ARTISTRY THROUGH CODE:

THE APPLICATION & IMPLICATION OF A.I. AND GENERATIVE ART

Thesis submitted in partial fulfillment

of requirements for the degree of

Bachelor of Arts in Art History

by

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Spring, 2023

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Abstract

Artificial intelligence (AI) is ubiquitous in everyday life. Despite its benefits, it has created a negative perception of generative art as a valid artistic practice. After defining several classifications of AI-related visual art groups, this thesis argues that generative, algorithmic art deserves more recognition as valid works of art.

This research presents a discussion of artists who utilize generative processes to create their work, algorithmically and otherwise. Their methods and intentions inform the discourse on generative art and its supporting philosophical theories. Specifically, topics from the interdisciplinary field of cognitive science, such as "the extended mind hypothesis," help support the understanding that computers and software programs act as extensions of the artist. This reflects the natural evolution of generative art from the past into the present era.

In this thesis and positive consideration of generative art, a case study is provided of exemplary artists who use AI in their process to create interactive pieces that address crucial societal issues, offer meaningful immersive experiences, evoke emotion, and cause audiences and members of the art world to reconsider the idea of simulation as part of a material and cognitive evolution. Given the new perspective of generative art that emerges from the study of these artists, this research asks what AI might do for the future of artmaking as it integrates artwork with machine learning. By also analyzing creative adversarial networks (CAN) and the various degrees of artist intervention, the role of computers is reimagined as a tool for producing artwork that audiences often find more appealing than human-made artwork. This thesis concludes that the generative process changes how we define and value AI-assisted art.

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I. Introduction

Artist Sol LeWitt says of the functions of conception versus perception that "If the artist wishes to explore his idea thoroughly, then arbitrary or chance decisions would be kept to a minimum, while caprice, taste, and other whimsies would be eliminated from the making of the art."[1] This statement about the nature of artistic authorship argues that the degree of pleasantness or awkwardness in a work of art matters less than its process of creation. LeWitt's conceptual art would today be considered under the title of generative art, which is a creative process more than a genre unto itself. The debate regarding generative art — that which is generated by a computer — has its roots in the second half of the 20th century when the rise of artificial intelligence (AI) caused an uproar in the art world. The corporate and industrious social atmosphere of the 1960s caused some artists to embrace technology and explicitly emulate factory-like production. LeWitt's words about this era reflect that generative art may come from a programmable formula, yet it still blends processes that are under varying degrees of control by the artist, similar to an artist placing sticks in the water and observing their oscillations.[2] While a machine can produce art, the intentional planning of the piece initiates from the artist's idea. Thinking that the artist's will is what completes the artwork reflects ego, not creativity.

Ideas fuel art, and a computer is a machine that helps undertake the process. When viewed from this perspective, generative art assumes a long history of tool and machine use that could be said to date back thousands of years. While this thesis does not ask whether there is a direct link, the research on generative artwork will focus on how art is made rather than what art

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[1] Sol LeWitt, "Paragraphs on Conceptual Art," *Artforum* 5, no. 10 (1967): 79.
[2] Margaret A. Boden and Ernest A. Edmonds, "What is Generative Art?," *Digital Creativity* 20, no. 1-2 (2009): 30, https://doi.org/10.1080/14626260902867915.

is made and the degree of autonomy exercised by the artist who expresses it. While AI-created art is different in its process from traditional art, it is also no different than other kinds of generative art. There is still a spectrum of "strong" and "weak" artwork that represents the amount of work done by the human artist who designed the system.[3]

The definition of art has changed over the centuries. Fine arts were not included under the heading until the 17th century, and it took another century or so to include painters as artists instead of referring to them as craftsmen or workers. Today, the tendency is to view and reinterpret older works of art through the lens of contemporary contexts and modern aesthetic standards.[4] The terminology has evolved in parallel with the changing dominant styles, bringing us from romanticism and classicism to today's yet collectively unnamed inclusion of computer, generative, algorithmic, and evolutionary art. LeWitt's pioneering work in the 1960s featured collaborative wall drawings made by others who followed the artist's instructions (figure 1).[5] This valued the creative process over the solitary effort to make something unique, and this process is what will be referred to as generative art, including AI-created artwork.

In distinguishing between these newer art forms and carving out a meaningful space for generative art, some emphasize clarity of language and proper framing of generative art's history. They include generative music and architectural design in their discussion of systems that create complex artworks using simpler components and allow for the discovery of new

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[3] Jon McCormack, Oliver Brown, Alan Dorin, Jonathan McCabe, Gordon Monro, and Mitchell Whitelaw, "Ten Questions Concerning Generative Computer Art," *Leonardo* 47, 2 (2014): 2.
[4] J. P. Hodin, "Contemporary Art: Its Definition and Classification," *College Art Journal* 10, no. 4 (1951): 342.
[5] "Sol LeWitt," *GSA*, accessed February 23, 2023, https://www.gsa.gov/cdnstatic/45_Sol_LeWitt.pdf.

creative methods, stressing the how over the why.[6] The controversy comes from asking whether and to what extent to program or procedure can be ascribed some creative autonomy. If the machine alone can create the artwork and make the necessary decisions as to what pieces to include and leave on the studio floor, then the artist/programmer has no autonomy and, therefore, no place in the creative economy. If, however, generative art includes a distributed process that cuts across the artist/programmer and their tool/computer, then the generative system itself contains the creative autonomy that values both contributors.

An understanding of embodiment is also necessary to address this question and distinguish between the artist's decision and intent to create and the process that ensues. Embodiment is the act of making an idea visible, bringing it to life through tangible expression. When an artist distributes authorship across their skillset and tools, it allows for a deeper introspection into the meaning of agency and creativity.[7] A generative artist whose process includes machines outside of their body that help manifest an idea into physical presentation aligns with the interdisciplinary notion from cognitive science of extended cognition. In this field, theorists use the metaphor of a ship to illustrate distributed agency. A ship is not solely steered by the captain but rather accomplished all the way down the chain of command.[8] Whoever creates the first command can claim agency just as the AI algorithm that works within the set parameters to create unimaginable outcomes can also claim agency in the process. Both agents can embody the artist's intent, which is what the audience resonates with and values.

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[6] Philip Galanter, "What is Generative Art?: Complexity Theory as a Context for Art Theory," *in GA2003: 6th Generative Art Conference*, (Milan, Italy, 2003), 3-4, accessed February 21, 2023, https://philipgalanter.com/downloads/ga2003_what_is_genart.pdf.
[7] Boden and Edmonds, "What is Generative Art?," 39-41.
[8] Andy Clark, *Supersizing the Mind* (Oxford, UK: Oxford University Press, 2008), 13.

Jon McCormack's and Ian Cheng's work is used to showcase this trait through their evolutionary and artificial art, herein both considered as subsections of generative art. The discussion of generative art applies to the past, present, and future and is generally intertwined with the larger philosophical discourse on what art is. Through an interdisciplinary study of the communication and interaction between artists as human agents who utilize computers as machine tools, this work seeks to highlight generative artwork that extends, embeds, and embodies generative art, affirming its value in the art world.

McCormack uses algorithmically defined digital imagery and sounds to simulate nature's evolutionary processes in a complex model that results in an immersive, interactive experience of art.[9] In line with contemporary artists who use different media, their work speaks to social and political issues. Similarly, Cheng uses simulation to explore the emotional experience of expectation versus perception.[10] The artistic exploration of positive and negative emotions taken with programmed rules for creation is central support for this work which aims to substantiate generative art as an integration of artificial and creative intelligence.

II. Randomness, Computer Imagery, and a Philosophy of Realness

The literature on generative art points to the once-novel idea of electronically created art as cyberspace and technology came into the discussion and began to frame the present norm of the day. Taking inspiration from cognitive science and theories of emergence, evolution,

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[9] "Morphogenesis Series," Jon McCormack, accessed February 21, 2023, https://jonmccormack.info/project/morphogenesis-series; *Jon McCormack*, "Eden," ADA, 2000, https://digitalartarchive.at/database/general/work/eden.html#:~:text=Eden%20is%20an%20interactive%2C%20self,possibly%20mating%20with%20each%20other.

[10] "BOB: Bag of Beliefs," *Ian Cheng*, accessed February 21, 2023, http://iancheng.com/BOB.

embodiment, and the self-organization of actual and artificial life, the 1960s saw the beginning of taxonomically classifying the yet unlabeled practice of what was synonymously referred to as generative, electronic, computer, process-based, digital, and AI art. A sufficient list of the important aspects of artwork is needed to categorize and evaluate artwork. Philosophers and AI experts Boden and Edmonds believe that a work of art involves appreciating it in terms of accepted conventions, for no object is inherently excluded from candidacy.[11] The art world is also available to anyone who attempts to confer the status of "work of art" upon an object. As such, the art world is a social entity; an institution that serves as an extended tool for cognition and thinking about a work of art.[12] Cognitive scientists Gallagher and Crisafi see cognition as a distributed set of processes that loop in and out of brains and social institutions that are designed with cognition in mind.[13] This applies to the art world.

Museum goers and art critics alike enact a work of art's candidacy along socially delineated aesthetical values. Critics compare contemporary works to past masterpieces to discern similar qualities or critique lacking components. Audiences resonate with an artwork's aesthetic value or not, positioning the work in question along their existing spectrum of experiences with other works of art. In both cases, whoever designates a work of art as such is acting on behalf of the art world as a social institution, and agreeing upon its bestowed status is a social act.[14] Bachrach philosophizes that the artworld, as an institution, is open to anyone, and anyone who engages in deliberating its status is acting on behalf of that social institution. Since

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[11] Boden and Edmonds, "What is Generative Art?," 22.
[12] Jay E. Bachrach, "Dickie's Institutional Definition of Art: Further Criticism," *Journal of Aesthetic Education* 11, no. 3 (1977): 27, https://doi.org/10.2307/3332166.
[13] Shaun Gallagher and Anthony Crisafi, "Mental Institutions," *Topoi* 28, no. 1, 2009: 47.
[14] Bachrach, "Dickie's Institutional Definition of Art," 29-32.

no object is excluded from candidacy, anything can be disputed as a work of art. The act of disputing takes place in a social context that builds naturally upon prior beliefs and definitions.

In other words, a "work of art" is not created in a vacuum or produced automatically by either an established artist or a machine. An artwork that is called "art" is the result of a distributive social practice involving the artist, the art world, and the audience. Generative art pushes the boundary a bit further to include AI algorithms and the computers that program them, but this too is a technological evolution of artistic tools and not a whole new concept. Generative art is "art" in that it is socially debated and defined, even though the randomness and chaos that accompany AI can cause critics to question its place in the art world. In response, art theorists reframed seemingly chaotic complex systems as unpredictable rather than random.[15] AI allows for algorithms to potentially produce all possible states of a programmed function, which introduces uncertainty as the artist does not know the specific outcome. AI systems mimic real life in their chaos and sense of cause and effect, so much so that they can feel more lifelike than reality. The outcomes are vast, but they are not random. The role of randomness in generative art is not new. Improv artist Paul Bley is a good example of a creator who has gathered inspiration from the random outcome of coin tosses or rolling dice, but such pure randomness is not the case with computers and programmed deterministic functions.[16] From this perspective, randomness serves only to humanize the imperfections of a process by intentionally allowing space for incompletion when creating a work of art.

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[15] Galanter, "What is Generative Art?," 6.
[16] Jon McCormack, Oliver Brown, Alan Dorin, Jonathan McCabe, Gordon Monro, and Mitchell Whitelaw, "Ten Questions Concerning Generative Computer Art," *Leonardo* 47, no. 2 (2014): 9.

Early digital art was generative in its process and instruction-based approach. Just as LeWitt's conceptual art was generative in its execution in the 1960s when his hallmark wall drawing installation was completed by telling assistants what to do, pioneer digital artists in the same decade introduced computer-made artwork that was created from a machine-like process that happened inside of the computer rather than physically constructed outside by an artist.[17] In simple terms, computers do what artists do, but they do it faster and with better precision, allowing many iterations in minutes that would take a human artist years to complete. Digital art used other objects than the artist to create the work of art, but it accomplished the same result as the artwork that came before it in the ongoing spiral of art and life in imitation of one another. Critics still pressed the issue of whether or not this kind of art was real even though real, biological life was also produced in the operational process of evolution. This step-by-step process responded to fitness, selection, and survival. The bothersome aspect, then, had to do with what philosopher Jean Baudrillard refers to as hyperreal works -- those that are made in hyperspace. These confound the idea of imitation and simulation, operationally substituting what was real with a digitized rendering of what was real.[18] Instead of real still-life art made up of tangible objects set upon a physical tabletop, there was digitized imagery of real-world objects cut and pasted into a hyperreal space. This format is imitation in the sense that the digital version is based on the actual version, but it is also simulation in the sense that Baudrillard meant where reality is usurped by a model.

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[17] GSA, "Sol LeWitt."
[18] Jean Baudrillard, *The Body in Theory: Histories of Cultural Materialism*, trans. Sheila Glaser (Ann Arbor, MI, 1994), 2.

To define generative art as real, there is an important distinction to make between what is simulated and what is not real or false. For the purpose of this thesis, "false" means that the artwork does not produce any kind of emotional resonance in the viewer, yet simulated artwork does in fact produce this effect.[19] Simulation-based artistic processes seem acceptable to the art world if they create the same set of responses in the audience as "real" artwork since "real" is a feature of artwork that emerges in the interaction between the viewer and the art. Interactivity becomes a possible source of criteria to judge the aesthetic value of a work of art, and rather than the typical separation of a work of art as either computer-generated and technological or aesthetically appealing, generative art becomes embedded in the same cultural and historic conventions of both art and science.[20] Artists who represent their experience of the world using advanced technology and computer modeling can create an imagined reality that may or may not unfold for viewers, just as human-made artworks can be relatable or not with a viewer.

Using the fable of a map of an empire that was so detailed it covered the land exactly to explain simulation, Baudrillard philosophizes that the hyperreal territory of today's digital focus does not require a real object to model, which illustrates their idea of simulacra.[21] Critics question whether generative art is a representation of real art or a mere simulation of the creative process. In defense of its artistic status, Baudrillard points to the utopian ideal of equivalence in the symbol and the true object that would accuse a simulation of being false. He claims that it is no longer a question of the work's ideology, as the more traditional ethic will "obscure the real process of work and the objective process of exploitation," but the question should be about the

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[19] Baudrillard, *The Body in Theory*, 3.
[20] Beverly Jones, "Computer Imagery: Imitation and Representation of Realities," *Leonardo*, Supplemental Issue 2 (1989): 31.
[21] Jean Baudrillard, *The Body in Theory,* 1.

scenario of the work.[22] Simulation in the generative sense of process encases the concept of representation as a simulacrum that lacks an original object to simulate. Consider the ancient drawings on the caves in Lascaux. Visitors are allowed to peek at the original but can only physically visit the replica site not far from the caves to preserve the art. In the socially extended and accepted mingling of real and replica, there is no difference regarding the act of experiencing this work of art. In the same way that no one would argue that the ancient artwork qualifies as such, the subjective experience of generative artwork is similar to that of a work of art created under a different process.

When generative art is taken as a process, a picture of reality emerges that captures the artist's intended imagery and emotional effect created in less time and with more accuracy than the artist's hand could accomplish alone and unaided by technology. The question of technology's place in the art world becomes a broader critique of capitalism and the embedded social demand to mass-produce things where it seems unfair to be able to produce a generative artwork so quickly, threatening to destabilize the art world. Such is not the aim of generative art, though, which offers the masses a transparent method of creativity that is powered by AI and programmed algorithms. From this viewpoint, the idea that the medium is the message implies for generative art not only "the end of the message but also the end of the medium" since there is no physical medium and no universal intended message.[23]

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[22] Baudrillard, *The Body in Theory*, 6.
[23] Jean Baudrillard, "Simulacra and Simulation," *Wordpress*, December 2014, https://0ducks.files.wordpress.com/2014/12/simulacra-and-simulation-by-jean-baudrillard.pdf

III. Authorship and Authenticity in Complex Systems and Algorithms

Having established generative art more definitively as a process that spans the artist, tool, and the social context that the work of art enters, the words of LeWitt ring true, "The idea becomes a machine that makes the art," and "the idea itself, even if not made visual, is as much a work of art as any finished product."[24] Critics bothered by the inclusion of this art form under the umbrella term of art and hesitant to confer such a status are perhaps concerned with the complexity of the algorithmic systems and computer programming that underly generative art.

Any complex system is made up of many smaller parts that integrate locally and self-organize without the need for a human agent to continuously control its unfolding.[25] In this sense, complex does not mean confusing, and these systems have existed in art since primitive times. Consider the geometric patterns of Islamic textiles or repeating border designs in ancient art.[26] The concept of generative art is old. The controversy comes from the seeming esoteric knowledge required to understand and properly utilize complex systems in computer programming. Here, too, an ancient idea is found where people use graphics to understand complicated systems. Computer-assisted imagery happens quickly and with little input, and art enthusiasts have tended to stray from high-tech images constructed this way. Using this past trend to keep looking away from computer imagery, though, risks missing the development of new meaning in advanced technology.[27] It is no longer safe to assume that the efficiency of new technology makes art superficial.

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[24] LeWitt, "Paragraphs on Conceptual Art," 82.
[25] Galanter, "What is Generative Art?," 5.
[26] Galanter, 12.
[27] James Elkins. "Art History and the Criticism of Computer-Generated Images," *Leonardo* 27, no. 4 (1994): 336.

The observed chaos, randomness, and algorithmic complexity can be understood as part of a new system that produces a new set of rules for artists to use. In the same way that algorithms swiftly compute a function one step at a time, the process of making art is also iterative.[28] An artist begins, observes, corrects, and continues to work, mark by mark, in a stepwise process. The rules programmed into the algorithm act as constraints, much like an artist working at the moment would employ decision-making at each new mark. Critics argue that humans are more attuned to the complexity of form than a computer, which implies a machine could not match the creative process. Often, computer algorithms are trained on input images of existing artwork that inform its progression moving forward with its computations.[29] Similar to an artist's sense of control with each mark that feels intentional, the computational network can learn to tend toward certain preferred solutions with each iteration.

An algorithm is a process. It is a procedure programmed by a human, trained on vast datasets, and left to compute within its constraints. The bulk of the work done by the computer is where questions of authorship and authenticity enter the critique of generative art. Because it is invisible to the outsider, internally manipulated, and unapparent in the final work of art, critics question where the art comes from – the artist or the machine.[30] If it indeed comes from the human agent who initiates the procedure, then the question is whether technology can exist outside of the programmer's biases and prejudice. Not only can any novice with basic programming knowledge now sculpt generative art, but AI-powered art can perpetuate harmful

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[28] Boden and Edmonds, "What is Generative Art?," 26.
[29] "Is Artificial Intelligence Set to Become Art's Next Medium?," *Christie's*, accessed Feb. 21, 2023, https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx.
[30] Holle Humphries, "A Philosophical Inquiry into the Nature of Computer Art," *The Journal of Aesthetic Education* 37, no. 1 (2003): 33.

internalized stereotypes that people possess.[31] Careful analysis is needed here as the products of generative art can shape how people see the world. Even once authorship and authenticity are properly sorted by the art world, they will still be subject to human bias that could create an unequal experience among audiences and require monitoring to avoid propagating the damage of Western preconceptions.[32]

An examination of autonomy in generative art begins with a suitable definition and understanding of different types of autonomy in the world. Technologically, there is physical autonomy, as observed in biological systems, and then there is mental autonomy which is characterized by free will. When discussing agency in generative systems, self-organization is the underlying aspect that critics point to. They ask if the system can operate independently and if a computer constitutes a "self" to self-generate results.[33] If a computer could learn beyond its programming and adapt and produce in ways that the programmer did not foresee or design, then the artist could concede authorship to the machine. This phenomenon is emergence, and if unattended to the discussion may cycle into further questioning about the authorship since it is the artist who creates a self-organizing process.

Artists like McCormack argue that the existing language does not accurately capture the behavior of what some call generative art emergence.[34] The concept is appealing and requires

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[31] Elliot Wong, "AI Art Promises Innovation, But Does it Reflect Human Bias Too?," *SuperRare Magazine*, October 18, 2022, https://superrare.com/magazine/2022/10/18/ai-art-promises-innovation-does-it-reflect-human-bias-instead/.
[32] Wong, "AI Art Promises Innovation."
[33] Jon McCormack, "Working with Generative Systems: An Artistic Perspective," in EVA '17: *Proceedings of the Conference on Electronic Visualisation and the Arts*, (London, United Kingdom, 2017), 217, https://doi.org/10.14236/ewic/EVA2017.47.
[34] Gordon Monro, "Emergence and Generative Art," *Leonardo* 42, no. 5 (2009): 476, http://www.jstor.org/stable/40540082.

further categorization that considers the complex artist-machine system on various levels. Gordon Monro, another generative artist, outlines simple-to-complex emergence, many-agent emergence, difficulty-of-prediction emergence, surprising emergence, and "Frankensteinean" emergence.[35] In one sense, simple rules lead to complex actions such as in the game of chess. In another sense, the system can produce unanticipated results even though the creator has full knowledge of its work. Still, another perspective to consider is when a system outdoes the human creator and takes on human attributes and emotions. Consider an algorithmically programmed musical composition that has learned to trend toward the emotive properties it trained on. Generative art emergence would have to go beyond the system's rules and perform "on its own" to be truly autonomous, and this concept requires further research before a conclusion can be drawn.

Until then, critics will continue to survey the boundary that separates the artist from the tool just as they continuously question where to draw the line between an everyday object and a work of art. Recall the metaphor of steering a ship to understand extended cognition where the steering happens down a chain of command. Anyone or anything that contributes to the steering is part of the process. Cognition is human-centered in that it happens inside the brain, but it extends beyond the internal cognitive core and across brains and bodies out into the environment. Functionally, concerning accomplishing a task, the external processes can do things that the internal ones cannot.[36] By letting the environment take care of some of the cognitive tasks, external supports are relied upon. While this assumes a stable external structure, it allows for cognition to extend infinitely. This notion from cognitive science informs the

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[35] Monro, "Emergence and Generative Art," 476-477.
[36] Mark Rowlands, "The Extended Mind," *Zygon* 44, no. 3 (2009): 636.

discourse on conferring the status of art to works created by a generative art process. Skin and bones, like hardware and software, become arbitrary boundaries that exist conceptually to maintain coherence between separate systems to understand them separately. However, when it is shown that the natural kind of processes that happen inside of a computer also happen inside of the head, then both kinds of processes hold meaning and value.[37] Functioning as an extension of the artist's brain, the computer is a creative assistant to realize the artist's vision.[38] Further, the computer expands the artist's reach into their own consciousness for what is possible to create and simulate in virtual worlds and realities.

The discussion of authenticity in generative art is worth distinguishing from that of autonomy and authorship. A study of creative adversarial networks (CAN) attempted to produce art that confused the human audience as to its style label (Renaissance, Baroque, Impressionism, Expressionism, etc.), which the network was trained on to discriminate between.[39] The purpose was to create a system of generative art that people confused with modern artworks, and they found that subjects could not easily determine whether the creator was a human or a computer.[40] They also often preferred generative art over traditional artworks. Aesthetic preference generally increases with familiarity as more viewings positively relate to strong emotional affect or

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[37] Frederick R. Adams and Kenneth Aizawa, "The Bounds of Cognition," *Philosophical Psychology* 14, no. 1 (2001): 44.
[38] Holle Humphries, "A Philosophical Inquiry into the Nature of Computer Art," *The Journal of Aesthetic Education* 37, no. 1 (2003): 44.
[39] Ahmed Elgammal et al., "CAN: Creative Adversarial Networks, Generating 'Art' by Learning About Styles and Deviating from Style Norms," in *8th International Conference on Computational Creativity (ICCC)*, (Atlanta, GA, 2017), 4-5, accessed Feb. 21, 2023, http://arxiv.org/abs/1706.07068.
[40] Elgammal et al., "CAN," 16.

preference.[41] Another feature of fine art appreciation is novelty, which also relates to generative art and helps explain the viewer's preference for this kind of art. Aesthetically, it is both familiar and new. It is authentic. Unlike the average art enthusiast, though, experts might suppress their initial effect to intentionally reflect and evaluate the work of art's authenticity.[42]

The possibly suppressed transmission of feeling through generative art practices creates a new conflict for critics. Part of the struggle here is the general tendency to discredit emotional reasoning when determining an artwork's aesthetical value.[43] It is more acceptable to judge art from within its cultural context. Philosopher Arthur Danto believes that an object is "art" based upon a society's inherited body of knowledge regarding the history of art as discussed in the art world.[44] Computer-generated art seems to defy this perspective since it is both similar to and different from what modern culture has deemed as "art." For art to contain the assumed aesthetic essence, it must be from the social fabric and interpretable by the art world. It must be about things that exist in the physical world as well as the product of an artist's actions.[45] To be contemplatively appealing, though, an artwork only needs to be experienced from the attitude of having an aesthetic interest in its viewing. The art world can still be said to have produced such creations by being a social institution designed with human cognition in mind, which might

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[41] Paul Hekkert, Dirk Snelders, and Piet C. W. van Wieringen, "Most Advanced, Yet Acceptable: Typicality and Novelty as Joint Predictors of Aesthetic Preference in Industrial Design," *British Journal of Psychology* 94, (2003): 112.
[42] Hekkert, Snelders, and van Wieringen, "Most Advanced, Yet Acceptable," 116.
[43] Gary R. Jahn, "The Aesthetic Theory of Leo Tolstoy's What is Art?," *The Journal of Aesthetics and Art Criticism* 34, no. 1 (1975): 60.
[44] Holle Humphries, "A Philosophical Inquiry into the Nature of Computer Art," *The Journal of Aesthetic Education* 37, no. 1 (2003): 14.
[45] Richard Lind, "The Aesthetic Essence of Art," *The Journal of Aesthetics and Art Criticism* 50, no. 2 (1992): 118.

include the emotive effects that ensue. The art world itself is embedded in the social self that is influenced by its surroundings.

Before turning toward case analyses supporting generative art's inclusion in conventional definitions of art, it is helpful to consider the art form's social nature to highlight its inherently valuable trait of uniqueness. The general fear that AI will replace human artistry is invalidated in light of how algorithms are trained. What makes generative art interesting and aesthetically valuable is that it blends the familiar and the unique, yet it still requires original traditional input to form a comparison. Part of its intrigue comes from experiencing something unexpected. In support of the contemporary social commentary that addresses issues of diversity and inclusion, generative art inspires new avenues of creation that are open to anyone who does not identify as an artist but who perhaps has computer programming skills. There could be a wave of aspiring artists who use computers to create and express, thereby adding to the spectrum of "strong" and "weak" art and forming a new basis for future comparison.

Related to the discussion of the social nature of generative art is that it yields unique problems. Machine learning can also take place across datasets comprised of AI-generated art, which poses a specific and immediate concern to concept artists given the rapid growth of online AI art generators.[46] Since the technology has evolved faster than the relevant legislation that protects copyright infringement and intellectual property rights, artists face great unknowns regarding income potential and proper compensation for using AI-generated images that are in their particular style. An AI art-generating application can produce hundreds of thousands of

[46] The Journal, "When AI Comes for Your Art," *Spotify*, podcast audio, March 7, 2023, https://open.spotify.com/show/0KxdEdeY2Wb3zr28dMiQva?si=J8ERNGEWSp6yRf1TeGPcRw&app_destination=coopy-link.

images in the style of an artist that the artist did not actually create, and this is a difficult area for the artist while the courts decide how to proceed with these unprecedented issues. The valuable uniqueness inherent to generative art is easily mass-produced under current unrestricted online media culture practices. Some artists have taken AI to court to fight for the protection of their creative work, but there is presently no final decision.[47]

IV. Case Studies of Generative Artists: Jon McCormack and Ian Cheng

To satisfy the working operational definition of a generative artist as discussed herein, a sample of McCormack's and Cheng's work will be analyzed along certain criteria that exemplify the AI/generative process of creation while also aligning with modern trends, such as addressing existing societal issues. After introducing the artist and describing their key works of art and the associated process of creation, the pieces will be contextualized along distinct lines. First, the artwork will be shown as an extension of the artist's physical and mental creative tools, supporting the idea that a computer or other external device is part of the artist's extended network of available resources. Second, their work will be situated in the social context that allowed for both its conceptualization as well as its acceptance or rejection in the contemporary art world. This method of evaluation will highlight the generative practices that produced the artwork and the social institutions and conventions that support these and other generative artists in their mission to advance human creativity and thought using computers in their art.

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[47] The Journal, "When AI Comes for Your Art."

Jon McCormack's Codeform, Eden, and Fifty Sisters

McCormack expresses this fear by saying, "We're naturally scared of anything where we take away something from people, particularly something as precious as being creative and art," which is "that thing that differentiates us from every other species on the planet."[48] As a researcher, professor, and artist, McCormack is interested in generative art, evolutionary systems, computer creativity, virtual reality, machine learning, and interactive design. His artwork is widely exhibited in some of the world's most distinguished galleries, from the Museum of Modern Art in New York City to the Tate Gallery in the United Kingdom and the Australian Centre for the Moving Image in his native country.[49] His creative work with new media art and computational design is highly merited, and his research offers the academic community new ways of viewing computational creativity. McCormack's artwork surveyed below exemplifies the use of an extended network of tools to expand the limits of human creativity while speaking to modern social trends and issues through generative art practices.

As an artist, McCormack was first inspired by science and technology, experimenting with chemistry and computers then photography and animation.[50] Their work is a display of evolutionary biology, mathematics, computer science, and human intelligence integrated with the co-creative use of software and AI. Since the 1960s, McCormack has been advancing the use of a programmable computer, an extended tool for creativity and artists since the digital age began. McCormack gathered inspiration from computer scientist Chris Langton and the concept of biological life as defined more by mechanisms than materials where non-biological sources of

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[48] "Jon McCormack," *AIArtists*, accessed March 9, 2023, https://aiartists.org/jon-mccormack.
[49] AIArtists, "Jon McCormack."
[50] Alice Fleerackers, "Creators – Jon McCormack," *Artthescience*, August 22, 2019, https://artthescience.com/magazine/2019/08/22/creators-jon-mccormack/.

media can support, and the writing of evolutionary biologist Richard Dawkins also motivated their desire to create a new system of evolutionary art and interaction to serve creative purposes.[51]

These influences are evident in McCormack's artwork, teaching, philosophy, and research. Presently, their written work aims to describe and critique the process of generative art and classify it in a meaningful way.

Within the generative art community of researchers, McCormack's categorical approach focuses on the media used in its production, the problems it addresses, and the period and stylistic influence.[52] This kind of deconstruction makes the form more transparent and invites constructive critique of a field that is still widely variable. Four important aspects of the framework that emerges are the entities, processes, environmental interactions, and sensory outcomes involved with the generative process.[53] Entities are the conceptual parts that are expressed, processes fuel the change within the generative system that may happen algorithmically or visually, and the interactions happen in the experience of generative artwork, leading to outcomes that can alter a person's perception. This framework allows for the analysis of generative pieces as enacted by the entire system of the creator, media, and viewer. This approach is neutral concerning the utilized technology and does not necessarily require advanced technology for its analysis.[54]

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[51] Fleerackers, "Creators."
[52] Alan Dorin, Jonathan McCabe, Jon McCormack, Gordon Monro, and Mitchell Whitelaw, "A Framework for Understanding Generative Art," *Digital Creativity* 23, no. 3-4 (2012): 2.
[53] Dorin et al., "A Framework for Understanding Generative Art," 8.
[54] Dorin et al., 21.

McCormack is vocal about the term generative referring to the processes that lead to the creation of something new. More than any other media's approach to creation, generative systems can create complexity, novelty, and surprise.[55] The computer, as a tool, is ideal for generative artists because of the associated software that can be programmed with rules for creation, like the "rules" of biological entities as "programmed" in their genetics. This is evident in McCormack's artwork in the form of seemingly biological entities that evolve programmatically. This simple use of the software is criticized for being repeatable, but there is nothing generic about the generative process.[56] Similar algorithms can produce similar outcomes with various meanings just like how a group of writers who use the same word-processing program would produce the same outcome of a piece of writing with diverse themes and expressions. McCormack addresses this and other concerns in their research and teaching.

Not every programmed outcome becomes a work of art. Many times, the computer gets it wrong, but this is not the point. The computer can also produce something new that is meaningful and valuable – an idea, a poem, a solution – without having to be creative, which is a quality that, presently, is still reserved for the programmer.[57] However, the computer can potentially exceed the programmer's expectations and knowledge. This kind of emergence seems creative, but only when evaluated in a vacuum. Creative human culture is collective, collaborative, and cumulative as compared to individual creativity which is made stronger by the

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[55] Jon McCormack, "Working with Generative Systems: An Artistic Perspective," in EVA '17: *Proceedings of the Conference on Electronic Visualisation and the Arts*, (London, United Kingdom, 2017), 214, https://doi.org/10.14236/ewic/EVA2017.47.
[56] McCormack, "Working with Generative Systems," 216.
[57] Jon McCormack, Oliver Brown, Alan Dorin, Jonathan McCabe, Gordon Monro, and Mitchell Whitelaw, "Ten Questions Concerning Generative Computer Art," *Leonardo* 47, 2 (2014): 3.

accumulation of knowledge and application.[58] As tools for creative thinking, computers allow programmers and artists alike to simulate worlds that hold great expression and add to the aesthetic value of an artwork. When viewed through the lens of fine art, generative art's programmable approach and creative methodology can reach far beyond the traditional boundaries of what can be conceived.

Codeform (2014)

Codeform is an example of a generative art system that makes use of a computer to complement human creativity. It is an evolutionary and interactive virtual world. Under programmed instruction, a computer system converts a viewer's ticket number into a binary string genome, like a chromosome (figures 1 and 2).[59] The system constructs a graph that accounts for the combination of four different possible outcomes, depending on the rules for being a parent, child, or sibling at each node (figure 3). The graph then provides a phenotype for each viewer that is visible on the 3D graphic (figure 4). The creatures behave as humans do. They live, die, use resources, and procreate. A database tracks the tickets and creatures across their lifetimes so that viewers can return to their designated entity within the artwork and see how their creature fared in the evolutionary system.[60] The generative work expresses the usefulness and diversity of phenotypes in an interesting aesthetic that occupy an immersive space. The goal of this project was to create a dynamic system that consistently resulted in useful phenotypes over the greatest possible territory, which is not easy since quantity is no guarantee of quality.

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[58] McCormack et al., "Ten Questions," 4.
[59] Jon McCormack, "Codeform: A Balancing Act between Variation and Utility in Evolutionary Art," *Leonardo* 49, no. 3 (2016): 258, http://www.jstor.org/stable/43834359.
[60] McCormack, "Codeform," 259.

Essentially, the ticket conversion process is a form of mapping the number to an observable space in an appealing way that could be performed by hand.[61] The computer quickly computes according to the rules and generates a phenotype as an artist could do following a set of decisions. In this way, it extends the artist's capability. Any random-looking, unappealing phenotype (according to the rules) would be discarded much the same way a person would choose. A human artist would make fewer mistakes but over a much longer time. McCormack uses the computer as a comparably primitive tool that is incapable of the same sorts of things a person could do, yet it is fully capable of expanding human intelligence. Its own creativity is limited to the rules and subsequent possible diversity, but there is no limit to what it stirs in the viewer's mind as they contemplate their existence in a virtual genetic system of determinism, competition, and reproduction.

Social themes abound in *Codeform.* Viewers see McCormack's interpretation of evolutionary biology play out in a speeded-up exhibition of a dynamic creative process. It stimulates existential questions of creation and provides a detached visual rendering of humanity's population growth, resource use, competition, and vulnerability. It adds to the conversation of social and ethical responsibility in a heavily populated space with shared resources. It causes viewers to wonder about the programmed limitations and possible combinations of phenotypes that might represent inter-creature breeding. Its entities undergo a process that is affected by each viewer's interaction with the system, and there is no limit to the possible interpretation of expression or sensory outcome. It is a collaborative work of art that integrates the artist, computer, and viewer in a social commentary about technology, art, and the

[61] McCormack, 260.

evolution of a species that must balance its utility and diversity with a set of rules or guidelines that determine all possible outcomes.

McCormack says that if the art is really good and moves viewers emotionally the way great art does, then the art world will begin to accept machine-made art.[62] Value emerges through the act of appreciating a work of art, and this value is necessary to declare that a work of art is an aesthetically sound candidate for that appreciation.[63] The immersive aspect may impact this formula for value since there is an added dimension of experiencing the work of art by becoming a part of its ongoing systematic evolution. This may force viewers to think in a new way as most new technology does when it enters society. New technology and media tend to follow a traditional course of enhancement, obsolescence, retrieval, and reversal.[64] These arise simultaneously rather than linearly as cause and effect of new science received by the existing culture. The conscious experience of a virtual world model may challenge viewers to bestow a new kind of value upon a work of art after meeting an artificial reality that blurs the boundary between worlds and what can and cannot be programmed or controlled.

Eden (2020)

The sonic ecosystem of *Eden* that viewers experience via a large digital screen preceded the digital genome of *Codeform,* but it displays a similar sort of interactive immersion. *Eden* is an artificial, self-generating ecosystem where creatures move and respond to food as they forage,

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[62] AIArtists, "Jon McCormack."
[63] Jay E. Bachrach, "Dickie's Institutional Definition of Art: Further Criticism," *Journal of Aesthetic Education* 11, no. 3 (1977): 34, https://doi.org/10.2307/3332166.
[64] Paul Boye et al., "Machine Flaws in Generative Art," in ISEA2019: 25th *International Symposium on Electronic Art*, (Gwangju, Republic of Korea, 2019), 715, accessed Feb. 21, 2023, https://www.researchgate.net/publication/344862974_Machine_Flaws_in_Generative_Art.

survive, and reproduce.[65] The landscape is adaptive, which means the creatures evolve in an evolutionary manner that makes use of fitness and selection. McCormack programmed a new system of time into the work along with traditional biological principles of survival and inheritance. Creatures produce sound and respond to the sound produced by the viewer, moving toward the sounds through a programmed system of identification and location that correlates sound with color.[66] People become part of the evolutionary process of the *Eden* creatures through their interaction within the sonic space where the virtual entities learn to generate sound and attune to the sounds of others internal and external to the digital system. This use of interaction and sound exemplifies *Eden* as a creative extension of McCormack's conscious understanding of generative processes.

Music is another art form that makes use of generative processes to create sound algorithmically via machine learning across large datasets of user preferences and listening behaviors. In both music and the visual arts, the idea of a "Frankensteinean emergence" is observed as the system tends to outdo its creator in the sense that its unpredictable outcomes allow for often surprising emotional experiences.[67] This emergence, which supports the system's autonomy, extends the emotional capacity of the generative system spanning the artist, computer, and viewer. McCormack erases the boundary between real and artificial space by effectively using motion sensors and a sound system in the installation space.[68] This version of McCormack's artificial evolution has an open-ended feel to it given that the exhibit is self-

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[65] Jon McCormack, "Eden," *ADA*, 2000, https://digitalartarchive.at/database/general/work/eden.html#:~:text=Eden%20is%20an%20interactive%2C%20self,possibly%20mating%20with%20each%20other.
[66] McCormack, "Eden."
[67] Monro, "Emergence and Generative Art," 477.
[68] McCormack, "Eden."

generating and no two experiences of it generate the same sound. The viewer's movement affects the creatures in the artwork who are programmed to continuously map sounds in the landscape, move toward them, and proceed in unexpected ways.[69]

Eden is inspired by nature. The artificial ecosystem of creatures who move, adapt, and learn their surroundings in the dynamic interaction with other real and artificial beings resonates with concepts such as urbanicity and human development. In the *Eden* world, if no humans interact with the sonic landscape, then the land dries up of substrate and resources and the creatures die of starvation.[70] This adds to the social commentary on fears that surround AI. In a way, McCormack's collaborative creation is the visual answer to the question of what could happen if computer algorithms were able to replace actual nature that has been lost to human population growth and development. In essence, *Eden* implies that life would dry up in the absence of true human interaction. McCormack seems to have programmed certain death of a species that attempts to survive without human beings, or at least they have presented the issue for debate. Generative artists engage in discussions of technological body politics when their creations threaten to collapse futurity by assuming machines will become beyond human control.[71] Without a new framework, such as presented by McCormack's research, the art world risks reducing self-generated worlds to possible futures where art has no meaning and machines assume the responsibility of evolutionary power.[72]

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[69] Marisa Olson, "Life and Death in the Artificial Ecosystem," *Rhizome*, July 28, 2006, https://classic.rhizome.org/editorial/2006/jul/28/life-and-death-in-the-artificial-ecosystem/.
[70] Olson, "Life and Death."
[71] Zoë Sofia, "Contested Zones: Futurity and Technological Art," *Leonardo* 29, no. 1 (1996): 63, https://doi.org/10.2307/1576279.
[72] Sofia, "Contested Zones," 64.

As both a pioneer and persisting force in generative art, McCormack is well-suited to illustrate the value of this art form. Some theorists believe that the present era is the Stone Age of the digital arts, and the future will focus less on the virtual and more on the aesthetic that comes from the relatively new practice of generative art.[73] People will be less focused on the question of who the artist is, the artist or the machine, and more interested in the idea of human beings as primitive robots in the foreign virtual territory who are tasked to untangle the associated ethical concerns as new visions for humanity emerge.[74] People have not developed with these digital extensions, and human intuition is not yet trained on indirect virtual experiences. The benefit of art here is in providing a simulation as a generative force that can challenge the existing system of determining a work of art's value, which some have referred to as an era of "transaesthetics" where the usual criteria fall short and force redefinition considering new practice and information.[75]

Fifty Sisters (2012)

There are several components of McCormack's *Fifty Sisters* in the Ars Electronica Museum in Linz, Austria.[76] Viewers are greeted by a two-story high installation of 20 digital images dispersed among white panels in the museum foyer. Each image is 1m x 1m and depicts a plant-like form created algorithmically. There is also an interactive portion where the guests can browse through the images on a touchscreen computer and learn more about each one, and the

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[73] Roger F. Malina, "The Stone Age of the Digital Arts," *Leonardo* 35, no. 5 (2002): 465, http://www.jstor.org/stable/1577252.
[74] Malina, "The Stone Age," 464.
[75] Charlie Mills, "Simulations: The Death of the Real in Baudrillard," *Academia.edu*, 2004, https://www.academia.edu/17431857/Simulations_The_Death_of_the_Real_in_Baudrillard.
[76] Jon McCormack, "Representation and Mimesis in Generative Art: Creating Fifty Sisters," *xCoAx2013* (2013): 71.

remaining images are presented more conventionally in rows where the images can be inspected up close or from a distance (figure 5). The fifty images are derived from oil company logos, which offer primitive graphics as a starting point for McCormack to feed into the computer code and allow for the artificial evolution of form.[77] The title refers to the "Seven Sisters" – seven oil companies that formed a cartel and controlled the oil industry from the 1940s to the 1970s.[78] A sequential understanding is offered through the *Fifty Sisters* installation so that viewers can grasp how the image changed from its original input imagery to the digital rendering on display.

The generative process could have happened by hand over many steps. Once a logo was chosen, a 2D image was created on a computer, and then the basic elements were divided and converted into 3D geometric images.[79] McCormack then programmed the software to simulate the "growth" of the image according to the rules, like how DNA guides the development of biological life. The rules give instructions and limitations regarding the relative size and relation of symbols within the digital space. The final form is dependent upon the way the rules mutate the image over time, and the result is often a surprise as the original logo is not always recognizable in its abstracted form. The 3D forms are output as geometric models that are then red into a renderer that uses "photorealistic" techniques to finalize the image.[80] This work of art is a direct representation in various ways – as a real plant, as a computer image, and as a corporate logo. Viewers also experience different representations of the piece as they can trace the image from a code through to its final graphic form.

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[77] AIArtists, "Jon McCormack."
[78] Jon McCormack, "Fifty Sisters," *ACMSIGGRAPH*, 2013, https://digitalartarchive.siggraph.org/artwork/jon-mccormack-fifty-sisters/.
[79] McCormack, "Representation and Mimesis in Generative Art," 73.
[80] McCormack, 75.

Fifty Sisters explores biology and evolution as well as humanity's oil dependence and its impact on the environment. Big cities experience a petrochemical cloud overhead, oil spills destroy crucial habitats, and the global warming crisis is worsened by humanity's relentless reliance upon oil, which is the highest-earning industry worldwide.[81] McCormack's social commentary is visualized in these fifty images of corporate consumption. This work speaks to humanity's changing relationship with the world and how people have come to experience nature more through a digital screen than out in the world itself.[82] The images can produce complex emotions in viewers who may simultaneously feel pleasure from the aesthetic presentation as well as fear surrounding the depth of meaning behind the project and the complex process that created it outside of their general understanding. To the general museum visitor, generative art involves practices that are still largely beyond human comprehension.

Fifty Sisters is engaging, interesting, interactive, surprising, socially discursive, and aesthetically pleasing, but its value as a generative artwork is greater than these properties. In changing the way generative art is evaluated, its process must be examined alongside the final product of that process. McCormack says that "one of art's roles can be to reveal what is normally hidden or taken for granted, bringing it into awareness (or even sub-consciousness)."[83] What the process represents is important. How the process performs its representation also matters. Generative art has layers of representational meaning, and each level has its own structure and function in the final product. Since the work done by computer programs and algorithmic codes happens outside of direct perception, the tendency, and perhaps easier option,

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[81] Jon McCormack, "Fifty Sisters."
[82] McCormack, "Working with Generative Systems," 216.
[83] McCormack, 77.

is to keep this part of the process hidden. However, when these aspects are brought into the conversation and general valuation, they can reveal the most distinctive and interesting qualities of the artwork produced by the artist-machine collaboration.

Ian Cheng's BOB, Life After BOB, and Emissaries

Cheng's art does not fit into a typical category. It is a digital, fluid, choreographed, and actively programmed simulation that is neither a video game nor a movie.[84] Cheng's characters are both human and animal, and they interact with each other according to coded outcomes that lead to unpredictable results beyond the artist's full control. The process is generative, cutting across the artist, computer, and audience in an act of technological storytelling. As a student of cognitive science and special effects, Cheng combines technology and narrative to embed various perspectives and contradictions in their work to create a sense of universal cause and effect.[85] This interdisciplinary background is how Cheng instills meaning into the works of art that highlight the power of language to complete a visual story that the viewer's mind is both inside and outside of at the same time. In a true simulation of reality and the human experience, Cheng's characters come to a crossroads where everything up to that point breaks down and their previous model of the world falls away leaving them to change and embrace a new perspective as their past unravels into their growth.

Influenced by animator Hayao Miyazaki, Cheng explores the complexities of human behavior in an imaginative and generative way. Animation, according to Cheng, is the Trojan

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[84] Jason Farago, "An Interview with Ian Cheng," *Even Magazine*, 2016, http://evenmagazine.com/ian-cheng/.
[85] Farago, "An Interview with Ian Cheng."

horse for young viewers to explore the scary issues in the world because it provides a virtual space that is interesting and inspiring as much as it reflects reality.[86] The software Cheng uses allows for many of the regalia of filmmaking without the film crew and long timelines for creation. As an artist who creates animations through the scope of a video engine, Cheng's process mimics software that can produce quick and vast iterations, updates, and shareable codebases for future work. Cheng sees this sort of AI-generated process as closely aligned with the process of raising children who are essentially programmed by their parents that pass on their own narratives along with their anxieties and beliefs about the world.[87] Art that fuses science, technology, and language is Cheng's vehicle for programming characters who are motivated by the desire to optimize their happiness within societal constraints.

BOB (Bag of Beliefs) (2019)

BOB is a fractalizing serpent-like artificial lifeform in a world of simulated surprises who adapts physically, mentally, and socially as they die and reincarnate across lifetimes. (See figure 6) People instinctively attribute the status of sentience to living creatures who exhibit emotional capacity in the sense that the creature can be upset by a mismatch in their expectation versus reality that they have to deal with.[88] By overcoming negative emotions and continuously updating their belief states to accurately reflect their ever-changing perception of reality, sentient agents self-organize. People deny this attribute to non-sentient objects that cannot experience upset not because they are inorganic but because they do not self-legislate in this way. These

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[86] Ido Nahari, "Empathy is an Open Circuit: An Interview with Ian Cheng," *Spike*, November 16, 2022, https://www.spikeartmagazine.com/?q=articles/empathy-open-circuit-interview-ian-cheng.
[87] Nahari, "Empathy is an Open Circuit."
[88] "BOB: Bag of Beliefs," *Ian Cheng*, accessed February 21, 2023, http://iancheng.com/BOB.

kinds of rules are programmed into *BOB* in Cheng's attempt to give an AI-generated system the experience of upset and self-growth. To give *BOB* a brain that could process such complex dealings within the environment, it first needed a body to sense and generate action, which is what Cheng did during the first year of *BOB*'s conceptual development.[89]

To express Cheng's belief in how a sentient being is connected across the brain, body, and environment, *BOB* needed a locomotive system, external and internal sensors, pain receptors, vision, motion detection, metabolic energy, and structural integrity, among other features.[90] Once equipped with predefined basic actions, *BOB* needed a way to integrate the sensory input into an internal system of beliefs and computational logic. Inspired by AI scientist Richard Evans and psychoanalyst Carl Jung, Cheng created a coherent system of rules that can make increasingly analytical interpretations of sensory input that gave *BOB* a cognitive architecture driven by beliefs that inform desires which motivate action in the world, leading to potential upset.[91] *BOB*'s desires are tended to by inner demons that compete for control of *BOB* and are affected by emotional responses to encounters in the environment. As *BOB* moves through virtual space, viewers experience the decision-making process and subsequent upset and growth in *BOB*'s ability to make accurate inferences and deal with the environment of triggers.

Although *BOB* is far away from being considered a sentient being, it gives the audience a lot to think about as they move through their own world of entanglements, upsets, and self-determined growth according to a set of beliefs states that they hold as true in the creation and production of thought and action. AI-generated consciousness provides a new lens to appreciate

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[89] Ian Cheng, "BOB."
[90] Cheng, "BOB."
[91] Cheng, "BOB."

the cognitive processing and functionality of human agents. Looking at sentience this way, as a method of dealing with upset, consciousness seems to be the vehicle for pursuing positive emotional states as it tests its beliefs out in the world.[92] Cheng's generative work supports the value of pushing viewers past their usual mode of thinking by displaying consciousness as a programmable function that extends thought and action into the environment. It is art in its aesthetic, intrigue, and creative process, socially constructed in composition using advanced technology and enacted through the artist's unique expression of the human experience.

Life After BOB (2021)

After creating an AI character with a body, personality, and life story that changes across the exhibition in an example of art with a nervous system, Cheng created *Life After BOB.* This generative work is about mental health and the human suffering that comes from constantly rewriting life's path.[93] Cheng draws inspiration from playing games like *The Sims* during childhood that teach players to contemplate the complexity of mental and social space. The "lizard brain" tries to reduce this complexity to familiar narratives that people can identify with and use to simplify reality. With *Life After BOB,* the exhibition extends beyond screens in an enhanced architecture that builds a whole world around Cheng's eight-part miniseries of anime work that provides a multisensory experience for viewers.[94] The audience embarks on a psychological journey that unfolds beyond the screen, extending into the viewer's shifting

[92] Cheng, "BOB."
[93] Ann Marie Alanes, "Can AI Unlock the Unconscious?" *RightClickSave.* October 14, 2022, https://www.rightclicksave.com/article/can-ai-unlock-the-unconscious.
[94] Alanes, "Can AI Unlock the Unconscious?"

technological and cultural contexts.[95] Coupled with an algorithmic code that continuously changes the experience, Cheng integrates storytelling narratives within an open-ended virtual space to help bring this installation to life.

The evolution of media helps define this work as generative in its process. Cheng tells the story of *Life After BOB* through anime, inviting non-Western animation into the creative process. Anime focuses more on the character's internal thoughts, feelings, and dispositions to explore complex topics in settings that help create the mood.[96] This mode of animation speaks to the viewer's inner child who must first be paying attention before any existential problems can be tended to. This is a safe sort of engagement that fosters personal exploration as much as entertainment that viewers fall in love with, which is an example of emergent or unexpected behavior that is born from weaving together AI systems and narratives in a way that nears a transcendent experience.[97] Cheng's way of keeping up with and adding to the perpetual technological change experienced presently is to invite the audience to put away their reactive "lizard brain" and equip themselves with tools to navigate the volatile terrain of reality.

The AI lens of *Life After BOB* enables adaptive artwork, makes each experience personal to the viewer, and can potentially transform the narratives that guide viewers' lives. Thinking of the mind as a co-inhabited space where the individual's inner scripts are guided both by themselves and an AI agent extends the mind beyond the self.[98] In *Life After BOB,* a "Bag of Beliefs" is installed into a character's digital reality which extends into their nervous system in

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[95] Light Art Space, "Ian Cheng: Life After BOB," accessed March 18, 2023, https://lightartspace.org/programme/life-after-bob-the-chalice-study.
[96] Alanes, "Can AI Unlock the Unconscious?"
[97] Alanes, "Can AI Unlock the Unconscious?"
[98] Light Art Space, "Ian Cheng."

an ongoing experience as they encounter difficulty in the environment. Ultimately, users encounter the issue of the human-driven self versus the AI-driven self. This pushes the boundary between technology and art and between humans and their machines, which addresses the most interesting and timely issues related to AI in modern times.[99] Imagine a narrator that is AI-driven and personally adapted and trained to the individual. While the concept of AI is still evolving, Cheng's incorporation of a narrative is valuable in its ability to help characters and viewers make sense of their world as they grow, and it illustrates the power of the unconscious mind to be primed enough to contemplate AI's impact on humanity.

Art is an effective vehicle for such self-exploration. It upgrades the subconscious reaction to complex systems and reprograms the mind to adequately encounter negative experiences. Cheng's art is alive in the sense that it promotes open-ended play and paradoxical characters with undetermined futures.[100] Cheng made *Life After BOB* to speak directly to the audience's unconscious, hypnotizing them in digital space intended to reprogram their thinking. Most viewers stay to engage with the entire episode, and some even pause the scene to interact with the characters and objects, which could become a more standard feature of films in the future. Where most filmmaking treats narrative media as fixed and laborious, it could take more of a software-making approach that favors quick, inexpensive iterations that develop continuously, expanding the audience's experience of the art.[101] This para-narrative experience aligns with new generative processes in art that give people a new understanding of the human experience.

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[99] Light Art Space, "Ian Cheng."
[100] Alanes, "Can AI Unlock the Unconscious?"
[101] Alanes, "Can AI Unlock the Unconscious?"

Emissaries (2017)

Cheng's virtual ecosystems have evolved into virtual simulations of life. The *Emissaries* trilogy that came before *BOB* was primarily about the environmental conditions that shaped and were shaped by an ongoing cognitive evolution. In three episodes, Cheng centers on a different emissary whose past unravels into an emerging reality.[102] In it, narrative agents are placed into an open-ended system with chaos and conflict that they must face and overcome. Viewers first enter an ancient community exposed to volcanic explosions where a young emissary experiences narrative consciousness that threatens the other pre-conscious beings in the community. In the distant future, when the volcanoes are controlled by AI, the second dog-like emissary is on a mission to collect the experience of stress after a human is resurrected by AI. Finally, during the heart of the now fluidized AI era, a puddle emissary that is bored with its god-like power incites mutations toward a generative death.[103] The complex content is delivered through live, interactive simulations in an immersive digital landscape. Cheng utilizes data-mining and AI technologies to predict behavior and motivate communication between the characters and objects in the space.[104]

It was important to Cheng to both introduce explicit narratives into *Emissaries* and then relinquish control of how those narratives unfold. With simulation-based programming, Cheng was able to create an autogenerative system that worked within the programmed rules, but the outcomes seemed meaningless to the viewer who was not connected to the infinite chaos of the system. Narratives were the most powerful way for Cheng to embody *Emissaries,* giving viewers

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[102] Light Art Space, "Ian Cheng."
[103] Light Art Space, "Ian Cheng."
[104] Stuart Comer and Ian Cheng, "Ian Cheng's *Emissaries,*" *MoMA,* March 6, 2019, https://www.moma.org/magazine/articles/40.

a character with behaviors to observe and predict.[105] This made it feel real and present, and it gave viewers a sense of meaning in the chaotic digital world, which are valuable qualities of Cheng's work. Like the video games that inspired Cheng, the artist wanted to create a world that viewers fell in love with. *Emissaries* incorporates this level of engagement by tying in issues of governance and design that are controlled across the dynamic system created by the artist, the computer, and the audience member who is immersed within that world end enchanted enough by it to remain even though the content could potentially destabilize their usual mentality.

Like McCormack's work, Cheng's generative art has its own system of artificial time. With *Emissaries,* time is emergent in the sense that there are no clocks but only the succession of desires that motivate the characters to keep going within the narrative.[106] Characters die and respawn in a video-game fashion, and time is virtually infinite. The simulations are also potentially infinite as they could continue, creating a different story with unique results each time. The work is not rooted in physical reality, so different rules apply. With *Emissaries,* the digital images are generated in real-time, about 30 per second, and this aspect of time has some impact on the visual output, which is neither photorealistic nor complex in style.[107] To focus the audience's attention on the inner disposition of the emissaries, simple graphics are animated so that they can gather what is happening in the expression that emerges from simplified renderings. The aesthetical value is less tied to perfection and complexity and more to the idea of existing between physical reality and the virtual reality created by algorithmic code.

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[105] Comer and Cheng, "Ian Cheng's *Emissaries.*"
[106] Comer and Cheng. "Ian Cheng's *Emissaries.*"
[107] Comer and Cheng, "Ian Cheng's *Emissaries.*"

The chaos that accompanies AI is also found in the natural world. People are embedded in the unpredictable systems of the environment, culture, and technology. The more they understand how a system functions, the more appreciation they have for the greater process as well as their role within its operation. Here, the use of narrative bridges this understanding. Cheng says narrative helps to "connect surface phenomena with the underlying complexity that generated it."[108] Cheng uses art as a vehicle for training the viewer's narrative complexity, which is present yet underutilized. Although people are cognitively wired to produce inner narratives that express their unique understanding of the connection between their inner selves and outer environment, they tend not to unless or until they are prompted to do so. This feature of art as a portal for developing new skills adds to the overall value of Cheng's generative work as an agent of evolution, technologically and physically.

From the cognitive science perspective, narratives are a part of the general cognitive evolution. Researchers in this interdisciplinary field find that narratives relate strongly to internal, often unspoken, established scripts. If a story is worth telling, then it will be about the breaching of an implicit canonical script.[109] These get overwritten when the agent flexes their cognitive muscle and creates a narrative understanding of their unique situation. Some theorists believe that narrative and self are inseparable, and even the most silent of listeners is an author of an emergent narrative.[110] Cheng is a student of cognitive science and incorporated this human attribute into their generative artwork. By encouraging viewers to break their old scripts and explicitly create new narratives, the artist weaves in themes of identity and personal evolution,

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[108] Comer and Cheng. "Ian Cheng's *Emissaries.*"
[109] Jerome Bruner, "The Narrative Construction of Reality," *Critical Inquiry,* 18 (1991): 11.
[110] Elinor Ochs and Lisa Capps, "Narrating the Self," *Annual Review of Anthropology,* 25 (1996): 20-21.

connecting the characters to the audience at a basic human level. Cheng lays bare the process of an agent being acted upon by the outer world, whether volcanoes or other cognitive agents, and invites others to broaden their awareness of self and their connection to others.

Cheng's art exists somewhere between the affordances of the tools used (computer, hardware, software) and the outcome that is produced with every viewer interaction and algorithmic iteration. It is a system choreographed by an artist who understands and values the power of a person's beliefs to drive their thoughts and actions as well as the human capacity for narrative complexity. This process compares the internal processes of a computer with those of a human agent and challenges the conventional wisdom that the two are dissimilar.[111] The thinking that computer-programmed art is too complex or not transparent enough to understand gives simulated work a negative connotation. The human brain also simplifies, processes, and codes information based on the internal scripts that are believed, and it uses this information to choose a future course of thought or action. The conscious mind can switch scripts and scenes and adopt different models to understand how the world works, and technology extends this process to and through the tools used to think and create. The art world is a place where people take the time to appreciate interesting work, whether it is a still-life painting or an immersive installation. The generative process and technology used by McCormack and Cheng offer a way to both acknowledge and capture different versions of the story of an organism's or object's evolution in virtual time and space.

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[111] Jason Farago, "An Interview with Ian Cheng," *Even Magazine*, 2016, http://evenmagazine.com/ian-cheng/

V. The Future of Generative Art

Generative art holds great potential during the modern digital era when society is saturated with information from traditional and online media sources that imply a gap between the real world and their externally constructed hyper-reality. If this is a digital revolution, then it would mean all information could be reduced to numeric code that translates the simulated world through the human senses using AI technology.[112] As machine learning integrates further into everyday life and continues to collect and categorize information, it also allows generative art to penetrate the arbitrary boundary that separates a person's inner world of thoughts and feelings from their external reality. Media sources and art museums become extensions of humanity, existing because of and in support of cognitive evolution, and the art world becomes a place to explore and expand the understanding of virtual agents and where they contradict and overlap the real world.[113] Audiences can experience works of art that are both detached from and created by an artist who exposes AI and ML as akin to natural processes.

In the broad sense of generative art being an ancient process of creation that includes the artist's tools as part of the artist, generative art is older than AI and ML. These came into the public realm with the advancement of the computer age in the second half of the 20th century. The various versions of generative art that have branched off from the central idea all offer a unique way to reinterpret current artwork rather than force AI art into a genre of its own.[114] When generative art is seen more as a process-based lens than a contending category to

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[112] Yeonsook Park, "Can Artworks by Artificial Intelligence be Artworks?," *AM Journal of Art and Media Studies* 20, (2019): 114.
[113] Park, "Can Artworks by Artificial Intelligence be Artworks?," 116.
[114] Mitchell Whitelaw, "The Abstract Organism: Towards a Prehistory for A-Life Art," *Leonardo* 34, no. 4 (2001): 345, http://www.jstor.org/stable/1577161.

traditional artwork, then it can enter the shared space of creativity. AI-assisted art simply organizes and processes information and then reproduces it through virtual media for an interactive audience experience. Computers are dynamically organized, which is also a distinctive trait of humanity, and this is no mere metaphor. Generative art often involves a thorough engagement with certain processes that create coded rules and systematic outcomes where "life emerges from the interactions of formal elements in a medium deliberately abstracted from nature."[115]

While true to their nature as abstractions of the physical world, generative art also extends its reach into the more spiritual aspects of humanity. Through art, humans have always tried to "raise something immortal and transcendent."[116] When all things can be reduced to simple numerical code, people can exist virtually anywhere given access to sufficient technology. In effect, generative artists such as McCormack and Cheng create a computational "being" that generates creative output. This sort of artistic imitation is not an imitation of life, as ancient philosophers proposed. Instead, AI art imitates art. As creators, McCormack and Cheng infuse their creativity into the AI processes they use, and the art form surpasses its own medium.[117] This trend has been in motion and is expected to continue in various forms of interactive installations and networks that integrate real and virtual worlds. This is an evolution from machine learning to machine intelligence where the AI system assumes some of the work

[115] Whitelaw, "The Abstract Organism," 345.
[116] Christiane Paul, "Renderings of Digital Art," *Leonardo* 35, 5 (2002): 471.
[117] Paul, "Renderings of Digital Art," 472.

that human agents usually do by not only modifying its process but also self-reflecting as it grows.[118]

The issue of granting creative power to generative systems is relatively new to the art world and a good reason to further explore how AI systems operate. This is especially true considering the innovative output and high "arousal potential" of some generative artwork.[119] This term refers to the various patterns of stimuli that can be programmed for and tend to pique the interest of human viewers. For example, consider a generative system that is trained on a vast data bank of art images from the last several hundred years and coded to force the AI system to seek out an outcome that is similar enough in style to count as art yet unique enough to count as original. Researchers studied what happened when this kind of system was evaluated by people in an experiment to determine whether or not they could distinguish between the generated art and the human art. Results showed that people often confused the two and sometimes gave the generated art a higher rating on its novelty, complexity, unexpectedness, astonishment, and ambiguity – collective variables that constitute aesthetic value.

AI systems can learn to adapt their output continuously along these lines, which seems to imply that the system would require a steady flow of new art to learn from. Abstract paintings, especially, are used to train AI and experiment with simplified duplication studies between real and generated images. A painting by Piet Mondrian from 1917, which is considered the artist's most accomplished work due to its thematic and specific use of vertical and horizontal space (abstracted into ideas of masculinity and femininity) was digitally rendered by computer

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[118] Yeonsook Park, "Can Artworks by Artificial Intelligence be Artworks?," *AM Journal of Art and Media Studies* 20, (2019): 119.
[119] Park, "Can Artworks by Artificial Intelligence be Artworks?," 117.

software and used in a comparison study.[120] When translated to code, this picture becomes a series of attached and detached lines as the program calculates data points according to its instructions. In essence, every picture can be broken down and reverse-engineered in this way whether it is human- or machine-made. In the study, participants were shown both images and then asked which one they preferred and which was produced by which method. The computer-generated image was preferred, and the majority of participants could not correctly categorize which image was produced by which method.[121] The judgment was made solely based on different visual patterns, though, and no weight was given to any emotive effect. The computer acted as an extended medium for the programmer to use in completing the image, yet both images were conceived by a human agent, and no merit is detracted from Mondrian's work.

The full impact of AI and ML on the creation and perception of art where a digital copy can transport the human artist's emotional intention is still underway. As the field continues to clarify terms and refine developments in communication tools and technology, generative art systems move further away from facsimile-like copy art that was initially created in response to consumer demands and for the simple reason that some machines were invented to make copies.[122] The term "generative" was meant to distance the field from these aspects of technological capability. Yes, a novice artist can produce a copy of their favorite image that looks sufficiently professional, and there may continue to be a wave of amateurs who lack the full understanding of the nature of their tools and creation. This, plus the previous discussion of

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[120] Michael A. Noll, "Human or Machine: A subjective Comparison of Piet Mondrian's 'Composition with Lines' (1917) and a Computer-Generated Picture," *The Psychological Record* 16, (1966): 1.
[121] Noll, "Human or Machine," 9.
[122] Sonia Landy Sheridan, "Generative Systems Versus Copy Art: A Clarification of Terms and Ideas," *Leonardo* 16, no. 2 (1983): 103-104, https://doi.org/10.2307/1574794.

misused AI art generators, is not a call to align with anti-machine efforts that work against creative impulses but rather an observable phase of what happens when new technology is adopted by society.[123] With the thorough study of generative artwork by creators such as McCormack and Cheng, true integration of software engineering and creativity can be realized and appreciated as the field grows.

In light of the case studies herein that illuminate the complexity of the dynamic system that cuts across the artist, their tools, and the interaction with an audience, Baudrillard's notion of the hyperreal and simulacra can be revisited. The generative works of McCormack and Cheng do not represent any sort of external truth but rather a "symbolic exchange of signifiers" that refers back to coded input in the absence of an original model to simulate.[124] The issue is not about modern society and its artistic processes becoming artificial, but that people need to recover their ability to make a distinction between real and artificial. Generative art occurs on screens, which have infiltrated all layers of modern society. For some theorists, the output is both a simulation of reality – evolutionary processes, for example – and a simulation of the creative process, making both the content and the medium artificial.[125] It has been argued, also, that even though generative artists make their artifice explicit, the work has not sufficiently supported people's ability to distinguish between generative art and human art, and it has instead confounded the audience. People need to be told that an image is AI-generated to know that it is so. This marks the onset of transaesthetics where the value of generative artwork like McCormack's and

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[123] Landy Sheridan, "Generative Systems Versus Copy Art," 106-108.
[124] Charlie Mills, "Simulations: The Death of the Real in Baudrillard," *Academia.edu,* 2004, https://www.academia.edu/17431857/Simulations_The_Death_of_the_Real_in_Baudrillard.
[125] Mills, "Simulations."

Cheng's surpasses the usual categorizations and challenges the way people think about art and perhaps themselves.

In this hyperreal era where the algorithm has superseded the artist, concepts of real and artificial may matter less than issues of process and intent. In 2018, an AI-generated artwork, *Portrait of Edmond Belamy*, sold for $432,500 at auction, which was about 40 times greater than its estimated worth.[126] Trained on 15,000 portraits from over seven centuries of artwork, a new image was created that had been cultivated according to programmed discriminatory rules. Machine art can be just as inspiring and thought-provoking as human art. In the past, the artwork was defined primarily by the aesthetic intent of the artist. To say something about the world and express emotions, there had to be a human agent steering the ship. Today, the artist is whoever has the idea to set in motion using generative techniques, and the machine is an extension of their creative process. When the whole chain of command is considered, the artist may be at the wheel, but it is the wheel and its connection to the vessel that gets the work done. The whole system is art, not just the image produced.

The sublimation of art to symbolic code brings new and greater value to the system. Technological advances in computers have solidified them as extensions of human cognitive processes with new potentials to explore. Among these, certain aspects of interpersonal communication and relationship dynamics are being emulated by interactive installations as computer scientists and artists work toward the dream of computers with human-like agency and reasoning enough to emote and engage with viewers.[127] The transparency is refreshing and

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[126] Christie's, "Is Artificial Intelligence Set to Become Art's Next Medium?"
[127] Christine Tamblyn, "Computer Art as Conceptual Art," *Art Journal* 49, no. 3 (1990): 253-254.

allows for models that demonstrate the opposite expectation as well. Some systems are designed to show how people fail to communicate by evading questions, stalling, or giving trivial responses.[128] In almost any case, creators work toward repositioning art's place in the broader social context where the final product is complete when the audience interacts with it, softening the divide between the artist, the machine, and the viewer in unprecedented ways.

Generative artists are like every artist who has gathered inspiration from past styles, physical sciences, and universal creative energy to understand the form and function of parts as they relate to the whole. They combine abstract symbols from artificial worlds into concrete images that embody natural and formal structures into artwork that evolves in its own direction.[129] AI's role in the process is as an extended tool for artistic abstraction onto a virtual medium that is capable of creating ever newer forms brought to life by the artist wielding the tool. AI art has a prehistory that is valuable in itself for destabilizing traditional notions about contemporary approaches to art. Generative art borrows from and applies computational methods that center on natural physical processes and progress toward sometimes metaphysical expression that transforms the real world into an endless space for further innovation.[130] From this perspective, generative art is like all art that is primarily concerned with creativity.

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[128] Tamblyn, "Computer Art as Conceptual Art," 255.
[129] Mitchell Whitelaw, "The Abstract Organism: Towards a Prehistory for A-Life Art," *Leonardo* 34, no. 4 (2001): 346, http://www.jstor.org/stable/1577161.
[130] Whitelaw, "The Abstract Organism," 347.

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