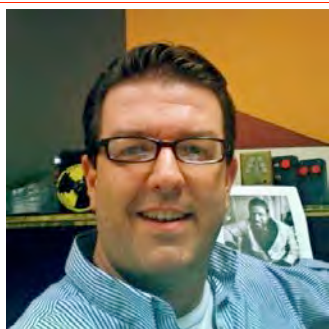


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**References:**

- [1] Brian Ferneyhough,  
*Collected Writings*, ed.  
By James Boros and  
Richard Toop, Taylor &  
Francis, 1995  
[2] David Rothenburg,  
“Get Out of Whatever  
Cage” in *Musicworks* 58,  
Spring 1994  
[3]  
<http://www.crackle.org>

**Paper: Collaborating with Machines: Hybrid Performances Allow a Different Perspective on Generative Art****Abstract:**

In the simplest view of generative art, an artist creates software, enabling it to make some aesthetic decisions on its own, and then sets it in motion, allowing the software to take over and generate the work we end up seeing. A purist might consider it cheating for the artist to intervene at any later stage. As an improviser and frequent participant in interdisciplinary collaborations with humans, I find the same thrill in collaboration with humans as I find when developing generative agents: the pleasant surprises of unexpected results I never would have thought of on my own. This has led me to explore a variety of possible collaborative relationships with my generative agents, and this has allowed me to reframe the simple view of generative art-making as one point on this spectrum of collaborative relationships.

Whereas in traditional art, the human artist is fully responsible for the pre-production and the final presentation of the work, the simplest view of generative art has the human artist responsible for pre-production and a machine (created by the artist) fully responsible for the final presentation. In actuality, the pre-production phase most often involves a feedback loop in which the artist constructs a system, sets it in motion, evaluates its output, and adjusts the system to behave differently. Some artists, like composer Brian Ferneyhough [1], have left the machine in the pre-production stage, using it only to produce raw material, and manually shaping it to create the final presentation. In contrast to the above models, works like John Cage’s *Inlets (Improvisation II)*[2] and Michel Waisvisz’s instrument the Kraakdoos (cracklebox)[3] have indeterminate (machine-dependant) decisions built into every performance, leaving the human performer to wrestle with the machine to mutually arrive at aesthetically pleasing results during the performance.

Examination of some of my compositions elucidates and expands this spectrum of possible relationships between human and machine in the final presentation of the work. These performances involve techniques such as complex feedback systems, live coding, physically and mentally strenuous performance conditions, and the “grain” of natural and social phenomena. In this framework, the traditional generative art model can be seen as one point in a rich spectrum of human-machine relationships, and this can pave the way for exploring new relationships. This also allows for reflections on the aesthetics of generative art: the authenticity of the machine’s product and the effort of the artist and performer.

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Composition, improvisation, instrument design, aesthetics, authenticity, collaboration

## Collaborating with Machines: Hybrid Performances Allow a Different Perspective on Generative Art

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### Premise

In the simplest view of generative art, an artist creates software, enabling it to make some aesthetic decisions on its own, and then sets it in motion, allowing the software to take over and generate the work we end up seeing. [1] Artists who work with generative systems know this process involves a lot of trial and error before finally letting a system run on its own for the public to see. In many situations, an artist may take an editorial role and select, arrange, or adjust the output of the system before being viewed by the public.

As a musical improviser and frequent participant in interdisciplinary collaborations with humans, I find a similar thrill in collaboration with humans as I find when developing generative agents: the pleasant surprises of unexpected results I never would have thought of on my own. My preferred tool (for myself and for my students) is the Max graphic programming environment [2], because its real-time operation allows for programming development through *improvisation* (i.e., trying out “what ifs” as we think of them) instead of staged experimentation (i.e., write code, compile code, evaluate results, decide to keep or edit the code). Besides making it easier to discover fortuitous accidents, this improvisational process engages different mental processes. This trial-and-error stage is worth discussing in the context of creating generative art, but as demonstrated in the simple model above, it is easy to overlook.

Many of my musical creations highlight the trial-and-error stage of the process by putting it *on centre stage*: composing environments in which computer and human performers collaborate on stage to realize a musical performance. This has led me to explore a variety of possible collaborative relationships with my generative agents, and this has allowed me to reframe the simple view of generative art-making as one point on this spectrum of collaborative relationships.

## 1. The Production Process as Collaboration

In traditional composition, a composer writes all the notes and a performer plays all the notes. Up to a certain level of ability, the performer acts as a music playback system, hopefully a “high fidelity” one. However, we readily recognize that the best performers bring their own influences to the composition and somehow make the performance unique and more rewarding than a simple high fidelity reproduction of the composition: outstanding performers are celebrated for the nonlinearities they introduce. They add substance to the performance and somehow make it something more than what the composer created alone.

The twentieth century saw many examples of indeterminacy used in musical compositions, in which more demands were placed on performers to make creative decisions before the composition could become complete and ready to play, more than simply providing an expressive interpretation of fixed notes. Works like these might be placed along a continuum of substance contributed by the composer or the performer.

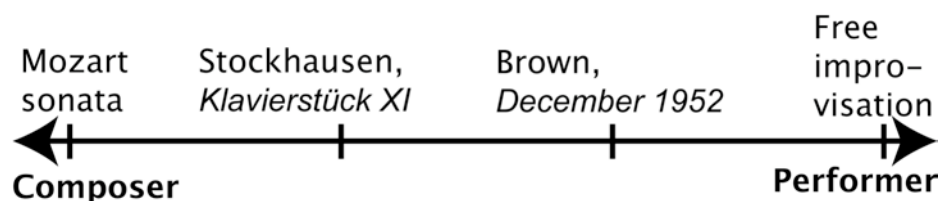


Figure 1. Continuum of relative substance contributed by the composer and performer for a few example musical works. [3,4]

This framework makes a clear distinction between pre-production (the role of the composer) and presentation (the role of the performer). In traditional art forms, the human artist is fully responsible for the pre-production and the final presentation of the work. The simple view of generative art has the human artist responsible for pre-production and a machine (created by the artist) fully responsible for the final presentation. In actuality, the pre-production phase most often involves a feedback loop in which the artist constructs a system, sets it in motion, evaluates its output, and adjusts the system to behave differently. Some artists, like composer Brian Ferneyhough [5], have left the machine in the pre-production stage, using it only to produce raw material, and manually shaping it to create the final presentation. In situations like this, the workflow of the pre-production stage becomes complicated to trace. So, let us consider works in which creative decisions are made by both human and machine in a more easily defined space: on-stage during live performance.

John Cage’s composition *Inlets* [6,7] instructs performers to hold and tip water-filled conch shells, which will cause them to produce very sparse gurgling sounds. However, while a shell won’t gurgle until the performer tips it, the performer cannot force the gurgle to happen at any particular instant. There is a degree of randomness built into the instrument. Michel Waisvisz’s instrument the *Kraakdoos* (“cracklebox”)

[8] is a simple yet complex instrument based on an amplifier circuit in a feedback loop with six body contacts for the performer to complete the circuit (with artistically-valuable infidelities) by completing the circuit with his or her own skin (by lightly touching the pads). Both *Inlets* and the Kraakdoos bring indeterminate (machine-dependant) decisions built into every performance, leaving the human performer to wrestle with the machine to mutually arrive at aesthetically pleasing results during the performance. They are like the indeterminate compositions described above. However, these works allow us to limit our focus to onstage events during performance, and they draw distinctions between human and machine, instead of pre-production and presentation.

So, let us combine these ideas and consider generative art in terms of the human instrument builder and the randomness of the machine, live on stage in performance.

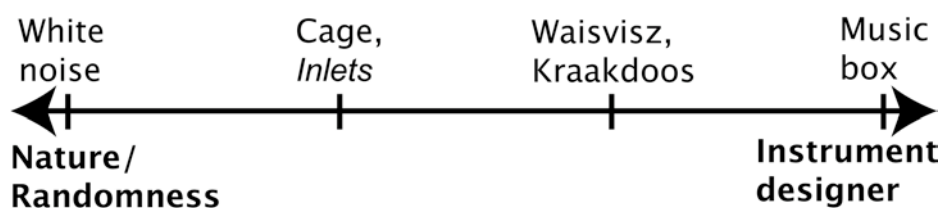


Figure 2. Continuum of relative substance contributed to a performance by the instrument designer and by nature or pseudorandom processes.

This diagram requires some discussion before moving on. Clearly we can't equate every musical instrument designer with composers. In this diagram, "instrument" refers to a music-creating machine with an increasing degree of determinacy toward realizing *one* musical performance, one "composition," as a music box does. When we normally think of musical instruments, we think of "universal" or "neutral" ones capable of playing (seemingly) any composition, for example a piano. In this discussion, however, we are considering substance contributed to a single, specific performance, and the makers of traditional (neutral) instruments don't contribute much substance to the realization of specific performances. (The influence of neutral instruments is worthy of considering, but at another time.)

## 2. Cheating and When We Care About It

We have been discussing *substance*, and I mean this in the ontological sense: what makes an artwork a "work" in the first place, what factors/roles contributed to its identity as a work, and how substantial that identity is. [9] This allows us to examine situations when a human artist designs a machine, sets it in motion to produce results, and then intervenes/edits those results before presentation: is this cheating? Well, it *can't* be cheating unless someone has broken rules. A generative art purist might consider it cheating for the artist to intervene at any later stage, but it can't be "cheating" as such. It might be *lying*, if the artist falsely suggests that the public is seeing the unadulterated output of an algorithm, but this is subject to the way a work is presented and the context outside the work itself.

I believe we would tend to agree that while it may not be fruitful to consider whether a practice is cheating, an unadulterated generative work has more substance. That fact makes the work more special, in a way akin to Walter Benjamin's idea of *aura*. [10] We feel differently about a work when we know it was created with certain notable constraints. Be it more authentic, rare, or impressive, the substance of the work is somehow increased in our minds. Therefore, aside from discussions of cheating or dishonesty, the substance of a generative work can be lessened by editorial intervention by its human creator.

What we can learn from this discussion is that this kind of integrity, authenticity, etc.—however you want to name it—is something we care about. *That* in turn means it is something that can be manipulated as an expressive element in an artwork, building and resolving tension to shape the experience.

### 3. Example Performances

The following is a brief discussion of generative performances of mine that allows us to apply the frameworks laid out above: live performances that explore relationships between human and machine creators and expressively exploit issues of substance. These performances relate to the category called Live Algorithms [for Music] as defined by Blackwell and Young, [11] except that discussions of live algorithms typically place more emphasis on the machine's ability to hear and understand the human performers, whereas my works explore a variety of relationships between human and machine and favour the simplest form of machine listening/cognition that would be effective for each performance situation—this often means that the machine isn't "hearing" or "understanding" the human in ways like the human is hearing and understanding the machine. I believe this ends up contributing to the substance and discussion-worthiness of the works in the end.

#### 3.1 *Elektro* and *Tappatappatappa*

In 2005, I created an automated live sampling environment for solo cello titled *Zur Elektrodynamik bewegter Cellisten* ("*Elektro*" for short). Even though it is a non-traditional composition (on which we won't focus in detail here), I composed it using the traditional model described above: I created the composition in cycles of trial and error, then delivered it to the cellist to perform. During this trial-and-error stage, however, I made a quite fortuitous accidental discovery that ended up yielding a distinct generative performance I ended up titling *Tappatappatappa*.

The nature of *Elektro* is that it does not contain any sounds of its own to play. It captures sound from the soloist, folds it upon itself into intricate counterpoint (via various applications of digital delays), and reintroduces the transformed material to the performance, allowing the human performer to respond in turn. With regard to Blackwell and Young's machine listening, the software only tracks the amplitude envelope of the soloist, allowing the software to opt to play in tandem with the soloist, invert the envelope so that it may trade off with the soloist, delay the envelope so that it echoes the soloist, or ignore the envelope so it seems independent of the soloist.

During the trial-and-error stage of creating *Elektro*, there were several times in which I needed to provide a simple input sound in order to confirm that the software was processing and responding to the sound as I intended. The simplest way to do this was to tap on the internal microphone on my laptop and listen to the results through its internal speakers. Since the microphone was very near the left internal speaker, feedback loops would easily form during these tests. While this was inconsequential to developing *Elektro*, it made clear to me that this system was vibrant and ready to sing in its own voice if allowed to do so—that is the performance I call *Tappatappatappa*, using the same software as *Elektro* but with a feedback loop instead of a soloist.

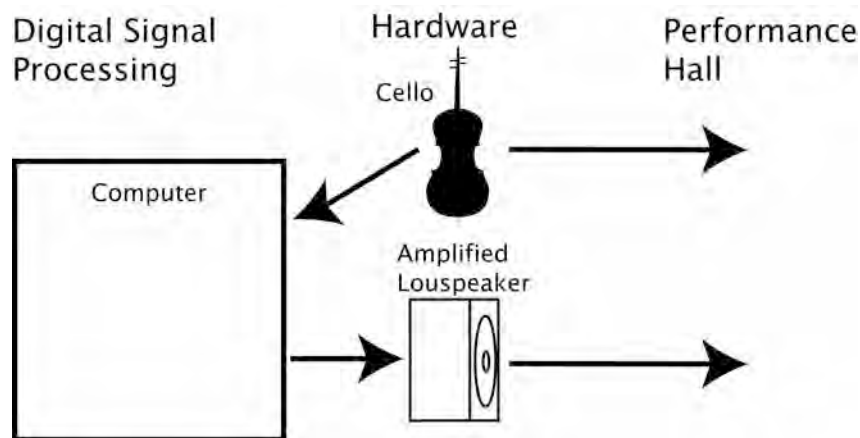


Figure 3. Configuration for *Elektro*.

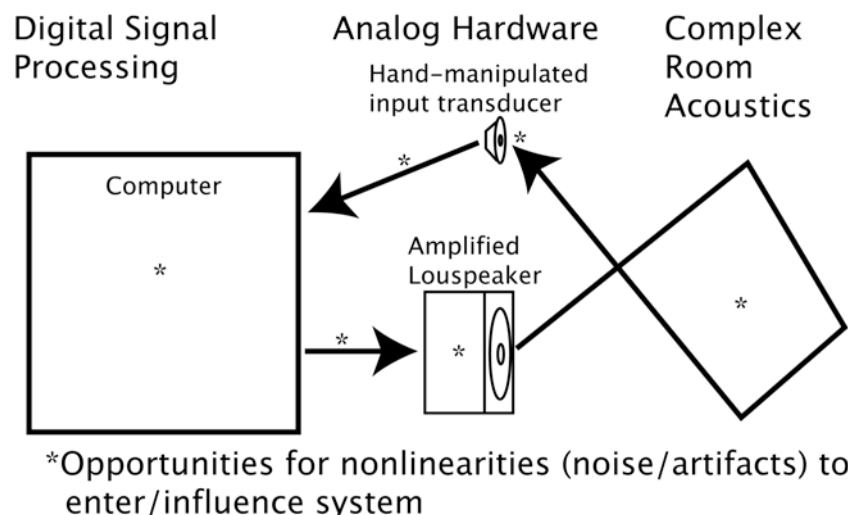


Figure 4. Configuration for *Tappatappatappa*.

In *Tappatappatappa*, the human performer is only able to guide/coax/steer the emerging voice of the complex feedback system. This system has digital, analog,

and acoustic stages, and each stage introduces its own nonlinearities that end up creating the sound heard in performance. It is an emergent beast and the human is merely its tamer (hardly its master). The human performer is only able to:

1. Make small changes to the length of the acoustic portion of the feedback loop by moving the input transducer around in space,
2. Introduce small sounds into the system by tapping or stroking the input transducer, as if providing a grain of sand to allow pearls to form, and
3. Trigger the software to move on to its next selected mode of behaviour and musical structure at a specific moment (the software will ordinarily change modes on its own; when the performer triggers a change, he or she cannot specify what mode to change to, only that the change occur “now”).

*Tappatappatappa* can be thought of as a musical instrument, but one in which its own computation becomes the resulting sound: a *computation instrument*. [12] The beauty (if harsh) of this instrument’s voice may be explained by Stephen Wolfram’s principle of computational equivalence: “...almost all processes that are not obviously simple can be viewed as computations of equivalent sophistication.” [13] Wolfram goes on to suggest that processes humans perceive as complex or beautiful are perceived that way because the processes themselves are as sophisticated as the humans perceiving them. Such systems make it, as Gary Flake puts it, “easy to forget that the rules are really in place.” [14]

The substance of this piece lies in the facts that it includes sounds I don’t know how to make any other way, its results are highly unpredictable (risky, even), and its results are unique to the current performance situation: the room acoustics, and the sounds currently resonating in the system. In performance it bears resemblance to the “human editor” model of pre-production in that the human performer has a form of “veto power,” but it turns the power structure upside down: the human is at the mercy of the machine.

### **3.2 A Treatise on the *Æsthetic of Efforte***

*Treatise* (for short) also places the human performer in a precarious position, but this time it is strenuous both physically and mentally. In its essence, it is a live coding environment for MIDI-controlled Yamaha Disklavier piano. To this, the environment adds an requirement for “breath control.” The performer must blow into a microphone producing noise in seven frequency bands in order to fill seven corresponding virtual bellows that scale the volume of any note triggered as if they were real bellows powering a reed or pipe organ. This not only adds the mental strain of maintaining this unusual form of volume control, but it creates the physical strain of producing so much wind motion, and doing so puts the performer in an unusual (sometimes light-headed) mental states.

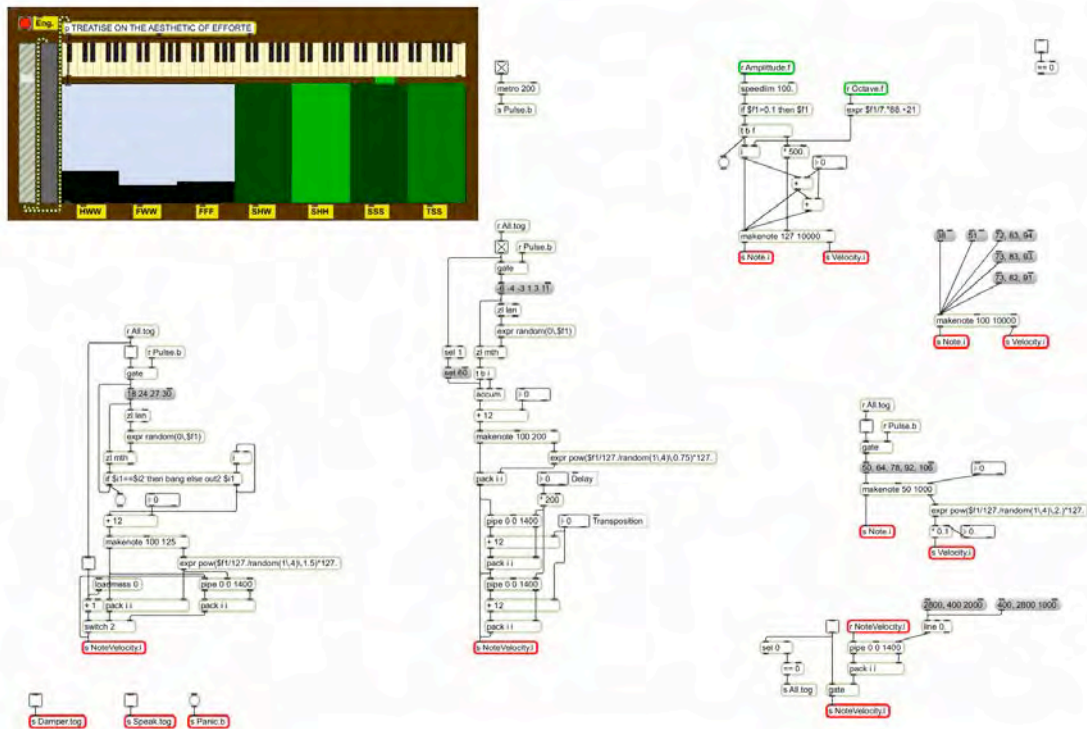


Figure 5. Performance screen for *Treatise*. The virtual bellows are reflected in the upper left corner. The rest of the screen is open for live coding of MIDI instructions during performance (in Max).

In this piece, it is almost as if the human is the one that is prepared and then let loose to see what comes out instead of the human letting the algorithm run free. The substance of the piece lies partly in the fact of this precarious situation of the performer and also in the specialness of the creative decisions the performer makes while in this state: under pressure, strained to certain limits, and a bit dizzy.

### 3.3 The Collected Works of Ferin Martino as Conjured by Your Presence

Ferin Martino is the human-like name I gave to a piano-playing algorithm I created. When presented as an interactive art installation, the algorithm proceeds in making piano-playing decisions on its own, but its decisions are disrupted by the input from a camera focused on the visitors. Simple frame differencing and mass calculations yield a single value corresponding to the amount of movement in front of the camera, and this value shapes the activity level of the note-making decision processes in the algorithm. This means that increasing or decreasing motion in front of the camera disrupts the music the algorithm would have played on its own. Because it builds structure by recombining material from its short-term memory, a single disruption can cause the music to spin off in a new direction very quickly. Because the algorithm regularly changes its modes of response to input (in decidedly unsophisticated ways despite their complex results), spending some time with the installation evokes a



sense of a playful character on the part of the software. At times it may accompany motion in literal cartoon-like ways, at other times it may provide sensitive accompaniments to complement the motion it sees, and at other times it may seem to ignore the motion.



*Figure 6. The frame-differencing camera view of Ferin Martino that disrupts the piano-playing algorithm as it performs. Here, the viewer has just waved his hand around in the area between himself and the camera, so that area appears the brightest.*

In contrast to the last two pieces discussed, *Ferin* does not involve danger of failure, but its specialness does derive from a similar phenomenon. Once you have observed the work, it has necessarily changed, and so the true “complete works” of Ferin Martino are something one can never truly hear. After spending time with it, you may begin to question whether you caused the musical gesture just played or if it was a coincidence. The risk involved here is the precious tenuousness of your understanding of the relationship between the machine and the human contributions. It is delicate and ephemeral. Authenticity is ungraspable, washed away by the viewer’s own observation of it.

## 4. Conclusion: Posthuman Performance as an Analytical Platform

### 4.1 Asking Questions

McCormack, et al [15] ask, “What new kinds of art does the computer enable?” Besides processing previously unimagined amounts of data and structure, let us not forget that doing so quickly also means the ability to do some of that work in real time. Besides the convenience of quick results, this means we gain the opportunity to see these structures played out as performances, these processes applied as improvisations, and we in turn gain the opportunity to engage them with our improvisational mindsets, not just the mindsets of incremental experimentation. This facility allows our tools to step up to the level of being our collaborators, and it allows for us to analyze them as such. McCormack, et al also ask what generative art can teach us about creativity and about art. I believe real-time collaboration with our algorithms will be an invaluable platform for us to learn those lessons.

In his imagined conversation on the topic, Galanter [1] asks, “Isn’t generative art about the issue of authorship?” and proceeds to assure us that generative art tools are independent of the meaning an artist may wish to convey. I agree, but I hasten to point out that generative art is special in its ability to illuminate issues of authorship, and as shown above, it can manipulate our sense of those issues (authenticity, presence, causality, etc.) as an expressive element in an artwork.

Galanter’s question is so pertinent because of our acute sensitivity to issues authorship, or more broadly, authenticity. In a chapter analyzing virtuality in art, I have proposed a framework in which we examine an artwork in terms of where and why the mental model it builds eventually fails. [16] In one kind of work, the mental model “fails” the human viewer, causing the viewer to “pop out” of the world the work has tried to evoke. Sometimes this is an opportunity for one to ask oneself why the work existed, to reflect on a second level of meaning, for example, “Why would someone mass produce prints of soup cans and put them in galleries?” In another kind of work, the human “fails” the model, meaning that some part of the viewer’s abilities, sensibilities, disposition, or habits of self control have broken the aesthetic experience. (In an extreme example, “This performance artist is naked, bleeding, and freezing—we have to stop the performance and get her medical attention.”)

This moment of popping out gives one a chance to see oneself *seeing* the work, to notice how and what it made one think and perhaps learn something about oneself in the process. In situations like that, we get a chance to glimpse ourselves from the outside.

### 4.2 Posthuman Performance

Galanter [1] also ponders, “Is generative art modern or post-modern?” and explains that it is ideologically neutral. Again, I agree, but I hasten to raise a point at the opportunity. Aside from that discussion (pitting modernist science against postmodernist humanities), it may be more fruitful to consider generative art in the ways in which is it *posthuman*, not meaning against or abandoning the human, but the ways in which it evokes perspectives *outside* the human. Works like these can be

called posthuman because the influence of nonhuman elements upon creative decisions is overt—this is a more objective assertion than discussions of [post]modernist aesthetics. These works lend themselves to analysis in posthuman terms. [17]

In this paper, I have examined generative art not as a solution to the problem of defining creativity or art itself, but to show that hybrid performance can be a platform to let us reflect on those things in order to better understand them and apply that understanding to traditional forms of art. Collaborative generative performance situations like these give us ways to step outside ourselves, to see *seeing*, hear *hearing*, create *creating* and watch it unfold, partly as a third party. They allow us to view the *human* from the outside—this unique perspective offered by posthuman art is easy to overlook with minds curious to know the future of art. This allows us to begin to notice the more subtle but significant influences of technology on human creativity as we examine more traditional forms of art and ask, “Which artworks are indeed purely human after all?”

## References

1. Galanter, P. 2003. What is Generative Art? Complexity theory as a context for art theory. *International Conference on Generative Art*. Milan, Italy: Generative Design Lab, Milan Polytechnic.
2. Cycling74. Max. Computer software application. [www.cycling74.com](http://www.cycling74.com) [accessed 10 November, 2013].
3. Stockhausen, K. 1956. *Klavierstück XI*. London: Universal Edition.
4. Brown, E. 1952/1954. *December 1952*. In *Folio and 4 Systems*. G. Schirmer.
5. Ferneyhough, B. 1995. *Collected Writings*. Boros, J. and Toop, R. eds. Taylor & Francis.
6. Cage, J. 1977. *Inlets*. Edition Peters.
7. Rothenburg, D. 1994. “Get Out of Whatever Cage.” *Musicworks* 58.
8. Waisvisz, M. Kraakdoos. Electronic musical instrument. [www.crackle.org](http://www.crackle.org) [accessed 10 November, 2013].
9. Morris, J. 2009. Ontological Substance and Meaning in Live Electroacoustic Music. *Computer Music Modeling and Retrieval: Genesis of Meaning in Sound and Music*. Kronland-Martinet, R. et al, eds. Berlin: Springer Verlag.
10. Benjamin, W. 1936/1969. The Work of Art in the Age of Mechanical Reproduction. *Illuminations: Essays and Reflections*. Arendt, H., ed. Schocken.
11. Blackwell, T. and Young, M. 2005. Live Algorithms. *Artificial Intelligence and Simulation of Behaviour Quarterly* 122: 7-9.
12. Morris, J. 2008. Embracing a Mediat[is]ed Modernity: An Approach to Exploring Humanity in Posthuman Music. *Performance Paradigm*, v. 4.
13. Wolfram, S. 2002. *A New Kind of Science*. Wolfram Media. [www.wolframscience.com/nksonline](http://www.wolframscience.com/nksonline) [accessed 10 November, 2013]. 716–717.
14. Flake, G. 1998. *The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems, and Adaptation*. MIT Press. 11.
15. McCormack, J., et al. 2012. Ten Questions Concerning Generative Computer

- Art. *Leonardo* (to appear, accepted July 2012). MIT Press. Extended version at <http://jonmccormack.info/~jonmc/sa/wp-content/uploads/2012/10/TenQuestionsV3.pdf> [accessed 10 November, 2013].
16. Morris, J. Humanness, Elevated Through its Disappearance. 2011. *Meta-Plasticity in Virtual Worlds: Aesthetics and Semantics Concepts*. Mura, G. ed. Hershey, Pennsylvania: IGI Global. 116.
17. Gomoll, L. Posthuman Performance. 2011. *Total Art*. 1:1.