an agreed-upon authoritative source, whether that be the score or a previous recording. It is done so by observing multidisciplinary excellence that demonstrates both physical skills and real-time decision making that is particular to the technological assemblage and reflective of a personalized gestural and sonic vocabulary.

3.3 The Audience's Perspective: Trans-disciplinarity

The audience no longer perceives virtuosity through the performer faithfully reproducing the fixed musical work. The audience determines virtuosity by how the performer is deftly unifying interdisciplinary and multidisciplinary skillsets into a transdisciplinary act of meaning-making. This is a fluid process, as audiences may encounter paradigms of human-computer interaction that may be entirely novel to them. Meaning making is invoked by the performer's ability to translate their real-time decision making into a display of physical skill, but this intent is evoked through every audience member's cultural situatedness and the shared performance environment.

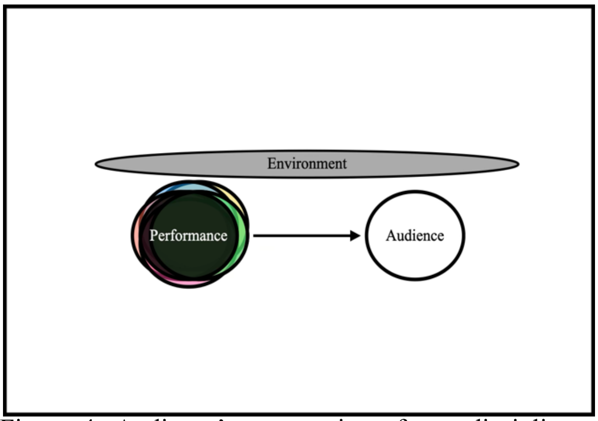

Figure 4: Audience's perspective of transdisciplinary virtuosity

A performer's transdisciplinary virtuoisty is determined by the degree to which their intent is accurately perceived without alienating the audience, no matter how complex, displacing, or virtualized the technological assemblage may become. The audience must also disassociate from their prior conceptions of performance virtuosity to recognize the recombination of disciplines that form a new model of mediation within a context-specific environment.

Recalling Boden's idea that the perception of creative activity requires an audience to recognize its aesthetic value, these three perspectives demonstrate that each contains within them their own value judgements. Discarding these prior notions of value is not easily accomplished. Yet the value in each AI-mediated performance can be alternatively thought of as how these three perspectives—all of which represent a faction of the audience in some manner—gauges or experiences an aesthetic of intentionality when observing a performer navigating a newly designed assemblage. If performing with such an assemblage (as well as designing one) represents a line of flight from the established sociotechnical hierarchies involved in music production, then value cannot solely be gauged based on preconceived aesthetics, expectations, or prior music experiences, but through evaluating a performer's intent and execution, as well as their exploration or discovery of musical forms, playing approaches, and sonic vocabularies immanent to an interactive system. This underscores the importance and centrality of the human's real-time decision making in comprovisation.

Since the design of the system and the effectiveness of a performance can become so contingent on each other, it is often the case that the one person performs both roles. Combining both models of virtuosity in AI-mediated environments, these individuals have developed specialized performance techniques while becoming versatile artists, music technologists, designers, and practice-based researchers.

4 CASE STUDIES

Rowe provides a classification for interactive computer music systems using three dimensions: event organization, response methods, and performance paradigms (1992), which lends a multidimensional framework for analyzing not only how the following AI-mediated environments are designed, but the ways each performer positions themselves in relation to its interactive components. Events can be organized based on through-composed scores or contingent on performance. Response methods can transform, generate, or perform material in sequence, and paradigms can either augment pre-existing musical instruments or create artificial performers. These are not strict delineations, but helpful classifications for parsing the unique qualities of each interactive system.

Table 1: Rowe's Classification of Interactive Systems

Dimensions	Classifications
Event Organization	Performance-Driven or Pre-Composed
Response Methods	Generative, Transformative, or Sequenced
Player Paradigms	Virtual Player or Augmented Instrument

AI-mediated environments can be understood across these dimensions. Among the possible approaches, two of the most common can be thought of as 1) building and performing with a virtual, generative improviser and 2) designing augmented instruments for real-time sound processing. These case studies were selected, in part, due to each primarily reflecting one of these approaches. Moreover, they each represent a modularity in design and a flexibility in performance that demonstrates how assemblages and interaction techniques do not necessarily fit neatly onto any discrete dimension above, making these classifications, in many cases, a contextual tool rather than a way to make rigid distinctions. Both case studies discussed here consist of instrumental performance skills rooted in Western Art music and stress the centrality of the human within each interactive system.

4.1 Case Study: Scott Deal and Jason Palamara, AVATAR

Scott Deal is a renowned percussionist, improviser and professor who uses machine learning to improvise with virtual performers, most recently with a system named *AVATAR*. Developed by Deal and technologist Jason Palamara, who describes *AVATAR* as a "machine learning-enabled performance technology system" (Palamara, 2021), the software uses machine learning to create models of an individual's performance practices and personal playing tendencies.

Built as a series of Max for Live devices inside the DAW Ableton Live, the design of *AVATAR* includes an audio-to-MIDI conversion processing, and three other components: *avatar.learn*, *avatar.sig2dyna,* and *avatar.player*. Using pitch, velocity, duration, and chord choices included in the original MIDI file, *avatar.learn* builds a model unique to each performer. The *avatar.sig2dyna* component dynamically detects audio onsets that exceed a specified threshold. These triggered onsets are routed to a "choice" engine in the *avatar.player,* which can select from five playback behaviors—repetition, novelty, favorite four notes, chords, and phrase variation.

Palamara states that a performer can develop their own ML model from a MIDI file, then use the *AVATAR* to listen and play along with the performer, with those choices contingent on the real-time expressive and musical choices made between them. From this design method, *AVATAR* is not simply playing a selected musical genre or generating responses from a prompt; its spontaneous accompaniment is based solely on the analysis and particularities of each performer.

Figure 5: Past Every Exit, performed by Jason Palamara, Scott Deal, and AVATAR

Deal has been improvising alongside *AVATAR's* choice engine since its initial development, using it to complete his AI opera, titled *Lexia*, which premiered in 2024 (Hodson, 2024). Other pieces that feature Palamara and Deal improvising with AVATAR include *Past Every Exit,* where *AVATAR* listens to Palamara (violin) and Deal (vibraphone), responding on a Disklavier in real-time (Palamara & Deal, 2022). Along with the core components of *the AVATAR* system, there is additional recording, looping and audio processing functions, along with an Ableton Live session running a dynamic visual score that guides the decisions made by the performers.

4.2 Case Study: Rodrigo Costanzo, Data Knot, and Kaizo Snare

Rodrigo Costanzo is a multifaceted artist who builds human-focused software tools, often blending the natural and the artificial that recycle previous forms of virtuosity, distributing them through new technological disciplines (Kirn, 2025). Costanzo's work spans multiple instruments and modalities of performance, but one area of focus and technical rigor has been on creating hybrid drumming systems that enable expressive control over gesture mapping and the manipulation of sounds through the onset detection, incredibly detailed positional tracking, machine learning, innovative sensing techniques, and low-latency audio analysis.

One of his most recent contributions to the computer music community is *Data Knot*, a modular, customizable set of ML components for Max/Msp~ that are optimized for low-latency in real-time performance (Costanzo, 2025). Built from the FluCoMa toolkit in Max/Msp~ (Tremblay et al., 2021), *Data Knot* provides musicians with myriad accessible ML analysis techniques, including amplitude onset detection, real-time descriptor analysis, classification and clustering, regression and prediction, corpus analysis, synthesis, and physical modeling (Kirn, 2025). A user can create customizable Max patches that augment their instrument or any sound-making device while completely transforming its acoustic sonic profile.

Costanzo has been using components of *Data Knot in* his performances over the past five-year period, identifying his video series P*lay Talk Play* as a valuable space for using the library in a variety of capacities (Kirn, 2025). Numerous performances in the video series feature another musician improvising alongside Costanzo, often containing new hybrid instrument configurations for each ensemble. One of *Data Knot's* defining features is its scalability, making it an invaluable library for any number of ML-enhanced musical applications.

Figure 6: Costanzo performing the drums with custom software made within Data Knot

One of Costanzo's experiments that preceded *Data Knot* was the *Kaizo Snare*, made during his time as a composer on the FluCoMa project at the University of Huddersfield. Initially inspired by the esoteric virtuosity of turntablism, Costanzo created a high-resolution crossfader and combined it with a condenser microphone to simulate the scratching and cutting of DJ performance (Costanzo, 2020). Using the FluCoMa toolkit (tracking loudness, pitch, and the incoming spectral centroid), custom Max/Msp~ patches, a corpus of metallic objects, and incorporating a bass drum with its own library of processed sounds, Costanzo had created a completely novel instrument that simultaneously paid homage to past forms of virtuosity while demonstrating do-it-yourself expertise as a systems designer, instrument builder, and performer. Described as "a solo improvisation on drums and electronics using old and new technologies to expand an already expanded drum set" the *Kaizo* snare was performed at the Huddersfield Contemporary Music Festival in 2019 (Costanzo, 2020).

5 DISCUSSION: COMPARING CASE STUDIES

There are significant differences between both case studies. The virtuosity exhibited in *AVATAR* is distributed between multiple people collaborating on the system's design, whereas Costanzo was the sole designer of *Data Knot*. *Data Knot* is a modular package of tools that can be reconfigured to fit a litany of use cases. *AVATAR* was specifically trained as a virtual performer to generate musical output based on Deal or Palamara's real-time performance, while Costanzo's whole suite of tools enables users of *Data Knot*, FluCoMa, and Max/Msp~ to design augmented instruments that transform any incoming audio from a variety of input sources.

When contextualized within Rowe's classification of interactive systems, *AVATAR* is a performance-driven program that uses generative response systems to interact with a virtual improvisor, creating what amounts to a duet between the human performer and machine (or however many human performers at a given time, plus a virtual performer). *Data Knot* is a performance-driven toolkit used by Costanzo to create transformative response methods within the instrument paradigm, which resembles more of a solo performance setting than one featuring an interactive, virtual performer. The *Kaizo Snare*, a predecessor of *Data Knot*, is a clear example of an augmented instrument that uses transformative response methods within a solo performance.

Table 2: Categorizing AVATAR and Data Knot Across Rowe's Classification of Interactive Systems

Dimensions	AVATAR	Data Knot (Play Talk Play)
Event Organization	Performance-Driven	Performance-Driven
Response Methods	Generative	Response
Player Paradigms	Virtual Player	Instrument Extension

These classifications, as Rowe suggests, are not as stark as these outlines (1993). There are certainly gradations in their uses and classifications. *Data Knot* could be used to create virtual performers, potentially combining both transformative and generative response methods in the process. The MIDI values *AVATAR* generates could be routed to any number of modularized instruments in a DAW. Those signals could then be used as input to drive an ML-driven instrument created in *Data Knot.*

Despite their differences in how they map to Rowe's systems classification, the two models of AI-mediated virtuosity are present in both case studies. Deal and Costanzo rely on improvisation, both in terms of how they each generate input and react to their differing response methods, demonstrating how each case study places the human as the central mediator in each of their respective technological assemblages. All the performers make choices that directly influence the computational response methods, which in turn, inform subsequent decision during improvisation. Identifying virtuosity within each performance context is determined by how the performers reacted to these response methods in real-time and within their respective technological assemblages.

The compositional component in *AVATAR* can be observed in the system design that enables sound generation from a virtual improvisor, which is generally guided by human performance, audio threshold tracking, and initial modeling. A composer would use *Data Knot* and their knowledge of algorithms, audio analysis, interactive systems, and machine learning to build an augmented instrument from a library of tools within a larger set of objects.

Both case studies can use instruments from the Western Art music tradition as their system's input sources. Deal describes himself as merging "out of the classical music world and into free improvisation" and uses *AVATAR* within both improvisational and composition settings (Hodson, 2024). Many of Costanzo's augmented instruments are built from those rooted in the same Western Art music tradition. Both musicians have voiced opinions of AI-driven music platforms that expressed unambiguous critique towards the automatization of art. Deal has commented on his AI opera being a beautiful piece about hope…that explores the outer limits of what makes us human in an age of both ecological disaster and autonomous machines" (Hodson, 2024). Costanzo's *Data Knot* project has been characterized as an alternative vision for AI-enhanced music, enabling musicians to create workflows and a sonic character unique to their own identities (Kirn, 2025).

The human-centered design methods of both case studies underscore the importance they place on live performance. From a design and performance perspective, this is the site where these three components of Csikszentmihalyi's Systems Model of Creativity should coalesce, enabling composers and performers to identify interdisciplinary, multidisciplinary forms of virtuosity within the taxonomy of AI-mediated interactive systems.

6 CONCLUSION

AI's technological promises deliver the possibility of a renewed sense of hybrid vigor and collaborative performance between the canonized traditions and the technologically emergent. As an AI-enhanced music culture continues to evolve, there exists opportunities to reframe the understanding of musical virtuosity that is both synchronous with this moment of technological development and culturally responsive to broader societal discourses on the purported threat to human-centered creativity.

Going forward, more information will be needed in terms of how audiences respond to case-specific AI-mediated musicking and comprovisation. Too often music technology research painstakingly details systems design, focusing on what the machines does as opposed to what it means to an audience, which also consists of composers of performers.

In post-generative era of music production, the once distinct roles in music composition and performance are becoming further digitized and abstracted within sociotechnical hierarchies of enclosure and control. It is the intention here to provide practical and theoretical work that pushes creative communities to thoughtfully consider these two proposed models of virtuosity in AI-mediated environments— the performer as mediator and the composer as system or instrument designer—as the means by which to present emergent technologies within the inter-objectivity of a culturally-situated audience, so that new perspectives on musical virtuosity can be realized and built upon in the future.

REFERENCES

Alvargonzález, D. (2011). Multidisciplinarity, interdisciplinarity, transdisciplinarity, and the sciences. International studies in the philosophy of science, 25(4), 387-403.

Apreda, R., Bonaccorsi, A., Fantoni, G., & Gabelloni, D. (2014). Functions and failures: how to manage technological promises for societal challenges. Technology Analysis & Strategic Management, 26(4), 369-384.

Bhagwati, S. (2013). Notational perspective and comprovisation. Sound & score. Essays on sound, score and notation, 165-177.

Boden, M. A. (2010). Creativity and art: Three roads to surprise. Oxford University Press.

Boden, M. A. (2005). What is creativity?. In Creativity in human evolution and prehistory (pp. 27-55). Routledge.

Costanzo, R. [Amplifiers & Explosions]. (2025, October 15). Intro to data knot [Video]. YouTube. https://www.youtube.com/watch?v=iF-BwwEdrk4

Costanzo., R. (2020, August 15). Kaizo Snare « Rodrigo Constanzo. https://rodrigoconstanzo.com/2020/08/kaizo-snare/. Retrieved February 9, 2026, from https://rodrigoconstanzo.com/2020/08/kaizo-snare/.

Csikszentmihalyi, M. (2014). The systems model of creativity (p. 47). Dordrecht: Springer.

Dalton, A., Wolff, K., & Bekker, B. (2021). Multidisciplinary research as a complex system. International Journal of Qualitative Methods, 20, 16094069211038400.

Deleuze, G. and Guattari F., "A thousand plateaus: Capitalism and schizophrenia. 1980." Trans. Brian Massumi. Minneapolis: U of Minnesota P (1987)

Drury, R. (2024). You're Not Supposed to Launder My Music!: Music as Data in the Training of Generative AI Music Models. In Innovation in Music: Adjusting Perspectives (pp. 35-47). Focal Press.

Gioti, A. M., Einbond, A., & Born, G. (2022). Composing the assemblage: Probing aesthetic and technical dimensions of artistic creation with machine learning. Computer Music Journal, 46(4), 62-80.

Goehr, L. (2007). The imaginary museum of musical works : an essay in the philosophy of music (Rev. ed.). Oxford University Press

Hirsch-Kreinsen, H. (2024). Artificial intelligence: A “promising technology”. AI & society, 39(4), 1641-1652.

Hofkirchner, W., & Kreowski, H. J. (2023). Digital Humanism and AI. In Handbook of Critical Studies of Artificial Intelligence (pp. 152-162). Edward Elgar Publishing.

Hodson, J. (2024, November 26). AI music improvisation program — developed by IU professors — used to create ‘Lexia: An AI Opera.’ IU Newsroom. https://news.iu.edu/live/news/42914-ai-music-improvisation-program-developed-by-iu.

Kirn, P. (2025, October 23). Data Knot for Max is machine learning as musicians want it: human-focused. CDM Create Digital Music. https://cdm.link/data-knot-for-max-machine-learning-as-musicians-want-it/

Klingenberg, C. O., Borges, M. A. V., & do Vale Antunes Jr, J. A. (2022). Industry 4.0: What makes it a revolution? A historical framework to understand the phenomenon. Technology in Society, 70, 102009.

Krokowski, T., & Hirsch-Kreinsen, H. (2025). Once promised, forever believed? An essay on the blind spots of AI promises. AI & SOCIETY, 1-14.

Magnusson, T. (2019). Sonic writing: Technologies of material, symbolic, and signal inscriptions. Bloomsbury Academic

Magnusson, T. (2010). Designing constraints: composing and performing with digital musical systems. Computer Music Journal. 34, 62–73.

Morreale, F., Martinez-Ramirez, M. A., Masu, R., Liao, W., & Mitsufuji, Y. (2025). Reductive, exclusionary, normalising: The limits of generative ai music. Transactions of the International Society for Music Information Retrieval, 8(1).

Palamara, J. & Deal, S. (2022, May 19). past every exit, performed by Jason Palamara, Scott Deal, & AVATAR [Video].YouTube. https://www.youtube.com/watch?v=MH_tPaoW1f0

Palamara, J. (2021, June 15). Palamara AVATAR@IRCAM [Video]. YouTube. https://www.youtube.com/watch?v=czgyKod9w9g

Prem, E. (2024). Principles of digital humanism: A critical post-humanist view. Journal of Responsible Technology, 17, 100075.

Ronge, R., Maier, M., & Rathgeber, B. (2025). Towards a definition of Generative artificial intelligence. Philosophy & Technology, 38(1), 31.

Rowe, R. (1992). Interactive music systems: machine listening and composing. MIT press.

Söderman, J., Burnard, P., & Trulsson, Y. H. (Eds.)(2015). Bourdieu and the sociology of music education. Ashgate Publishing, Ltd.

Tremblay, P.A., Roma, G., & Green, O. (2021). Enabling programmatic data mining as musicking: The fluid corpus manipulation toolkit. Computer Music Journal, 45(2), 9-23.