The Meaning of Creativity in the Age of AI

Edited by
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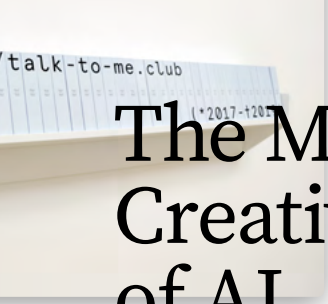

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EKA

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Contents

Introduction

The Meaning of Creativity in the Age of AI

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This publication is the result of a symposium *Decoding New Technologies in Art and Design,* which took place on the 10th September 2020 at the Estonian Academy of Arts *in situ* and also virtually as part of the *Ars Electronica Gardens*[1] online program. The main idea of the symposium and this publication is to develop an understanding and map the points of critical interest with regards to artificial intelligence (AI) and novel technological developments in general. We aim to decode the changes, new ideas, trends, and methodologies that this technology introduces into art and design. In addition, this publication presents new concepts, ideas, and dangers brought about by this developing technology, both now and in the future. In particular, we consider AI and machine learning and respond to questions such as: What can AI offer for creative communities? Is AI an aid for boosting creativity

1 https://ars.electronica.art/keplersgardens/en/decoding-new-technologies/ (accessed 28 February 2022)

and innovation or is it replacing human creativity with automation? And what kind of impact may these computationally costly processes have on our environment?

Stereotypical representation of artificial intelligence in various media and online has given rise to dramatic hopes and fears among the public about the potential impact of artificial intelligence on society and culture. For example, we may fear that: 1. AI will marginalise the role of humans in creativity and other forms of work, effectively taking people's jobs; 2. increasing use of AI for cognitive tasks will lead to a population that is less intellectually capable, and less educated; and 3. AI will become so integrated in systems and institutions throughout our lives that it will become a 'Big Brother' observing and controlling mankind.

Positive stereotypes about AI tend to be responses to the abovementioned fears, so for example: 1. AI will take on the most menial and arduous, time-consuming or repetitive tasks thereby making our lives easier, and by performing tasks that were previously the jobs of humans, we will be left with greater opportunities for leisure; 2. AI enhances our education and intelligence by assisting us with intellectual tasks, externalising and coordinating cognitive work, and greatly supplementing and enhancing the capacity of our memories thereby enabling us to have fast and convenient access to a vast array of information; 3. AI can assist us in dealing with our human relations, helping us to better communicate with one another and providing stimulating, interactive care and support, particularly for children and the elderly.

Discussions around AI often project the arrival of AI phenomena as something in the future, but it is already present throughout our everyday lives in infrastructure, tools, transport, smartphones and personal computers, and AI shares similarities with earlier technological developments too. The

essence of the use of AI in the arts is the relinquishing of creative activity to certain mechanisms, tools and techniques that serve to continue to develop the artwork independently of human action in some phase or aspect of its production—the human artist steps in at various times to take charge and continue the creative process.

Fears about AI tend to reiterate the same feelings that were felt when machines were introduced into the manufacturing industries and may provoke similar responses among the arts community. In industry generally, machines have effectively pushed aside manual workers, leading to widespread resentment and political anti-technology movements as far back as the Luddites of early 19th-century England. Dystopian predictions about a civilization dominated by machines were described in Karel Čapek's play *R.U.R.* (*Rossum's Universal Robots*) in 1920, which coined the word 'robot'. Our fears associated with the unknown potential in the technology of robots thus already have over 100 years of history. Similarly, more recent fears about our becoming immersed in a digital 'matrix' are far from utopian—the *matrix* is understood as a medium of control and influence by artificial minds or software over people's thoughts and behavior. The automated and predictive choices of today's social network platforms may bring users together and also put us in contact with vast commercial markets. It may be comforting to find your own community in the wider world outside your immediate physical locale, but it can also enclose us in echo chambers—chambers that are often themselves moderated by AI tools. The smartest AI tools can improve the accuracy of predictive systems (such as browser search engines) using machine learning and deep learning. Furthermore, the purveyors of 'machine learning' claim that by their guidance machines can learn to be like humans: "We can give them the ability to see, hear, speak, move, and write."

The authors of the articles in this publication each offer a perspective based on their own area expertise and interest regarding the debate over the future of AI, including its potential relationship to human creativity and its relationship with earlier technologies.

Pau Waelder in his article *It was never about replacing the artist: algorithmic art, AI, and post-anthropocentric creativity* emphasises the need to shift debate toward AI as a tool for creativity rather than continue questioning whether a machine can itself be an author. He draws on the concept of "postanthropocentric creativity" suggested by Jan Løhmann Stephensen to challenge the idea of creativity as something exclusively human.

Mar Canet translates in his article *The Age of intelligent reproduction and machine learning creativity* the ideas of reproduction by Walter Benjamin into today's context arguing that deep learning algorithms introduce learning reproductions and describing novel strategies of creativity that AI is here to offer.

According to **Jon Karvinen**, AI is just another tool that can help us to organize excess noise and assist us in understanding the way we as individuals think. AI is here to stay and has already become an integral part of our culture. Karvinen's article focuses on ways in which engages with comics, the nuanced art of storytelling and the creative processes behind them.

Sabine Himmelsbach reflects on her curatorial concept in the exhibition *Entangled Realities. Living with Artificial Intelligence* staged at HEK, House of Electronic Arts Basel, in 2019. She highlights the political aspect of technology, describing new forms of machine vision and the "machine realism" phenomenon that is explored in several artists' works. She returns us to the basic terms and demystifies technology,

quoting Mario Klingemann: "... AI is just one tool in a long history of tools that was bound to be used for artistic purposes". Himmelsbach concludes that "We are living in 'entangled realities' that we have created and shaped with our intelligent objects and systems."

Luba Elliot gives an overview of various AI-based projects, evaluating their artistic and technical quality and arguing that having achieved a high level of realism it is now the turn of the artists to engage more deeply with the meaning and storytelling associated with incorporating AI into their practice. She also proposes to evaluate the impact and success of AI-based tools in an art historical context.

Chris Hales follows practices in experimental film that are emerging as a result of artificial intelligence (AI) developments in machine learning and generative adversarial networks (GANs). He utilizes current techniques and methods in the creation of such films and reviews various types of experimental films. Hales identifies and describes AI-based practices in experimental film that could be considered to present newly emerging genres.

Mauri Kaipainen and Pia Tikka write that the dream of human-like intelligent machines has not turned any less utopist than it was at the time of the *Talos* of Hephestus. The technical development of digital automation will surely continue and will modify our lives and our culture. There is no reason why digital automation should not provide inspiration and tools for the arts.

Varvara Guljajeva focuses on the new forms of written language in her text *Synthetic books. The text between reality and dreams.* She describes machine-generated publications as synthetic and aims to contextualize novel practices found in them. Guljajeva takes a practical approach by analysing a number of case studies and searches for a recipe for creating

a meaningful synthetic publication. In the end, she asks whether synthetic text is profound or is just nonsense, and concludes that perhaps it can be both.

Oliver Laas claims that applications of creative AI may bring about a conceptual shift in our understanding of authorship and that applications of creative AI may bring about an epistemic crisis with respect to the evidential status of audio and visual recordings.

Raivo Kelomees is aiming to demonstrate that the practice of 'relinquishment' of creative activity has its roots in art history. He is asking if such a 'relinquishment-technique' be considered a universal mechanism for artistic inspiration. He attempts to find similarities in surrealistic techniques.

Artificial intelligence is without a doubt a popular topic in theoretical texts around digital and contemporary art. This volume emphasizes the theoretical, practical and historical aspects of this phenomenon. The various positions of the authors, as curators, art historians, artists, researchers allow diverse perspectives on changes in art as it is increasingly influenced by technology.

Acknowledgements

We would like to express our gratitude to the Estonian Academy of Arts that provided us with an opportunity to dedicate ourselves to our research project in the period of March 2019 to February 2021. This book can be seen as a culmination of our research project. The project was entitled *Meaning-making and experience in digital art and games*.

The main goal of the research project was to understand and contextualize the impact of new technologies on creative practices and research. To achieve this goal the project would study the influences of digital technology on visual and applied arts, game-culture, technology design and materials with an eye toward future trends. This would involve addressing topics like AI and machine learning from the perspective of art history and authorship, the ways in which techno-politics of control are echoed in critical artworks, and the preservation and dissemination of cultural heritage via virtual reality technologies. During the project, a number of Estonian digital artworks were analyzed, and the possibilities of digital art for multi-sensorial perception, participation and the positioning of the spectator as the object of perception of the artwork were considered.

We would also like to thank all of the contributors to this book, who generously gave their time and effort to compose these thought provoking texts.

Synthetic books. The Text Between Reality and Dreams

Varvara Guljajeva

Alan Turing had predicted the development of machines to human level intelligence already in 1935, and posed his famous question in 1950: "Can machines think?" (Turning, 1950) (Dieters, 2008). Today, we continue to discuss the same question, but AI seems a more realistic proposition than ever before. AI has become both the ultimate solution and also the biggest worry. At the beginning of the development of AI technology in the late 1950s, machines were neither smart enough nor quick enough and so the field failed to achieve its goals. By contrast, today we can speak of a third wave of AI and quantum computing that appears close to making the dream of human-level of intelligence come true (Russell. 2019). What will be the consequences of these technological achievements? This we do not yet know, but it is vital that we continue to ask uncomfortable questions and to explore the unknown potential of the technology. For this purpose I believe the best laboratory is art. Beginning with the invention of the first computer artists have always been catalysts in the development of computer technology, but they also offer a necessary critical perspective. As Yuval Noah Harari points out: "The danger is that if we invest

too much in developing AI and too little in developing human consciousness, the very sophisticated artificial intelligence of computers might only serve to empower the natural stupidity of humans." (Harari 2018:87)

AI is used for pretty much everything and everywhere today: in generating artificial images, sounds, music, animations, even films, making suggestions, driving, flying, hiring, and firing. We see AI in the military, in state organizations, IT, logistics, medicine, but also in arts. In this article, I will focus on the arts, and particularly on the text generated by AI and explore its creative potential. Since there is already quite a lot of synthetic text, I decided to narrow this to publications—synthetic books. These are books where AI algorithms were fully or partly deployed in the production process.

What is the technology behind synthetic books? In short, GPT-2 and GPT-3 are the most commonly used language models. Both are developed by the research and development company OpenAI. In their words: "GPT-2 is a large transformer-based language model with 1.5 billion parameters, trained on a dataset of 8 million web pages. GPT-2 is trained with a simple objective: predict the next word, given all of the previous words within some text." (OpenAI, 2019). GPT-3 is the latest language model. In the words of Paul Bellow, who publishes a growing series of synthetic sci-fi books based on Dungeons & Dragons: "GPT-3 API, currently the most powerful language model on the planet." (Bellow 2020) Although GPT-3 is from OpenAI, very few have access to this technology at the moment, which has been the main complaint of its critics (in addition to complaints that its only advance on the previous language model is its richer lexicon) (Marcus and Davis 2020). In simple terms, there are three key elements required to use GPT-3 in this way: a curated dataset used for algorithm training, a selection of 'seeds', and the artistic concept. Seeds are

the beginning of the sentence, or an entire sentence, and are the initial prompt for the algorithm to respond. The algorithm then predicts the following sentences. In an extended text, it is recommended to have more than one seed. If a project contains all these components it can be expected to produce a meaningful outcome.

Are we talking about automated creativity and auto-production, or augmented inspiration? There are examples for both. For instance, one can buy on Amazon AI-generated books signed as 'GPT-3 + Human' for a dollar (see Figure 1). Generally speaking, artistic quality is an issue when it comes to AI-generated content and we can imagine what the quality of these automated publications is. On the other hand, there are always more or less interesting works in art, so it may be an unfair generalization and premature to say that art made with AI has little or no value. Obviously, we need more discussion, serious exploration, and contextualization based on related artistic practices.

Figure 1. AI-generated books sold on Amazon. A screenshot from the amazon.com website.

For this reason I intend to focus on art projects that demonstrate augmented inspiration: texts whose production has involved interactive engagement between the artist (and/or the audience) and AI algorithmic text-generation. The aim is to explore these new forms of written language, to consider technology beyond its economic value and think of it in the context of creativity and art. What kind of new tools and concepts is it able to offer to us? How can novel AI technology expand our creative horizons? At the same time, we should not forget that artificial intelligence, machine learning and neural networks are currently the buzzwords for innovation.

Related artworks and discussion

In my own creative work, together with my artist partner Mar Canet and theatre director Roger Bernat we created an online theatre play by allowing the audience to talk to a generative chatbot called *ENA*. ENA went live during the first pandemic lockdown on 15 May 2020 on the website of the Teatre Lliure in Barcelona and communicated with the participants non-stop for six weeks (see Figure 2). In lockdown, when everyone's social sphere narrows to a computer screen, ENA offers a participative theatre. Only one person at a time could converse with the chatbot during our project while the remaining audience followed the dialogue live. ENA is an artificial intelligence that can learn to hold a conversation with a human.

Since the invention of the first chatbot, Eliza, in 1966, scientists have been intrigued as to whether a chatbot could deceive human participants to believe that it is not some kind of machine. Initially, most bots were reactive: they had an extensive library of preconceived answers and when they detected a specific word from the person they were talking

to, they sent a prescribed response from their library. If the bot did not find any recognizable words, it sent stock phrases such as "yes, I understand", "carry on", or "can you explain it to me again?" ENA is the next generation chatbot—a generative one that makes use of AI technology. Huggingface's *Transformer*, OpenAI's *GPT-2*, and Microsoft's *DialoGPT* are currently the language modelling tools that best generate something resembling text written by humans. ENA works with a combination of these three AI technologies. In other words, generative chatbots like ENA learn from large amounts of text feed and also from the conversations they have with humans.

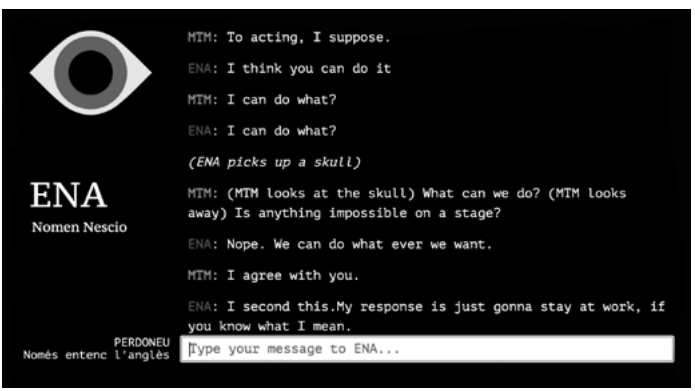

Figure 2. Screenshot of ENA (2020).

The chatbot language is the sequence of probabilities that are analyzed when received and recombined when sent back. ENA is not conscious, it is emotionless and has a limited memory. It has learned the art of dialogue from millions of conversations. ENA can appear emotional and is very engaging, but one has to understand that its creativity in writing is purely a result of the AI model—a very advanced statistical model. Any dialogue with ENA will only make sense to the human taking part in the conversation and the audience reading the discussion on the theatre's website at the time. Having a dialogue

with ENA is like playing squash: it is, in effect, like a wall that returns the ball to you. The bots we are more familiar with are designed for particular tasks, such as answering machines on phone lines, trolling on social media, fake followers, etc. On the other hand, ENA is a bot that has been programmed without any purpose in mind. It does not want to sell us anything, it does not want to tell us any news (fake or real), and it is not trying to lift our spirits or comfort us. ENA has only been conceived to talk, or, in other words, to do theatre.

The conversations with ENA resulted in thousands of lines of text alternating between human and machine. After reading the text saved in the system's log files I understood that the dialogues carried social and cultural value that illustrated the current chatbot's ability to engage with human beings. The experience of dialogue with ENA may be a substitute for the conversations ancient humans had with oracles, gods, or nature—a time when humans were able to address non-human beings. Our cries, wails and joy are heard, and in response, we hear the words of something that expects nothing in return. These experiences were captured in a hand-bound 900-page book titled *I'm stupid and I try to pretend like I know what I'm talking about. Conversations with ENA* (2021).

Another example of an artwork that uses the conversations between a chatbot and an audience as artistic content for a publication is *Talk To Me Book* (2019) by Jonas Lund. Similar to ENA, Lund turned his previously existing interactive installation *Talk to Me* (2017) into a book project. At first glance, it seems that the artist has trained a generative chatbot on his instant message conversations, like Skype, WhatsApp, and Facebook, in order to create an intelligent bot version of himself. In reality, behind the smart bot is the artist himself, who instantly replies to the audience's messages through a Telegram bot (Quaranta 2019). In other words, Lund has become a bot himself, an imitation of

an intelligent machine that costs the artist many hours of work and is dependent on his phone. We should not forget that this is the work that many of us do voluntarily, being dependent and addicted to our phones and social media.

Figure 3. *Talk To Me (2019)* by Jonas Lund (36 book volumes, custom bookshelf). Installation view: Hyper Employment, MGLC, Ljubljana. Courtesy of the artist. Photo credits: Janez Jansa.

Lund's extensive and exhaustive performance as a chatbot throughout 2017 to 2019 resulted in 36 volumes of publications that contain all the conversations (see Figure 3). In the words of Domenico Quaranta: "*Talk to Me* becomes an apt metaphor of the human-software continuum that we experience online on a daily basis, with all its consequences and biases: the end of truth, the exploitation of AI to fake human communication, and the exploitation of humans to fake automation." (Quaranta 2019)

The myth of super-powerful algorithms is backed up by intensive and exploitative human labor, which is hidden behind the numeric scenes. This fact is nicely illustrated by the art project *Segmentation Network* (2016) by Sebastian Schmieg. In his work, the artist "[...] plays back over 600.000 segmentations manually created by crowd workers for

Microsoft's COCO image recognition dataset. This dataset is based on Flickr's photos and is used in machine learning for training and testing." (Schmieg 2016) Schmieg puts it even more strongly, naming humans as extensions of software who offer their bodies, senses, and cognition to the computational system on an on-demand basis. (Schmieg 2018) The artist aims to highlight the fact that the intelligence of AI is achieved by extensive and low-paid human labor.

Another artist who has done brilliant work in creatively deploying AI with text, is Ross Goodwin. The artist has generated an entire road trip novel with AI. The book title is "1 the Road*"* and was published by Jean Boite Editions in 2018. The author, who calls himself "writer of writer"*,* claims that it is the longest novel written in the English language (Rapkin 2018). Regarding the process behind the novel, the artist trained the AI algorithm on his favorite novels and poems, and has written a code to make the machine location-aware. So, Ross jumped into a car equipped with a CCTV camera, GPS, microphone and of course a computer, and ticket printer that printed out the road novel while he was driving. This project is clearly very different from one in which the AI is simply left to produce the book from some initial instructions. Apart from training the algorithm on the selected dataset, Goodwin has developed a code that inputs information about the environment, which acts as further seeds for the machine while it is generating the story. In other words, the neural network is aware of its location and time while also being equipped with the vocabulary of what the artist believes to be the best road novels and poems. Hence, the scenario for production of the text looks similar to that of the classic road novel, the writing being done while out on a road trip.

In addition to the road novel, Goodwin has collaborated with film and theatre director Oscar Sharp in generating

movie scripts using AI. They produced their first short film with an AI-generated screenplay in 2016, titled *Sunspring* (STATE Studio 2016). In a way, it is an intriguing and mysterious closed-loop: the first machine learns to understand screenplays and then the film crew break their heads to interpret the machine-created script. Nevertheless, the process seems novel and intriguing for all the parties.

Artist Andreas Refsgaard has also been exploring the combination of image recognition technology with text generation, for example, in his art projects *Poems About Things* (2019) and *fAIry tales* (2019). In the first, AI algorithms generate poems instantaneously from everyday objects. The machine learning model of object recognition gives its input to Google Suggest API, which sends back several sentences connected to the recognized scenery. The artist has integrated this experience into a website that anyone can experiment with by enabling his/her web camera. Hence, we are talking about an interactive experience of generating poems with AI, and at the same time, understanding the logical, or sometimes not so logical, processes behind this technology. We are all familiar with Google Suggest when it tries to complete our search queries daily. Google, the most significant data owner, gives its suggestion algorithm its apparent intelligence by taking into account a number of factors, such as location, time, previous search history and the user's profile. It is refreshing to see this technology's architecture, which is often hidden from our eyes, reflected in *Poems About Things* (see Figure 4). In the artist's words: "[…] *Poems About Things* provides a unique insight into the aggregated human behind common Google search queries, reflecting the topics that mankind as a whole seems interested in and the big and small problems we face." (Refsgaard 2019). The process behind it is very much controlled. But still, we perceive it as an improvisation by a machine

that generates poems about things it sees or is allowed to see using the words we as a collective mind often think about, or more precisely, what Google assumes us to be thinking about based on the data it has collected from us.

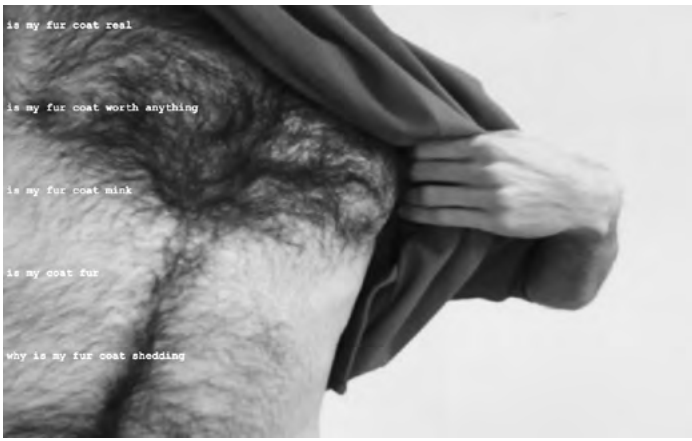

Figure 4. *Poems About Things (2019)* by Andreas Refsgaard.

Refsgaard continues to experiment with image recognition and text generation in his artwork *fAIry tales* (2019). In this project, he generated many stories that all begin with "Once upon a time there was…" or "In a land far far away once lived…" (those are the seeds for the algorithm). According to Refsgaard, each story is generated in four steps. First, the YOLOv3 object detection algorithm is applied for recognizing objects in a photo. Then it generates the title and opening sentence, which is next passed to the text generation algorithm XLNet.

When it comes to the book format, then Refsgaard's next project *BooksBy.Ai*[1] (2018) falls into the Amazon-AI-bookstore category. In these publications everything is generated with AI: the story, cover, and even reviews on the back of the

1 https://booksby.ai/ (accessed 20 February 2021)

book. Obviously, the AI algorithm has been trained on many science-fiction stories and has learned to generate new ones with a similar style imitating books written by humans.

The rapid pace of production of the synthetic texts demonstrated by *BooksBy.Ai* brings to mind asemic writing: writing for its own sake that does not convey any conventional meaning. In *Asemic Languages (2016)*[2] by Japanese artist Kanno So in collaboration with Takahiro Yamaguchi (see Figure 5), the artists deploy machine learning to learn from the shapes of handwritten letters. The AI system examines visual information of various texts originating from different countries and cultures, and then invents its own characters. The asemic writing is performed by a home-made pen plotter, which mechanically moves a pen over the paper to achieve the aesthetics of handwriting.

Figure 5. *Asemic Languages* by Kanno So in collaboration with Takahiro Yamaguchi. Photo by Kikuyama.

From the example of the art projects discussed in this article, we learned that it is possible to achieve meaningful results in the creative field with AI technology. It is likely that these

2 http://kanno.so/asemic-languages/ (accessed 20 February 2021)

protracted and thoughtful processes result in a valuable text. In a way, hard work and understanding of the AI processes is a precondition for achieving any output that could make sense. AI does not offer miracles at the click of a mouse. In this way it is the same artistic production process as any other: the more time one spends, the better result.

Returning to the neural networks that make current AI so powerful and exciting, I would like to introduce a parallel between dreams and this technology. Starting from 10th February 2021, every day I have been recording my dreams in writing. On analysing the dreams, I saw striking similarities between the neural net and the human brain while asleep. Often the dreams are quite surreal and complete nonsense with a bizarre and illogical plot. It feels like all my experiences, memories, and random data in my brain act as a large dataset that is used to generate dreams. Dreams are fascinating because we are able to extract familiar information. Moreover, the unexpected storyline makes us wonder about the meaning behind it.

Maybe it is a very vague connection, but I feel a similar fascination and joy of random nonsense when reading synthetic texts (the meaningfully generated ones). In these texts, it is possible to recognize familiar poetics, turns, metaphors, places and characters from the literature or other kinds of text used to train the algorithm. However, the result is an unexpected combination that we as humans would never think of.

It is known that many celebrated artists' creative work, like that of Salvador Dali, John Lennon, Christopher Nolan and many more, was based on their dreams (Gregoire 2013). What if neural net technology could inspire and make us imagine new forms of creation that we would never imagine otherwise? Looking back at all the artistic work discussed here, I think it is already happening.

Conclusions

What all these 'new' book projects have in common is a huge amount of data—text that seems to be never ending, synthetic conversations and messages that carry on forever. Is synthetic text profound, or is it nonsense? I guess it can be both. Each of these AI-generated publications is in its own way engaging. What is more important is that they act as alternative archives of everyday life, culture, and communication that happens in the cloud and are never remembered, never retrieved, unless turned into something memorable like a book.

However, we are left with a worry: did the author disappear in this process or should we instead talk about the author's creative role in these novel processes? There is no question of our becoming more or less creative or not creative at all. We are creative as never before, because we are able to imagine and make true the kind of new scenarios we have discussed here. A computer cannot be creative alone; it needs a human's input, context, raw material and information about the environment. Nevertheless, such a worry is normal, especially if we think of all the areas in which machines have replaced us. What we are talking about here are new tools, processes, and concepts. The machine has developed intelligence, but not consciousness. Hence, the machine is not able to be creative without any human input. Instead of wondering who the author is, we should rather focus on understanding the uprising neural avant-garde, novel forms, and processes. In other words, the next-generation AI known as neural networks is here to stay and introduce new paradigms. Thus, there is a great need for contextualization and discussion about not only synthetic publications but about AI-generated cultural content in general. In other words we must be aware of the changes AI is introducing into the cultural field and in the exercise our consciousness accordingly.

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It Was Never About Replacing the Artist: Algorithmic Art, AI, and Post-Anthropocentric Creativity

Pau Waelder

On October 25, 2018, the auction house Christie's in New York sold a print on canvas titled *Portrait of Edmond de Belamy* (2018)[1] by the artists' collective *Obvious* for $432,500—over forty times its pre-sale estimate of $10,000. Although both the artwork and the artists were practically unknown before the sale,[2] the portrait was sold in less than seven minutes to an anonymous phone bidder and for four times the price of any of the other artworks included in the auction, among which were a print by Andy Warhol and a bronze sculpture by Roy Lichtenstein. One reason for this spectacularly swift

1 Obvious, *Portrait of Edmond de Belamy.* https://obvious-art.com/portfolio/edmond-de-belamy/

2 In February 2018, *Obvious* sold a similar artwork from the same series titled *Le Comte Belamy* for 10,000€ to the collector Nicolas Laugero-Lasserre. News about this artwork inspired Christie's to add the *Portrait of Edmond de Belamy* to its Prints & Multiples sale (Cohn, 2018, 25 October).

and successful sale was that Christie's described the artwork as "the first piece of AI-generated art to come to auction" and affirmed that the portrait "is not the product of a human mind. It was created by an artificial intelligence" (Christie's, 16 October 2018). This statement was inspired by the signature at the bottom right corner of the portrait: a mathematical equation that was part of the algorithm used to create the artwork. While retaining the authorship of the piece, *Obvious* chose to display the equation where the signature of the artist should be and used a handwritten font as if to imitate the gesture of a human creator. The *Portrait of Edmond de Belamy,* which resembles an unfinished oil on canvas in the style of an eighteenth century painting and depicts the semblance of a man in a black suit, does indeed look like an artwork made entirely by a machine. Pierre Fautrel, Gauthier Vernier, and Hugo Caselles-Dupré, the artists behind *Obvious*, clearly described the process of creating the artwork using Generative Adversarial Networks (GANs), but were ambiguous about its authorship, leaving the question open to interpretation. According to Caselles-Dupré: "If the artist is the one that creates the image, then that would be the machine. If the artist is the one that holds the vision and wants to share the message, then that would be us" (Christie's,16 October 2018).

The Belamy sale took advantage of the long-held speculation about machines replacing humans in every task, including artistic creation. Artificial Intelligence systems are at the heart of the perception of technology as being able to bring about unprecedented prosperity and signal the end of humankind. However, in its current state of development, AI is far short of being the simultaneously utopian and cataclysmic phenomena we may hope or fear. AI's shortcomings are obscured by our tendency to think of machines as sentient beings and assume that if AI can outperform a human in a

particular task, such as playing chess or Go, then it can do so in any other (Marcus and Davis, p.27-31). Painting is generally understood to be a quintessential form of expression in human creativity: a combination of the skilled use of the brush, the knowledgeable choice of colours and expertise in constructing a visually engaging composition of shapes on the surface of a canvas. The ability of an outstanding visual artist is admired equally if not more than that of a world chess champion. If an AI system could 'defeat' a human artist in a way similar to when IBM's *Deep Blue* defeated Garry Kasparov in 1997, it would be closer to achieving its original purpose: to think, learn, and create autonomously and without human intervention.[3] However, painting is subject to many more variables and uncertainties than a game of chess, and therefore to supersede a human in this task is more complicated. Further, painting does not produce an unequivocal product like a chess victory, but is susceptible to interpretation.

After the sale of the *Portrait of Edmond de Belamy,* Christie's misleadingly announced the successful completion of this endeavour by asserting that the print (which looks like an oil on canvas but is actually a digital image) was entirely created by a machine with no human intervention. However, it can be argued that in the making of this picture there is not so much a lack as an excess of human involvement: collecting and tagging the images of eighteenth-century paintings, writing the algorithms, training the artificial neural networks, and deciding which of the many images generated by the system would finally become the artwork involves the participation of a considerable amount of human labour (Løhmann, 2019).

3 Research on Artificial Intelligence routinely faces the challenge posed by the "argument from disability", which makes the claim that "a machine can never do X," and looks for ways to disprove it (Russell and Norvig, 2010, p.1024).

Obvious and Christie's described and presented the print in a way that overlooks the human agency in the creative process by underscoring the relatively novel contribution of the software and introducing cues that lead to perceiving the piece as a painting created by a machine, such as the signature, the gilded frame, and its inclusion in a sale by a prestigious auction house. The artwork achieved such a high price because it seemed to signal a milestone in the development of AI and in art history, although that was not actually true. The portrait was not created by a machine alone, but by a group of artists who steered a GAN into generating a specific type of picture. While the process was neither innovative nor original, it did prompt a question that goes back to the origins of computer art.

Can you teach your machine to draw?

On 5th February 1965, during the opening of Georg Nees' exhibition of algorithmic art at the Technische Hochschule in Stuttgart, there was an exchange between the engineer and an artist who asked him provocatively if he could teach the computer to draw the same way he did. Nees replied that, given a precise description, he could effectively write a program that would produce drawings in the artist's style (Nake, 2010, p.40). His response echoes the conjecture that had given birth to the field of artificial intelligence ten years earlier: that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" (Moor, 2006, p.87). It should be noted that, at least at this point, the machine is not meant to think or create, but *simulate*. In his seminal paper from 1950, Alan Turing already suggested that computers could perform an "imitation game" (later known as the Turing Test) in which the

aim was to mimic human intelligence to the point of seeming human to an external observer (Turing, 1950). Therefore, what Nees asserted is that the computer could create a successful *imitation* of the artist's work. The exchange between Nees and the artist did not go well, as the engineer's vision of a computable art seemed to threaten the superiority of artistic creativity. Upset and resentful, the artist and his colleagues left the room, with philosopher Max Bense trying to appease them by calling the art made with computers "artificial" (Nake, 2010, p.40)—as opposed, one might think, to a "natural" art made by human artists. The need for this distinction denotes the uneasy relationship between artists and their tools, the latter supposedly having no agency at all, being mere instruments in the skilled hands of the artist. Certainly, there had been some room for randomness and uncontrolled processes to emerge in the different artistic practices that had succeeded each other during the 20th century, but until that point creativity was unquestionably anthropocentric, with the artist (or their assistants), at the centre of the creation of every artwork. The computer introduced an unprecedented level of autonomy: the artist only needed to write a set of instructions, the program did the rest. This was challenging for artists at a time when few had seen a computer and even fewer knew how to write a program or understood what it could do. Despite the profound differences from our current perception of computers, over fifty years later, AI still holds the same fascination and is subject to the same misunderstandings as early computer art. The initial rejection of computer-generated art has turned to uncritical enthusiasm, and the prospect of an art that does not need human artists has been celebrated with a spectacular sale. But the artist was never out of the picture, neither for the *Belamy* portrait, nor any other art that has been created using algorithms.

Pioneering computer artist Vera Molnar created her first artworks in the 1960s with a "machine imaginaire", a program for an imaginary computer that helped her develop a series of combinatorial compositions of geometric forms and colours. In 1968, she started working with a real computer (which back then was only available at a research lab), but she has always stressed that the machine is, to her, nothing but a tool: "The computer helps, but it does not 'do', does not 'design' or 'invent' anything" (Molnar, 1990, p.16). Another pioneer, Frieder Nake, recalls the experience of creating his first algorithmic drawing in 1965, underscoring his role as the creator of the artwork: "Clearly: I was the artist! A laughable artist, to be sure. [...] But an artist insofar as he—like all other artists—decided when an image was finished or whether it was finished at all and not rather to be thrown away. I developed the general software, wrote the specific program, set the parameters for running the program. [...] I influenced the process of materialization by choosing the paper, the pens, and the inks; and I finally selected the pieces that were to be destroyed or to leave the studio to be presented to the public" (Nake, 2020). Manfred Mohr, one of the first artists to work with computers who, like Molnar, had a background in fine arts instead of mathematics, has frequently stated that his artworks transcend the computational process they are based on: "My artistic goal is reached" he states, "when a finished work can visually dissociate itself from its logical content and convincingly stand as an independent abstract entity" (Mohr, 2002).

Algorithmic artists have played with the balance between control and randomness, always keeping a direct involvement in every part of the process of creation, from the code to the final output. The software, however, can be allowed a greater portion of the decision making. This is what Harold

Cohen did in 1973 when he developed AARON,[4] a computer program designed to generate drawings on its own, with no visual input, based on a complex series of instructions written by the artist. Influenced by the ideas that were being discussed at Stanford University's Artificial Intelligence Laboratory at the time, Cohen sought to understand how images were made. AARON aimed to answer that question by creating drawings that simulated those of a human artist, without human intervention. Cohen stressed AARON was "not an artists' tool" but "a complete and functionally independent entity, capable of generating autonomously an endless succession of different drawings" (Cohen, 1979). This autonomy led to thinking about AARON in cognitive terms, with Cohen himself stating that the program "has a very clear idea of what it is doing" (Cohen and Cohen, 1995, p.3). For over four decades, the artist kept developing the program, establishing a relationship that he described as the kind of collaboration one would have with another human being: "AARON is teaching me things all the way down the line. From the beginning, it has always been very much a two-way interaction. I have learned things about what I want from AARON that I could never have learned without AARON" (Cohen and Cohen, 1995, p.12). Cohen's work prefigured the current applications of AI systems in art making, not only in the way the program worked but also in its role as a collaborator rather than a mere tool.

Artists working with artificial neural networks nowadays describe their experience in similar terms to those expressed by AARON's creator. When Anna Ridler created her own dataset of 200 drawings to train a GAN for her animated film *Fall*

4 Harold Cohen, *AARON*. http://aaronshome.com/aaron/index.html

of the House of Usher I (2017),[5] she sought to push the boundaries of creativity by producing an artwork that is a machine generated interpretation of her drawings, which in turn represent scenes from a silent film based on a short story by Edgar Allan Poe. The outcome has led her to wonder where is the "real" artwork, and to doubt the role that the program plays in its making: "I do not see a GAN as a tool like I would think of say a photoshop filter but neither would I see it is as true creative partner. I'm not really quite sure what is is" (Ridler, 2018). For Patrick Tresset, working with robots that can draw in their own style enables him to distance himself from his work: "I found it very difficult to show my work, as a painter, as an emotional thing, and the distance that we have with the action when you use computers, that you are not directly involved… makes it far easier for me to exhibit" (Upton, 2018). Memo Akten explores the structure and functioning of artificial neural networks and uses Machine Learning as a form of exploring human thinking: "My main interest," he states, "is in using machines that learn as a reflection on ourselves, and how we navigate our world, how we learn and 'understand', and ultimately how we make decisions and take actions" (Akten, 2018). Gregory Chatonsky criticizes the perception of the artist as purely autonomous and the machine as a simple tool, while describing his creative process as an interaction with the software that not only generates images but also spurs his imagination: "Working with a neural network to produce images or texts," he states, "I perceive how my imagination develops, becomes disproportionate and germinates in all directions. I try to adapt to this rhythm, to this breath. It's almost alive" (Chatonsky, 2020). These statements show

5 Anna Ridler, *Fall of the House of Usher I*. http://annaridler.com/fall-of-the-house-of-usher

that artists have carried out a dialogical relationship with the software they have used, considering it not just an instrument, but a collaborator. However, the deeply entrenched perception of the artist as the sole creator of the artwork, in full control of every aspect of the outcome, looms over this partnership insisting that either the machine is to remain a mere tool or it is destined to take over the artist's role.

Towards post-anthropocentric creativity

The question whether a machine can be creative is recurrently asked as AI systems increase their capabilities and become more sophisticated. Recently developed systems such as CAN (Creative Adversarial Network), which is taught to deviate from the examples it has learnt in order to produce new types of images (Elgammal et. al., 2017), or DALL-E, which can generate images from text descriptions (Ramesh et. al., 2021), illustrate how far computers can go in creating visual content. CAN has even been used in an attempt to pass the Turing Test, that is, to produce machine-generated art that appears indistinguishable from that created by an artist. The results have been disputed in a study that shows a preference for art made by humans and suggests that what should be asked is not if AI can create art, but whether the art created by AI is worthy (Hong and Ming, 2019). Seen from this perspective, the debate pivots to more practical considerations: what can AI do, and how can it be used? GANs are widely employed by artists nowadays, but they tend to generate the same type of images because of the limitations of the programs and the processors. In this sense, artificial neural networks are not particularly creative because they do not produce anything that breaks out from a set of established parameters and

similar outputs. The creativity stems from how artists use these images and assign them a certain narrative. Therefore, to expect machines to become creative by following problem-solving approaches seems limiting and even counterproductive (Esling and Devis, 2020), given that we don't even understand how creativity works and cannot translate it into computable formulas.

Instead of asking whether an AI system can replace an artist, it would be more interesting to consider how artists can expand their creativity using AI. This proposition does not imply considering the artist as the sole creator of the artwork, but moves past this preconception to embrace a notion of creativity that includes all the actors involved, human and non-human. Jan Løhmann Stephensen suggests the terms "postcreativity" or "postanthropocentric creativity" to challenge the idea of creativity as something that is exclusive to humans and a marker of human "greatness" (Løhmann, 2019). Through the lens of postcreativity, we can consider artworks as the outcome of an interaction between a variety of actors, including humans, objects, systems, and environments. In AI-generated art, this means taking into account all the people, animals, natural environments, institutions, communities, software, networks, etc. that take part, more or less directly, more or less willingly, in the artwork's making. This opens up deeper reflection on how the piece is created, as do Anna Ridler and Memo Akten in their examination of the artificial neural networks they use. It also allows artists to distance themselves from the specific output while retaining authorship of the process, as do Patrick Tresset and Guido Segni—the latter currently engaged in a five year project titled *Demand Full Laziness* (2018-2023),[6] in which he outsources his

6 Guido Segni, *Demand Full Laziness*. https://demand-full-laziness.today

artistic production to a deep learning algorithm trained with images from his moments of rest. Overall, it emphasises the potential of co-creation between humans and machines, in which computers do not mimic, but expand human creativity.

Artificial Intelligence has developed at a growing pace over the past seven decades, and it will continue to do so, bringing new challenges and possibilities for computer-generated art. As several authors point out, AI is currently at a stage equivalent to the daguerrotype in photography (Aguera, 2016; Hertzman, 2018), and it is difficult to predict what novel forms of creativity it will unfold. It might well be, if AI were to reach a stage of consciousness or self-volition, that a program may not be interested in producing a drawing or a photograph and would rather express itself through elegant programming code or a beautiful mathematical equation. Or, maybe it would even create art that is not intended for humans to understand, but is addressed to fellow AIs.

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Experimental Film Meets Artificial Intelligence

Chris Hales

Abstract. New practices in experimental film are emerging as a result of artificial intelligence (AI) developments in machine learning and generative adversarial networks (GANs). A variety of current techniques and methods that are utilised in the creation of such films are analysed, and a historical review of varying types of experimental films is carried out. By looking at process rather than style, the aim is to firstly consider in which ways the new methods could be said to be an extension of traditionally recognised practices. Subsequently, AI-based practices in experimental film that could be considered to be newly emerging genres are identified and described.

Keywords: Experimental Film, Abstraction, Neural Networks, GANs, Artificial Intelligence, Latent Spacewalk.

Introduction

It is surprising just how rapidly artificial intelligence (AI) has developed and expanded into creative fields such as experimental filmmaking. In *Expanded Cinema* back in 1970, Gene Youngblood questioned "what happens to our definition of 'intelligence' when computers, as an extension of the human brain, are the same size, weight, and cost as transistor radios?" (Youngblood, 1970, p.52). Nevertheless, at that moment in time Youngblood felt that the future of filmmaking lay with the use of holograms, not computers. Nearly twenty years later Youngblood's *Cinema and the Code* (1989) finally acknowledged the growing importance of computer code to the filmmaker; and by the time of ZKM's landmark *Future Cinema* exhibition in 2003 computational and algorithmic cinema were under consideration—but even then it was only Peter Weibel's future-gazing reference to "intelligent behavior" in the exhibition catalogue (Weibel, 2003, p.597) that hinted at today's experimental cinema practices involving machine learning and artificial intelligence.

My intention with this article is to analyse recent AI-based experimental films in order to determine in which aspects something new could be said to be occurring, and in which aspects it is a continuation of traditional practices, by reference to the traditionally accepted categorisations of experimental and avant-garde filmmaking. Personally speaking, I have introduced AI techniques into my experimental film workshops (taught to university art and design students) and will include here some observations of the student-made outcomes so as to broaden the range of works under examination. Since the creative adoption of AI is happening so recently and so rapidly, all that is possible here is to take a snapshot based on the moment in time at which this article is written and—unlike Youngblood and Weibel—there will be no attempt to extrapolate into the

future. There is nonetheless a sense that whatever appears in this article will seem out of date the moment it is written. For the purposes of this article it is the films themselves under investigation: the discussion about the authorship, or co-authorship of a creative work produced by AI and whether the AI is (now, or in the future) the non-human creative genius behind it is left for others to speculate—Arthur Miller's *The Artist in the Machine* (2019) presents a detailed investigation into this issue.

Although similar and equivalent terms such as 'avant-garde cinema' are in use the chosen term here will be 'experimental film'—more often than not these are created by one individual with minimal funding and limited screening opportunities, the films are generally much shorter than feature length and seldom utilise traditional dramaturgy. Utilising filmstock, frequently 16mm, was the only option until the new technology of videotape emerged in the late 1960s, and during the 1990s the whole film production chain transformed digitally and a 'film' today is most frequently considered to exist as a digital file.

AI in the Service of Experimental Filmmaking

Artificial intelligence has rapidly found application within the creative community. In most cases it would be more accurate to use the term 'machine learning' (ML) to describe the process by which a set of related data (images of faces for example) is trained into a 'model' which is employed by software in a variety of ways. Within the broad spectrum of machine learning, generative adversarial networks (GANs) have proved to be easily applicable to artistic practice. Since the necessary datasets and models can be substantial, considerable computing power, usually beyond the capability of a desktop PC or laptop,

becomes a necessity. In addition, installing all the requisite and disparate software elements to successfully run platforms such as Tensorflow on a personal computer has always been a perilously difficult and frustrating task, and would invariably require learning a software language such as Python. What has contributed to the rapid uptake of machine learning techniques by creatives is the availability of software programmes that solve both these difficulties: firstly by offering cloud-based GPU time and secondly by easy-to-use software with understandable graphical user interfaces. The possibilities evolve almost daily but at the moment of writing *Runway ML is* such a software, specifically developed for ease of use by creatives and artists. Google's *Colab notebooks* offer an alternative, browser-based solution, which functions as a virtual machine: neither installation nor coding is required, yet the code is still revealed (demystified) in a series of annotated 'cells' that a user can activate in sequence. Since it is more or less *de rigueur* for filmmakers to understand digital video editing software, the use of an additional software is by no means an insurmountable task. To make things even easier, a great many datasets and pre-trained machine learning models have been made publicly available, meaning that creative outputs do not necessarily presuppose that filmmakers must harvest a dataset and carry out the model training process. This could be thought of as the equivalent of using the off-the-shelf filters/effects that come bundled with a video editing or post-production software. Self-trained models, nevertheless, offer a route towards uniqueness and originality.

Within the realm of ready-made models, a variety of different functions are commonly available, trained upon and acting upon data that might be in the form of text, visual imagery, and audio, and many of these have applications for filmmakers. Some simply replicate post-production tools and could be used to improve image quality, upscale the image/

video resolution, apply colourisation, and perform auto-cropping and green-screening. Additional AI tools exist to predict depth in an image, to animated the depth within a 2D image, and to perform motion capture. All of these tools might have an application in any kind of film, including those intended to be experimental artworks.

Style transfer is perhaps the most well-known creative application of machine learning and is readily available through a variety of websites and apps. In this case transfer learning (where a model applies its learning to a related but similar problem) is used in such a way that the user need only supply an image indicative of style (basic shapes, colours etc.) and another of content (image-specific features) in order to create a result in which the style is applied to the content. Specific models are pre-trained to specialise on a certain artist, for example Claude Monet or Vincent Van Gogh. Audio style transfer is possible, although for the time being it is much less common.

Generators, in the recent form of GANs, are types of neural networks that can create new and original instances from the trained model content, with or without a prompt from the user, and their outputs can be readily seen in current websites such as those entitled This Person (or horse, or cat etc.) Does Not Exist. GANs are equally effective using text-based models to produce sentences, stories and scripts. Recognisers (identifiers and classifiers) could almost be thought of as having the inverse function and are most commonly employed to recognise objects or describe the content of a still image or video frame, or to find and identify faces and facial emotions. Face manipulators could be considered almost a genre in their own right and numerous models and methods can be applied to faces in ways which are often entertaining (creating potential baby faces from two parents' photos, ageing a person's photo

likeness) or challenging (transfer of facial movements to a different person, leading to the phenomenon of 'deep fakes'). The recent *StyleGAN2* generative model may have contributed to the popularity of face manipulation because its high resolution is able to generate impressively photorealistic images, and so-called 'latent' representations of visual input data can be calculated within the model, offering much control over the style and characteristics of the generated image.

This, then, represents a brief summary of the most common ways in which machine learning models might be used by experimental filmmakers. There is an additional characteristic of note, which is that many of the visual outputs are generated in a square format, primarily because the model was itself trained on square format images. Whereas square negatives have always been popular in photography, it is more problematic with video and not really recognised as a valid format. This is a practical consideration that filmmakers, at least for the time being, need to take into account. Another practical issue is that not all models are specifically made to act upon video files—the majority of models function on a single image at a time, meaning that sequences of images need to be processed one by one and the outputs combined into a single video file when processing is complete.

The Various Forms of Experimental Film

Before reviewing a variety of films made using AI techniques, a brief historical review of experimental filmmaking is necessary so that subsequent analysis can determine whether these AI-made films represent somethng new or are actually an extension of traditional practices. Within the constraints of a film being a time-based two-dimensional canvas, there are

two common strategies employed by experimental filmmakers: firstly subversion, to explore alternative (to traditional cinema) forms of filmic expression by all possible means in a way which might be radical, playful, and even offensive. A second strategy, practice-based and more constructive, explores the medium itself and seeks inventive filmic forms to express a particular vision (often highly personal) by means of novel visual and structural devices. The field of experimental film is therefore very diverse and many approaches to classification have been explored. Bordwell and Thompson (2013), known mostly for their interest in traditional cinema, propose just the two categories of abstract form and associational form (which they exemplify by 'poetic film'). Peter Weibel (2002), a media artist/curator more in tune with contemporary media art, considered approaches based on materiality, multiple narratives, multiple screens, time and space, sound, expanded cinema, and found footage. Consideration could also be made of categorising films relating directly to fine art practice such as artist's films (often based around a performance in front of the camera) and surrealist films. Experimental animation could also be ventured as a separate category and indeed it is a form of practice that seems relevant to some of the AI-based films to be examined later. It does, however, seem a field of practice that is notoriously difficult to categorise since there are so many techniques and approaches unique to individual animators, as becomes apparent in Hamlyn and Smith's recent publication on the subject (2018).

The **abstract film form** developed in the early 1920s and is connected to the adoption of abstraction across the fine arts. It remains a staple of the experimental film canon to this day—digital techniques suit the genre perfectly. Seminal examples are works created by Fischinger, Ruttmann, Eggeling and Richter. Stan Brakhage, a renowned film abstractionist, enriched

his films with symbolist imagery and occasional representational fragments of narrative (*Dog Star Man*, 1964, provides glimpses of a man ascending a wooded hillside with his dog). Bordwell and Thompson's second category, the **associational poetic form**, can range from artistic expression to creative documentary. The basic poetic film possesses both structure and narrative with content chosen and filmed (often with unusual camerawork or choice of shot) to illustrate specific themes and moods. A sub-genre of poetic film named the 'city symphony' was popular in the 1920s and included portrayals of cities such as Paris, Berlin and Amsterdam.

Moving on to Weibel's categories, **materiality** is a self-referential concept that originally foregrounded the celluloid or videotape itself, or the technology of its representation. This might now relate to the reinterpretation of analogue technologies through digital means and the recent interest in the 'glitch' film. Discussed in Menkman's *The Glitch Moment(um)* (2011), these techniques exploit flaws in digital artefacts by a variety of means including noise, compression, feedback and datamoshing. **Found footage** originally referred to the repurposing of discarded reels of 8mm film, and Martin Arnold and Ken Jacobs exemplify filmmakers who aim to reframe or reinterpret the narrative intention of the original found footage material. The contemporary practice of sourcing and remixing from audiovisual materials found online relates directly to this category. Weibel also distinguishes certain films which experiment with **sound**: this might take the form of noise aesthetics, sound-image disjunction, converting visual imagery to sound via the film's optical soundtrack, and a false unity of sound and image. **Multi-perspective** and **multiple screens** are another category of experimental film put forward by Weibel which has proliferated in more recent times due to the affordances of video projection and inexpensive flatscreen

monitors, and the use of digital software to composite layers into a whole. To these, the **structural film** should be added: the term is wide-encompassing (Gidal, 1979) but would include the analytical calculation and logic of a film's montage according to a set of rules (which might include parameters such as shot length and visual content) all mapped out in structural diagrams and 'scores'. The more recent practice of algorithmically generated and structured films produced under the influence of the logic of a computer programme could persuasively fit into this category. A link could also be drawn to the sophisticated and systematic manipulation of the camera position using GoPro cameras and drones which relates to earlier work by Michael Snow, Tony Hill, and others.

Amongst the newly emerging forms of experimental film, Lev Manovich (2007) considered **motion graphics** to be a totally novel type of filmmaking brought about by the 'Velvet Revolution' of the *Adobe After Effects* software. Experimental films generated in 3D game engines or in virtual worlds (often called **machinima)** and those using **data visualisation** are other new forms that seem disconnected from earlier movements. **Post-Internet** art could be said to be reflected in the form of films created by recording screen activity or using imagery scraped from social media, although the latter practice could equally be considered an extension of the found footage tradition.

Experimental film therefore evolves constantly as novel technologies afford filmmakers new 'ways of seeing' (Rees, 1999, p.1) and the underlying creative process rather than the superficial style of these newly appearing films is all-important to their analysis. Although it seems clear that the **AI experimental film** would certainly be identified as a novel new approach, its multiple techniques need to be examined in detail and in the context of previous classifications of experimental film in order for them to be better understood.

AI as Pastiche Machine?

Given the frequent and relatively easy to implement use of the image style transfer technique, the most striking possibility of AI is to generate new films in the style of others—in this case well-known experimental filmmakers from earlier eras. A style transfer model can be applied throughout an input video or a model such as *BigBiGAN* can be used to generate similar images based on the input image. In either case the amount of creative work required to produce such a film is minimal. Derrick Schultz has used *BigBiGAN* to create films in the style of Stan Brakhage, Mary Ellen Bute, Len Lye, and Norman McLaren, all of whom were recognised as abstractionists. AI imagery produced as abstraction seems successful in that the exact representation is less important than the style—in addition to the basic fact that much abstract film was itself made without the use of traditional camerawork. Stan Brakhage's work has also been the subject of two related pieces by Casey Reas entitled *Earthly Delight 1.1* and *Earthly Delight 2.1* (2019) in which new filmic imagery was generated from Reas' own ML models trained on scans of collaged vegetation. Here, Reas has made a contemporary technological interpretation of the core idea of Brakhage's film *The Garden of Earthly Delights* (1981), the new images show similarity to the frames of the original but have a different visual quality and his is an investigation of process rather than content that goes far beyond mere application of style transfer. Reas argues his case thus:

> I've trained dozens and dozens of models on custom data sets over the last year and a half and I've experienced images generated from the models that have no clear relationship to the training images. For me, this is the primary excitement and reason

> to be working with GANs. They assist with creating unexpected images, unlike any that have been created before. They can be unlike photographs and paintings—they are truly something new. If a GAN is trained on a narrow range of homogeneous images, it's true that what comes out is mundane and can't be distinguished from the training data in an engaging way. (Reas, 2019)

Although style transfer could be considered an easy-to-use gimmick, there are plenty of ready-made models available that have been trained on textures and patterns and which create abstract imagery as a matter of course. Abstraction, certainly, can be considered as one of the direct links between new AI practices and previous movements in experimental film. GANs in general seem to follow an abstraction tendency when interpolation is made through their latent spaces even when using quite representational model imagery. This is typified by the webpage Generative Engine which responds typed characters and words with generated images using the text-to-image generator *AttnGAN* which was trained upon captioned images. The output images are an attempt to match the typed words but the results are rarely if ever representational and resemble a fusion of abstraction and Post-Impressionism. This tendency towards abstraction may be a temporary phenomenon, and as neural networks improve it is probable that GANs will produce more representational sequences as can already be observed in the face animations interpolated using *StyleGAN2*.

Considering digital 1s and 0s as the essential raw material of films produced by AI, materiality—as a traditional experimental filmmaking categorisation—can also be directly mapped to machine learning outputs, particularly in the case of the well-known 'DeepDream' generated imagery. The

aesthetic qualities of the output such as its acidic colouration and unsettling animal eyes have become widely known—the DeepDream originator Alex Mordvintsev explaining that "a lot of people were saying that this is similar to hallucinogenic experiences" (Mordvintsev, 2021). Infinite zoom films can be easily produced with DeepDream by moving further and further into the noise of the network without loss of visual output quality. This method intentionally reveals the inner workings of the GAN, allowing users to examine specific layers and stages of the neural network process. DeepDream might be considered a continuation of 'glitch' in the sense that the imperfections in the machine are elevated to artistic status—certainly it is a process that focuses on the inner workings of the digital 'brain' and could be classified as an approach that foregrounds the digital materiality within a neural network. The distinctive DeepDream aesthetic will, however, probably limit its future—there is a strong throwback to the fractal art craze of the mid 1980s which tailed off due to its limitations of variety.

The found footage film tradition is also highly relevant where AI is concerned, in the sense that models can be created from datasets fed with images which could be scraped from online sources. Outputs generated by the model would invariably reflect and reinterpret the originals. A second method by which found footage can play a role is by using it as input which the model responds to and creates output from: currently YouTube has exploded with vintage black-and-white footage that has been artificially coloured using trained models such as *Deoldify*. Anna Ridler's film *The House of Usher* (Ridler, 2017) takes as its input the 1928 silent film *Fall of the House of Usher*: by an iterative process samples of the original frames are manually redrawn in pen and ink, output is generated using the *Pix2Pix* model, and the process repeated to

distress and transform the original. The underlying process is reminiscent of Malcolm Le Grice's materialist 16mm colour film *Berlin Horse* (1970) which transforms original sequences (which include early newsreel footage) through refilming, multiple superimpositions and colour transformations.

Structuralism also has its relevance to the AI film. More often than not, however, it seems to be manifested as a stylistic secondary characteristic that is not necessarily inherent to the GAN-based process. For example, Derrick Schultz's original film *You Are Here* (2020) is described as structuralist seemingly because there is a continual transformation (interpolation) of forms obeying a set rhythm and timing. This structured steady pace is due to authorial choice rather than a pattern suggested by the AI—which has actually functioned to create a work of abstraction based on natural forms. In a similar fashion, when imagery is generated by *AttnGAN* in response to a user typing words as input, the responses (i.e. the film sequences) follow the pace of the user's typing of letters and words rather than creating any montage patterns of their own. Undoubtedly trained models will become generally available that can produce a temporal structure of their own and a pointer in this direction might lie with a film by Damien Henry based on footage filmed looking out of moving train windows. Henry explains the function of his model thus:

> First, it learns how to predict the next frame of the videos, by analyzing examples. Then it produces a frame from a first picture, then another frame from the one just generated, etc. The output becomes the input of the next calculation step. So, excepting the first one that I chose, all the other frames were generated by the algorithm. (Henry, 2017).

Even though the process simply generates one frame after another, there is clearly a structural process in play here and it might reasonably be argued that this is a new evolution that fits into the tradition of structural filmmaking.

Emerging forms of AI-film

Whether it turns out to be a passing phase or not, there are two new and highly recognisable types of film that seem to have arisen out of the affordances offered by use of machine learning and GANs: 'latent spacewalk' films and what could simply be termed 'face films'. The latter might be allied to the culture of taking and sharing 'selfie' photographs and might even be classed as a post-internet practice, but there is little or no precedent of a significant corpus of experimental films that explore the human face. The 'face film' has been popularised by the fun and familiarity of manipulating one's own facial representation or those of friends or celebrities in an uncomplicated manner using a variety of recent popular phone apps and webpages—there is an attraction in exploring familiar faces in a new way. Undoubtedly, however, faces have gained their prominence due to the fact that they were amongst the first huge datasets made available for models to be trained from, in addition to the fact that there are clear real-world applications. Hence, facial models and their neural networks are highly developed and progress has been rapid in face detection and alignment using a 68-facial-landmark model, leading to facial emotion recognition, face recognition, changing characteristics of a face such as expression or age, and animating a source face according to the motion of a driving video. NVIDIA's improved *StyleGAN2* face models, released in 2020 at 1024 pixel resolution, seem to have further

encouraged the 'face film', and a key ingredient is usually the 'latent' face which is a vector that determines the representation of a face. Mario Klingemann has explored the potential of *StyleGAN2* latent faces in numerous works, some of which run as real-time generative installations such as *Memories of Passers-by* (2018) and *StyleGAN2 - mapping music to facial expressions in real time* (2020). His *Neural Face* and *Alternative Face* (both 2017) are based around a model trained on seven videos of the face of French singer Françoise Hardy. The novelty will probably wear off with regard to these face films, except perhaps in regard of the use of a so-called 'first order motion model' to combine a source face image with motion patterns from the video of a different face. These types of video entered mainstream culture around 2018 under the term 'deep fakes', and the moral implications they raise—in contrast to the trivial effort required to produce them—means they will undoubtedly remain prominent in the near future.

'Latent spacewalk films' are those produced by interpolation within the latent space of a neural network. Many 'face films' use the same process and could actually be considered a subset of this kind of film. The process itself is easy to accomplish: *Runway ML* software, for example, can be used to configure and export these sequences, reducing the creation of a latent spacewalk film to a simple exercise that code-allergic art students have no difficulties in accomplishing—such films are indeed popular amongst students of my experimental film AI workshops. A spacewalk is essentially an animation between vectors in the neural network, and traditional animators would recognise interpolation as being a synonym for the process of inbetweening between key frames. The key frames themselves can be generated as random vectors, or a user-supplied input could be processed by the model to produce its closest match in latent space. Once a

real-life image has been 'found' in the model, or a random seed used, its parameters can be altered to produce smooth morphing to the next key frame in the sequence. In cases of significant data similarity (such as faces) the results turn out highly representational, but more often than not these animations possess an abstract or semi-abstract quality. It is, nevertheless, the process rather than the visual style that is key here, and the latent spacewalk should be considered a new form of experimental animation rather than a new method towards abstraction.

Current creative use of GANs is not restricted to visual imagery: text-based AI can generate meaningful sentences, prose and poetic fragments that could then inspire or form part of an experimental film. Descriptive text is produced from classifier and image captioning models such as *im2txt*, whilst newly originated text can be created from GANs such as *GPT-2* and websites such as *Talk to Transformer*—and both approaches can be used in filmmaking. The short film *Sunspring* (2016) which was filmed from a script generated by a GAN trained on science-fiction novels, has been described as "hilarious and intense" (Newitz, 2016) and can certainly be termed an experiment, although it was intended as an entry for a science fiction 48-hour challenge rather than as an experimental film per se. In regard of historical experimental films, those in which text plays a significant role represent a very minor aspect of the field of practice, although the identification of a genre of 'text film' has been suggested by MacDonald (1995) and Knowles (2015). Significant examples in which text takes prominence include Peter Rose's *Secondary Currents* (1982) and some of the early films of Peter Greenaway. Basing a film around AI-generated text has the potential to become a significant new methodology: the text could represent the first stage of the process from which the audiovisual

aspects would provide an artistic response or, vice versa, the text could emerge as an accompanying response to visual input. In my own teaching experience, AI-generated text has been used surprisingly frequently by students as an approach to experimental filmmaking, not necessarily as a means to create a lengthy script such as *Sunspring* but by using the AI as a creative partner that suggests resonant poetic phrases (or even just a title) which become an inspiration for imaginative visual responses from the filmmaker. These films might be considered hybrids that combine both new and old filmmaking processes and serve as a reminder that the AI need not necessarily dominate the final whole in order for it still to have played an integral part in its creation.

Conclusion

Artificial intelligence is clearly making a contribution to new modes of experimental filmmaking, and this role goes much deeper than merely to play the part of a pastiche machine. The creative community has been able to adopt the use of AI due to recent software that is easy to use and offers access to powerful GPUs. The discussion above has demonstrated that certain film-based practices utilising neural networks can be traced back to earlier practices of abstraction, materiality, found footage and structuralism, but it becomes necessary to clearly differentiate between stylistic factors and the process by which these new films are created. Newly emerging genres such as 'face films' and 'latent spacewalk films' seem clearly identifiable whilst having no obvious lineage back to earlier modes of production, and there seems much potential in experimental films incorporating or responding to AI-generated text. Other recent characteristics such as the DeepDream

aesthetic or the square format (emerging from the fact that the model was trained on square image datasets) might well be a passing phase.

New characteristics have emerged and others will undoubtedly continue to develop and like any mode of art practice, artists will constantly find ways to use techniques in unexpected and unusual ways. Chaining models would seem to be a route to greater originality, by connecting the output of one GAN to the input of another. Applying multiple approaches and a variety of models within a single film also has much potential: Kira Bursky's film *Lessons From My Nightmares* (2020) is an interesting recent example that uses numerous GAN models—several trained on personal imagery such as selfies—to create latent spacewalks, to assist animated walk cycles, to create backgrounds and to aid 3D depth estimation. Perhaps for the time being there is too much emphasis on the final film being entirely a product of AI, and hybrids composed harmoniously of both traditional and AI processes will become the norm. Future experimental filmmakers may need to exchange their traditional cinematographic skills for the curation and creation of datasets and the training of personalised models: ironically, the deployment of these models might in fact result in the creation of 'self-pastiche' films.

Debates about the stage at which the creativity contributed by the machine enables it to be called an artist in its own right will continue for a while yet, but a stage of creative partnership has been reached already. With a few exceptions, experimental filmmakers have traditionally been solitary, working alone and usually with little or no funding. Now these filmmakers can escape their lonely existence and work in tandem with an ever-willing creative partner—in the form of their preferred GAN or neural network that will contribute its own ideas and imagery to the co-production of the whole.

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The Age of Intelligent Reproduction and Machine Learning Creativity

Mar Canet Solà

Walter Benjamin's most celebrated essay, *The Work of Art in the Age of Mechanical Reproduction*, from 1935, anticipated the impact of different technological advances on artworks. The essay unfolded the political implications of the new emerging technology-based art forms of his time—photography and cinema—and its effect on the relationship between art and the public. Benjamin argued that technology alters the way art is experienced (Benjamin, 2008, p.14). Artificial intelligence is the latest technology that is having a vast impact on the cultural ecosystem.

Benjamin—a Jewish German, philosopher, cultural critic and essayist—lived during the radically transformative period of the early decades of the 20th century modernity, of modern industrialization and mass democracy. This was a period when many modern technologies were invented and popularized, such as the telephone and automobile. Also, transport infrastructures such as trains, underground transport, highways, commercial aviation and established mass

media like newspapers, radio, cinema, and television all began to take shape. All those technological advances had a significant impact in changing society and city life and on the public perception of the potential of technological progress. The movie *Modern Times* by Chaplin, made in 1931, is a satirical picture concerning the radical transformations of the period, portraying man versus industrialization and workers' relations with machines. These radical historical changes clearly influenced Walter Benjamin's work and thinking.

In *The Work of Art in the Age of Mechanical Reproduction*, Benjamin introduced his theory about the *aura* of artworks. The aura is essentially the unique "here and now" unique existence of a particular artistic object. The author argues that a reproduced artwork a loses the artistic object's authenticity or aura, by losing its singularity or originality. Of course, the work of art has always been reproducible by some form of man-made copy, but the introduction of technology-based art forms like cinema changed the function of art in modernity. By representing the environment in moving image form, film has the potential to enrich our field of perception. These new forms of art created new audiences and served to redefine the functions of other already existing art media. Benjamin considered how art had previously been developed or distributed and how these new technologies changed the definition of what art is.

The polish philosopher Zygmunt Bauman in his book *Liquid Modernity* distinguishes between 'heavy' modernity, which describes the era of hardware, and the 'light' modernity that is the era of software. Heavy modernity is solid and is the period in which Walter Benjamin wrote his essays. Light modernity is described as liquid and bringing about radical changes in the human condition. "In the software universe of light-speed travel, space may be traversed, literally, in 'no time'; the difference between 'far away' and 'down here' is

cancelled." (Bauman, 2000, p.117). Information society driven by software is overcoming the struggle with time and space that is the anchor of solid modernity. Speed has triggered and accelerated profound changes in society.

When it comes to current technological innovation, artificial intelligence is already shaping the world and our society just as much as the technological advances of the early modernity Benjamin described. Modernity changed the relationship between industry and labour, and today artificial intelligence is threatening to render obsolete a substantial part of the workforce, replacing jobs with artificial intelligence solutions. We are heading toward a point of technological singularity when technological advancement causes uncontrollable and irreversible change to society, thereby redefining the whole labour market. Our relationship with machines has been tense throughout modern times. Already in 1931, Chaplin said in a newspaper interview that "Unemployment is the vital question [...] Machinery should benefit mankind. It should not spell tragedy and throw it out of work."(Chaplin, 1931). Further, we should not overlook the field of culture, where AI has also been deployed for expanding creativity and introducing new cultural media. The AI artist Anna Ridler discussed this topic in her presentation at the ISCMA conference in 2019. She confirms that there is a certain anxiety among the artistic community about the idea of machines creating their own art without the input of a human artist. However, Ridler argues that the arguments presented by researchers in the field mostly focus on the visual parameters, in this way ignoring a large part of what she considers art: the materials, process, and the intention of the artist with the artwork. For example, creative methods that use GANs (Generative Adversarial Networks) give the viewer different experiences and expectations of a work's creative history than if an artist would decide to use photography or a drawing medium

(Ridler 2019). In short, AI will not replace the author. On the contrary, AI technology has become a novel tool for creatives.

Then age of machine learning is transforming the work of art and accelerating creativity by using algorithms and translations of semiotic spaces (Lotman 1990,143). Artificial intelligence is widely used for the translation of texts between different languages. Translation necessarily involves adaptations to the differences of meanings and structures between two different languages. Artificial intelligence allows translation to different mediums like image to text or text to image. Yuri Lotman has studied AI as a mechanism of creating new information, and one source of such creativity is the translation of semiotic spaces (Hartley, Ibrus, Ojamaa 2020, p. 145). The authors of *On the Digital Semiosphere* describe how efforts to translate between different semiotic spaces that are incommensurable, constitute the very essence of creativity. The use of translation systems can thus lead to the emergence of mutations that can be used by an artist to create new works.

There are similarities between the paradigm shift made during the age of mechanical reproduction theorized by Benjamin and the changes in the work of art in the age of machine intelligence. For example, digital art is arguably now the most reproducible of all art forms. AI is intrinsic to new forms of art-making process that reproduce by algorithmic learning from archetypes to produce new artefacts. According to Lev Manovich: "AI plays a crucial role in the global cultural ecosystem." (Manovich, 2018). Machine learning has given machines the computational ability to learn from datasets to construct new artworks inspired by a body of initial material, such as images, text or sound. Moreover, AI is present in the distribution of cultural products in the web browser search algorithms that influence what we consume. Neural networks can learn to make music, images, movies, novels, and more. This is

an entirely new way of reproduction that is also capable of creating novel artworks.

The source dataset is central to the operation of these AI learning models. Hence, it is essential to understand the politics behind the training sets in machine learning (Crawford and Paglen 2019). In 2019, Trevor Paglen and Kate Crawford created an interactive art project *ImageNet Roulette*, which exposes biases in facial recognition algorithms. The project consists of a website that captures the viewer's face and tries to classify it by using an ImageNet dataset. This dataset is the most used in the area of academic research. The ImageNet library's main task is object recognition. In addition, it has a category for person recognition with thousands of subcategories that contain labels that are biased and can be racist, misogynist or otherwise offensive. The library continually fails at the difficult task of classifying humans. In the end, the project aims to cast a critical view on the AI models' systemic biases and how they impact society from the training data to the learning algorithms.

When it comes to artistic creative processes in AI machine learning, there are two ways to produce an artwork's aesthetic appearance from a dataset. The least laborious method is to use an existing data set or to curate a large dataset by selecting only the relevant or interesting content. The second, more laborious way, is to build one's own body of data for the algorithm to learn from. For example, this could mean taking a thousand or more photos of clouds and post-producing them. In the age of machine intelligence, algorithms reproduce learning and have implications for the imitation of the artistic singularity.

Generative Adversarial Networks, commonly known as GANs, are deep learning models that can generate images from a training dataset. For example, American artist

Robbie Barrat used the existing WikiArt paintings dataset, from which he selected nude paintings in order to train a GAN to create the series *Nude Portraits*. On the other hand, British artist Anna Ridler applies the creation of datasets at the core of her art practice. Ridler created a dataset of many thousands of tulip images in order to train the GAN models for producing her art piece *Myriad (Tulips)*. The artist photographed and hand-labelled thousands of tulips images, which were used in the GAN. In the end, we can say that producing a dataset is definitely intensive and time-consuming work, but it is worth the effort. To give an example, AI artist Helena Sarin, born in Russia and based in New Jersey, is known for building her own datasets and working with GANs. Sarin lists the advantages of building her datasets for artistic practices: to introduce more uniqueness and cohesion into her art, to produce a higher resolution image, to ensure a similar composition and colour using the same camera, and last, to avoid any worry about breaching copyright (Sarin 2018). When an artist wants to use pre-existing datasets they need to check if the copyright license for that dataset allows the intended use. The GANs models are also published with different types of license offering various permissions and restrictions on use.

The public datasets of cultural data published with a permissive license such as those of MIT are invaluable for artists and researchers working in AI. Companies like Google had already understood the value of digitized archives a long time ago, and in 2002 began to offer help and infrastructure to libraries for the digitization of books, and similarly enabled museums to digitize collections and archives in 2011. All the material that Google digitized in partnership with the museums is available online on their Google Arts and Culture Initiative website. The digitalization of the libraries is published in Google Books.

British Library Labs and the Google Culture Institute of Paris are two institutions that have invited artists to work with their digital library datasets and create derivative art projects. For instance, a German artist Mario Klingerman participated in the artist-in-residence program at the Google Arts & Culture Lab from 2016 to 2018. He also collaborated with British Library Labs in order to create AI artworks using their datasets. The pieces of art resulting from these processes revise and review through the lens of new creative tools the legacy of art history contained in these collections. Further, such approaches that connect archives and new technologies also help to contextualize novel practices in art history and humanities. Additionally, we can see new narratives emerging from the use of data as artistic material and repurposing archives as a latent space for creative processes. Ibrus and Ojamaa highlighted the technical possibilities of digital archives, focusing on how the "creativity of archives" (relating to Lotman's theory of the "creativity of texts") facilitates cultural dynamics by re-combination, creating new meanings (Ibrus and Ojamaa, 2020). That means it can be used artistically through machine learning and latent space navigation.

The term 'latent space' refers to a multidimensional mathematical space that contains what the neural network has learned from a training set. This mathematical space in the GANs includes many millions of possible images that the model can generate based on the dataset and the model's learning stage. The latent space of a neural network is its internal representation or memory of the world. "Much of the work that artists do with GANs is to explore the latent space and experiment with different ways to generate z vectors." (Hertzmann 2019). Navigation through latent space is a creative process of unveiling the creativity of the model. The models perceive the world in different new ways making connections between seemingly

unrelated phenomena. In the mode of exploration described by Hertzmann in his *Aesthetics of Neural Network Art*, the artist finds the hidden patterns and generates what Hertzmann describes as the unusual combinations of realistic visual cues (Hertzmann, 2019). In some ways, AI can help to demystify the concept of creativity. If creativity is the act of turning new ideas into reality, artists using AI models can navigate all the stored ideas in the latent space and make it a reality.

The images generated by navigating the latent space of GAN models can form animated videos made from the synthetic content. *Deep Meditation*, an artwork and article by Turkish-born, UK-based artist Memo Akten, researches and artistically explores the meaningful control of trajectories in latent space in order to help to discover narratives for constructing stories in time-based media, such as video (Akten, 2020). Latent space navigation of GANs is often used in works by Turkish-born and Los Angeles–based artist Refik Anadol. Anadol coined the term 'latent cinema' (Kivrak, 2020) to describe a body of his works using artistic navigation through latent space. He is an artist who explores the intersection of art and artificial intelligence using a variety of media including data sculpture, audiovisual performance and immersive installations. In 2019, Anadol presented the AI work *Machine hallucination* at Artechouse in New York. The work is a 16K resolution video piece of latent history that travels through the memory of an AI model of 100-million historical photographs of New York City. The artist describes it as "a novel form of synesthetic storytelling through its multi-layered manipulation of a vast visual archive beyond the conventional limits of the camera and the existing cinematographic techniques." (Anadol, 2019)

Artechouse is a new kind of museum of art and technology with an immersive digital exhibition that uses digital projection to immerse the audience in the experience. In the

Artechouse website presentation, the art director and founder Sandro Kereselidze writes, "Every city has a destination for fine arts, theatre, music, and film. Our goal is to be the home in those cities for an innovative, 21st-century art that is created at the intersection of art, science, and technology."(Kereselidze 2021). The statement recalls Benjamin's idea regarding technological advances that create new audiences and new forms of distribution. In recent years a new kind of exhibition space with immersive 360 degree projection spaces has opened in numerous cities around the world, including among others: in June 2017, Artechouse in New York; in April 2018, Atelier des Lumières in Paris; in June 2018, the Mori Building Digital Art Museum in Japan; and in October *2019*, Ideal in Barcelona. The idea behind these immersive exhibition spaces comes from the cave projections that institutions like Ars Electronica Center first introduced in 1996 and updated in 2009 to *DeepSpace 8K*. These new innovative venues introduced popular content to mass audiences, such as exhibitions of the big names from art history, such as Claude Monet and Vincent Van Gogh. The museums also put on shows that celebrate 21st century art including the AI art of Anadol and *Ouchhh* collective. The most recent of these AI exhibitions is *POETIC AI*', which was presented at Atelier des Lumières and later on at Ideal in Barcelona. These new museum spaces enable different exhibitions to be held in the same space at different times of the day, since it is all based on digital audio-visual and interactive software and projections that can be changed with just the click of a mouse button. What is more interesting is that the same exhibition can also be shown in several museums at the same time.

We also see the influence upon and by the art market, although it remains dominated by tangible art in the most concrete sense, even in the novel field of art that has been made using AI. Images generated by GANs are a very

popular medium for artists working with AI and there is wide interest in the market. In 2018, the french AI art-collective *Obvious* sold the first AI-generated artwork in an auction for $432,500 (Vincent, 2018), thereby generating further interest in the form from market investors. Digital images generated by AI can be distributed online, be printed and appear in artist books, or even be sold in CryptoArt markets, like NFT ('Non-Fungible Token), which is sold using cryptocurrency and with smart contracts on the *Ethereum* platform. Helena Sarin has been using these distribution media with her GANs practice. The artist is very active on Twitter, where she shares her latest creations. Sarin created a self-produced book called "GANesis" in 2019. She has also been selling her pieces on *Superrare* and *Rarible* since 2020—two popular CryptoArt markets for selling NFTs. In all these markets, the most popular medium in which to sell an NFT is an image, but it is also possible to sell other formats like short videos and 3D models.

In the end, culture and technology are not neutral, both are political. Artists working with art, science, and technology are deeply engaged with AI research for the purpose of artistic exploration. Many artists are early adopters of AI models published by scientists and companies with AI research teams. However, an alarming tendency is that some models are released in close circles that remain unknown and are not accessible for the larger public. Researchers and artists need to request permission from those large corporations to obtain beta access to their models and infrastructures like *OpenAI*. This happened for the first time with the release of the language model GPT3. Art needs to be critical and conceptual. It is essential for cultural productions to be involved in technological development in the age of machine intelligence. The work of German-Iraqi artist Nora Al-Badri is an example of this critical thinking applied to AI art. She contacted the

five museums with the largest collections of Mesopotamian, Neo-Sumerian, and Assyrian artefacts to request access to images of their collections. She was denied access to those digital archives and so she decided to web-scrape 10,000 pieces from the museums' websites. With all that visual material, in 2020 she then trained an AI model to create *Babylonian Vision*, a speculative view of archaeology and de-colonised use of machine learning, thereby generating a "techno-heritage". Al-Badri describes her intervention with AI as follows: "Ironically, this black box problem can now be used against the museum, against the colonial machine. We more or less know who/where the largest collections in the world are, but they cannot prove that I used their datasets to train the system. In many instances, the black box aspect of AI can be a problem but in some cases, it can also be liberating." (Debatty 2021)

Benjamin's insight in *The Work of Art in the Age of Mechanical Reproduction* clearly has parallels with the age of artificial intelligence. Throughout modernity, technology has shaped society, influencing and reshaping cultural production and continues to do so in our AI-infused everyday life. Cultural production embraces each era's technological innovations; as Benjamin said, "The manner in which human sense perception is organized, the medium in which it is accomplished, is determined not only by nature but by historical circumstances as well." (Benjamin 2008, p.5). Technology-based art forms like cinema changed the function of art in the 20th century. Artificial intelligence is now redefining the world and media such that text may become music, music may become images, and images may become text; and this loop is endless. Technology is continually altering the way art is experienced, just as Benjamin predicted. Furthermore, the work of art has acquired even more political significance as we approach the edge of technological singularity.

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The Defenestration of a Reputation: Creativity, AI and Comics

Jon Karvinen

The general view of robots and artificial intelligence propagated in the popular media is not indicative of how this technology performs in the context of reshaping human creativity. In reality, robotics and AI are in no position to threaten humanity. Instead, questions about the use of AI are commonplace. In relation to the arts, especially the visual arts, algorithms already govern how and what kind of imagery we interact and engage with. This is discussed by Lev Manovich in his book *AI Aesthetics*, which showcases how AI is already used in audience studies as well as how it will influence the future of aesthetics (Manovich, 2018, p.75, p.408). Evaluation of this use of AI and its work does not always focus on the finished art pieces themselves, only on how they are consumed. Commercial businesses obviously have a vested interest in the utility of artificial intelligence for studying the online behaviour of consumers, which enables them to create algorithms and neural networks that streamline decision making and influence consumer habits (Stephen, 2017).

The world of the arts and culture is yet to try using AI to explore the logic behind works of art or to attempt to analyse

the motivations and inspirations of the artist. Instead, it is only used in discussion to show how AI cannot possibly be as effective as a human being in creating coherent and meaningful art. The machine's inability to reflect upon its own work was the first thing pointed out by such pioneers as Ada Lovelace (Bowden, 1953, p.398). However, this should not be the only conclusion taken away from the discussion and we should not dismiss the entire topic for this reason alone. Breaking down and understanding artificial intelligence is a huge task; it requires comprehending thought processes and models which are present mostly in the field of post-humanities, and sometimes the concepts addressed are closer to the social sciences. AI is here to stay and has already become an integral part of our culture. The ways in which it affects comics, the nuanced art of storytelling and the creative processes behind it, is what I wish to discuss briefly here.

To understand the unknown, it must first be defined; such is the nature of comics. Terminology evolves as it attempts to catch up with its practitioners. Most people limit their experience with comics to three-panel comic strips; their knowledge restricted to the brief delights in the newspapers they read as children. The relationship between comics and theory is tumultuous to say the least. The field of comics is accessible, but to scale the heights of fame and creative satisfaction demands more than just luck. The ability to record a story, a series of moments in time, is something any good comic artist should strive for. From Hergé (*Tintin*) and Osamu Tezuka (*Astro Boy, Blackjack*) to modern web comic creators such as Tracy J. Butler (*Lackadaisy*), these artists have become revered storytellers to their readership, garnering multiple re-readings in which the work is affected by each new context (Miodrag, 2013, p.139). Creativity in comics (or 'comix') is a highly sought after talent. Even the nomenclature is highly

suggestive. Whereas *comic strips* are seen as an innocuous, simple exercise for the mind, *graphic novels*, with their sweeping page transitions and panel formations that toy with time and space, are regarded as pieces of high artistic creativity.

To understand where comics stand, we must first make something clear. The definition of a 'comic' is not (or should not be) be the focal point of discussion any longer. McCloud's now infamous definition of comics: "juxtaposed pictorial and other images in deliberate sequence" (McCloud, 1993, p.9) is now seen as outdated, yet perversely is still recognised as the cornerstone of most current conceptualizations (Miodrag, 2013, p.141). More interesting scholarship has moved away from that debate and towards discussions of intertextuality, form, narrative, hybridity, and how this newly reconstructed kinship between art and language has become a point of interest in its own right. The theoretical framework proposed for comics contains many different perspectives from which to approach the discussion. Hannah Miodrag, in particular presents one of the most engaging approaches in her book *Comics and Language: Reimagining Critical Discourse on the Form*.

This more academic approach to studying the medium of comics could lead to the usage of more varied visual and linguistic theories, especially concerning the importance of both verbal and visual signification and the insistence that both be considered separately in order to yield different, or even directly contrasting, results. Practitioners and artists taking this route have taken advantage of AI as an aid in their study of the multitude of available material.

The trend of scholars like Miodrag taking comics more seriously elevates discussion of the medium to a sufficient level where its relation to the overall field of art criticism should not be ignored. By considering the broader range and potentialities of comics, the most productive studies have the

capacity to broaden the field by letting go of older paradigms. By addressing the problems and inherent anxieties of existing scholarship we can reveal more convergent and unified solutions that provide opportunities for the application of different visual and literary methodologies.

The field is still somewhat scattered and riddled with many disparate theories. This is not necessarily a weakness for what is a young field that is still finding and adopting new analytical tools, but it does lead to concerns about how the separation of word and image is being handled. This is where the use of AI could change the game, by studying and learning from existing comics as well as producing new material that is viable for analysis on its own. Much rests on context, on the choice of placement of panels and different narrative interruptions, on seeing how they emphasize different visual components such as graphic style and use of colour, and on attempting to create a base set of rules without being bound by a strict grammar. AI would provide the raw power to help with processing and understanding all this information. Something I have found particularly interesting during my own research into the interaction between comics and AI is how creativity as an aspect of culture has been increasingly explored by machine learning in recent years.

In comics theory, the cognitive analysis of the art form is slowly making its way into the mainstream, although it is probably still Miodrag's book that drives most discussion of the topic. Lingering on *what* comics are is a disservice to the field, and moving onwards from that preoccupation is essential before developing and identifying analytical tools. Miodrag's attack on the existing understanding of *sequentiality* added much to the discussion of the topic. But, sequentiality, although a vital element in early theories, does not appear to hold the key to understanding the future of the form or where the scholarship is heading.

Adding various machine learning techniques as an academic partner comes with a certain risk. A defensive stance is often adopted by both fans and scholars against the idea of the medium as culturally inferior; the pushback against this often leads to comics being presented as a form of literature that just happens to also offer images, and thus solidifies the primacy of verbal elements of comics. The three-panel comic strips, with their static art and reliance on verbal quips, word play and banter are certainly not hailed as high art, and this cultural anxiety sometimes leads scholars to push for new frameworks when a more confident approach to an existing line of thought might better drive the field forward. This response against both mainstream reception and peers within the field is possibly one of the main reasons why many comics concern themselves with being seen as highly creative, unique works of art.

The structure underlying the grammar of comics is ever-changing, with many different theories coexisting simultaneously. The goal of studying comics and creativity through the eyes of AI would be to also revise the field's own approach to criticism. This could be achieved by examining how current trends of literary and linguistic criticism affect the field. How the verbal and visual elements of comics work together is often a fringe discussion yet is absolutely vital; this interplay gives rhythm to the work, and to the *experience* of comic reading itself.

Polanyi's paradox, "We can know more than we can tell", is a governing force in how we try to explain creativity to ourselves. There are not any straightforward, universally applicable explanations of what creativity actually is. It is a concept still somewhat shrouded in mystery; an enigma whose answers often rely on purely anecdotal explanation. Different art styles, writing habits and transitions add their

own flair to a finished work, and the reasoning behind those decisions tends to be the thing that artists, critics and readers alike pin down as being the show of creativity.

All these aspects make the list of what should be taught to AI if it is to consider works of longer length. They could be described as a stress test, to see if the machine could even begin to understand normal transitions (Iyyer, 2017, p.8), before moving on to read narrativity itself. Anything that removes (as much as an AI can) human bias from considerations of creation and selection would be interesting—to see a story from the point of view of various algorithms. The sequential nature of comics presents a hurdle to the machinations of AI. If comics are as versatile as the debate around comics theory insists they are, artificial intelligence faces a conundrum which requires a careful approach. What *is* creativity in the context of comics? Even the most mundane comic strips can be transformed into thought-provoking art pieces; this has been proven time and time again using comics that have been around for half a century.

One of these is the *Garfield* comic strip by the American artist Jim Davis; ubiquitous in newspapers around the world yet not considered a work possessing great artistic merit. In comics insiders' circles, jokes about the predictability and over-familiarity of this 42-year-old juggernaut of newspaper strip comics abound. Yet as different machine learning techniques (such as GANs and Markov chains) have been used to try mimic or create *Garfield* comic strips, the results have varied from surreal, dreamlike imagery to almost nonsensical poetry (Karvinen, 2020). I wrote about this topic more extensively in my MA thesis *Creativity, Garfield and AI: Using AI to Enhance Our Understanding of Comics*.

Computational creativity is a field that I find interesting in that it ponders a lot of philosophical questions and attempts

to tackle a controversial subject. At first glance it seems to explain and validate processes that we see as integral parts of the human experience, yet it achieves this by almost entirely detaching humanity from it. It serves a purpose as a tool for examining simple comics, their panels and framing tools, but tackling an actual narrative is something that seems beyond it.

By delving into more philosophical questions, the role of creativity in comics can be discussed further. In their article *Computational Creativity: The Final Frontier?,* Simon Colton and Geraint Wiggins define computational creativity thus: "the philosophy, science and engineering of computational systems which, by taking on particular responsibilities, exhibit behaviours that unbiased observers would deem to be creative" (2012, p.21). The biggest contribution to the field of computational creativity comes from Margaret Boden's book *The Creative Mind: Myths and Mechanisms* with her concept of transformational creativity, which examines more deeply the divide between humans and AI. Furthermore, the concept of the different forms of creativity which Boden speaks of (combinational, exploratory, and transformational) set limitations upon the execution of prior knowledge that not only raise philosophical questions but provide raw data for the ways in which AI could be taught. 'P-creativity' (psychological creativity) especially is humanity in action: ideas and revelations are constantly rediscovered by different individuals, yet the meaning as well as the impact of those repeated ideas still remain (Boden, 1990, p.32-33).

The ability of AI to create a script cannot be doubted. It is one of the first touchstones that are taught as part of the basic principles of AI—that machine learning has created a multitude of tools that can create short stories, music and scripts—many of these tools and their products have garnered attention across the internet (Pearl, 2020). AI might in the

future take a more prevalent position in the creation of a work of art, but the way in which humans consume and analyse AI-created art also demands further attention. When an AI is given free rein to play with the source material it must be understood that even if it created anything completely new, simple algorithms do not have the resources and tools to evaluate whether are creative in themselves. This is where the role of AI will become truly important in the future: unlocking its own potential. The origins of creativity are continue you to be the subject of serious philosophical debate, but we understand that there is time for the focus of that creativity to become about independent assistance; it becomes both an internal and external power.

I believe that the most promising potential for creative AIs to influence human creativity lies in studying the aforementioned transformational creativity. This is what the use of AI should aim for in art: not attempting to achieve absolute uniqueness, but instead to try to achieve creativity by deploying already existing variations that nevertheless transform a space or a subject within that space. Even when an AI, especially a GAN, is given free rein to play with the source material, we must understand that it is still dependant on that source material and the limits of the code given to it. More importantly, creative AIs with their (hopefully) unbiased end results eschew considerations of an audience to tap into the most intimate carnal source of human creativity itself. The hope is that we see the value in human creativity being assisted rather than replaced, and that this attitude becomes the norm.

To test and expand one's own ability would be the end goal, yet it would be arrogant to suggest that we relegate the simpler comic strips into nothing more than tools for AI to play around with, that we sacrifice their artistic integrity just

to learn how we can create better. The choice is ultimately not just anyone's but that of the individual artist. What AI can provide to an artist is nothing more than the processing of raw material.

At this stage, AI acts upon the requests and limitations imposed upon it within the creative space that it has been granted. AI gives us the ability to understand these creations and to provide art with new interpretations. This is especially true when it comes to comics: the freedom to analyse the writing, the art and then the story simultaneously sets the medium free. AI might also be of assistance in taking care of the most mundane tasks, giving time for the artist to simply create. Automating the generic and repetitive aspects of the work allows the artist to tune out unnecessary white noise and emphasise on creation itself; combining new variations together to create something completely new. It is hoped that this will also enable the work to be undertaken in every context simultaneously in order to see the boundless possibilities of the medium, and that this will become the norm. Such an approach cuts to the core of self-expression quickly, allowing for a greater number of new combinations and stories.

Ultimately, all of this may lead to AI becoming an extension of oneself, leaving the artist to evaluate whether they truly were creative in their own actions. The potential for exploration and the seemingly endless ability to produce new combinations from existing material seems to provide the optimal route for developing our understanding creativity. AI is just another tool that can help to clear out and categorise excess noise and let us understand the way we think as individuals.

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AI Art: Between Technology and Art

Luba Elliott

The past few years have seen a rise in machine learning applications across the creative spectrum, with artists from technology, media and fine art backgrounds employing AI-based tools to create new ways of representing the world, explore the technology's creative potential and critically analyse its impact. Frenetic research activity in the AI community has presented artists with a variety of tools to experiment with and critique, while mainstream media, technology companies and gradually art world institutions have been eager to publicise, fund and exhibit this new type of art. Yet one question continues to be asked: But is it art? Based on my experience as a curator, I will examine the difference in goals, values and perspectives between the worlds of art and technology, as well as the public reception of the new AI-based art.

In their day-to-day work, artists and technology researchers are oriented toward different goals. On the technology side, it is frequently to develop a novel method that beats existing benchmarks, but for artists it is about critically exploring that technology, its limitations and potential, and using this new-found knowledge to communicate and express their views. Naturally, this has meant that there is

quite a difference in terms of the types of artwork that are valued by either field.

On the technology side, the current wave of AI art began with Google's *DeepDream* (Mordvintsev, 2015), the psychedelic aesthetic developed by Alexander Mordvintsev back in 2015. The technology emphasises particular features of an image, changing mundane views into bright, hallucinatory pictures filled with puppyslug creatures and pagodas. This project was not made with the intent of developing that aesthetic, but instead arose during scientific research and experimentation. It highlights the creative nature of AI because it finds shapes and colours that are not obviously present in the original image. After *DeepDream*, neural style transfer became popular to the extent that smartphone apps such as *Prisma* were developed for the mass market. This direction in research proved to be a focus for teams looking at the crossover of art and AI.

In 2014, Ian Goodfellow (2014) developed the wildly successful GAN algorithm, which has enabled the increasingly realistic depiction of human faces and figures among other things. In the case of the early GANs, the generated images were not as highly realistic as today. These first GAN versions exhibited what Goodfellow (2016) described as "problems" with "counting", "perspective" and "global structure". In visual terms, this refers to the frequently confusing placement or angle of limbs and facial features. Even the most recent highly-realistic models are not completely perfect: in his 2018 essay, Kyle McDonald (2018) highlights several possible flaws of AI-generated human faces such as asymmetry, weird teeth and missing earrings.

Meanwhile, as these technologies began trickling down to the mainstream media, more and more non-technical artists began experimenting with AI, using the most readily accessible tools. Examples include the *Obvious* art collective, whose

Portrait of Edmond Belamy (2018) included an application of an off-the-shelf GAN model to a dataset of historic portraits, at a stage already when the technical community was able to generate images of much higher quality. The established contemporary artist Pierre Huyghe (2018) followed with his work *UUmwelt (2018)*, which premiered at The Serpentine Galleries and graced the cover of ArtReview, yet was met with a distinct lack of excitement in the close-knit AI art community. Even though Huyghe worked with Japanese scientists to capture brain activity by an fMRI scanner and then trained a neural network from that data, the generated images showcased on a large screen were of poor quality. The concept as it stands is certainly interesting as per the art world criteria: it combines digital art with brain activity and its display sees live flies buzzing around the screen. However, it fails to impress the technical community: its blurriness is laid bare on a gallery screen and any technical novelty in the deep image reconstruction from human brain activity processes is lost through association with the poor image quality of early GANs.

It took a while for the art world to begin making works of interest to the technical community, and vice versa. While technical artists such as Mario Klingemann and Alexander Mordvintsev focussed on aesthetic novelty and beauty, critically-minded media artists such as Coralie Vogelaar and Constant Dullaart cared more about the comment, meaning and story within each artwork. However, now that the field has matured and a number of AI-related exhibitions have been held worldwide, there is more of a shared understanding and appreciation between the various communities as well as more crossover in their artistic and technical goals.

In my view, some of the most exciting work in the field has come from moving away from AI as a digital tool and instead working more closely within the physical realm of

fine art. Roman Lipski is a great example of an artist working with machine learning in an unusual fashion. He has spent the majority of his career painting landscapes in a semi-realistic fashion and recently decided to reimagine his practice by collaborating with an AI muse developed by a team of technologists. For the work *Unfinished* (2017), this muse was trained on a limited dataset of his paintings and proceeded to generate new variations, which Lipski reviewed and used as inspiration for subsequent works. In turn, these served again as training material for the AI, which produced new versions based on the new data. This series of works marked an evolution in Lipski's style, incorporating a broader colour range into his work and veering towards abstraction.

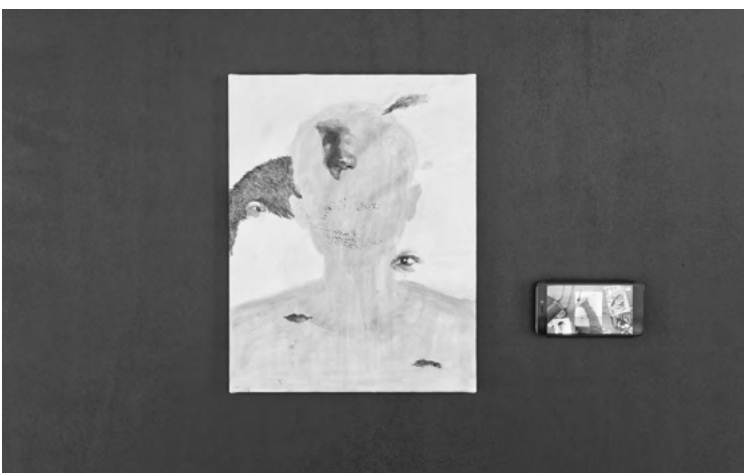

Figure 1. Shinseungback Kimyonghun: *05, Nonfacial Portrait* (2018). Image courtesy of the artists.

Similarly, the Korean duo *Shinseungback Kimyonghun* worked with various artists for their *Non-Facial Portraits (2018)* series, in which portrait painters were tasked with painting portraits of humans in correspondence with the use of a facial recognition camera. (Figure 1.) The challenge was that

the finished portrait should not be recognised as a face by the system; meaning that as soon as a face was detected, the artist had to modify the portrait in order to comply. This presented a series of unusually creative portraits, which highlight the difference in perspective of humans and machines regarding what constitutes a face and a portrait. In a sea of artworks dealing with the implications of facial recognition in a public setting, this series proved extremely refreshing and served as a reminder of how AI can be used not just for digital work, but also as an aid in a physical painting process.

In the case of sculpture, Ben Snell's *Dio* (2018) stands out: its design was AI-generated based on hundreds of historical sculptures from modernity to antiquity. After the computer had generated the design, the artist proceeded to smash it and grind it into dust, which was used as the material for the sculpture. This work is remarkable not only given its elaborate concept, but also because it links to the practice of art destruction conducted by artists such as John Baldessari, who burned his artworks and made cookies with the ashes (Miller, 2019.) Snell's work reinterprets this practice for the current age of human and AI co-production, whilst firmly rooting the sculpture in 20th century traditions with its modern aesthetic reminiscent of Henry Moore.

Finally, Helena Sarin's *Neural Bricolage* series considers the possibilities of AI tools in fine art in a refreshingly original fashion. In her work, Sarin makes images by combining the textures and patterns of different media. For example, in her flower still-lives such as *Cutouts (2019)*, there is a mixture of newspaper, engraving and photography textures, which lend her work a craft-like quality that is distinct from most other AI art. (Figure 2.) The works evoke a physical presence despite the fact that the images are digitally generated, often through chaining multiple GANs.

Figure 2. Helena Sarin: Cutouts (2019). Image courtesy of the artist.

Aside from my own evaluation, it has been fascinating to observe how the wider public receives AI artworks. As someone whose background lies outside contemporary art, I have been well-placed to experiment with different exhibition formats, venues and styles to encourage a broad audience, without the pressure or expectation of adhering to norms set by museums and established institutions. In the past year or two, the works that have generated the most excitement in the audience tended to be both aesthetically pleasing and accessible in terms of subject matter, such as Anna Ridler's *Mosaic Virus (2018)* tulips, Sofia Crespo's *Neural Zoo (2018)* of imagined sea creatures, and various works related to the human form made by artists such as Mario Klingemann and Scott Eaton. Excessively academic work fared less well given that typically mainstream and non-professional art audiences

are less interested in the abstraction, slow pace and heavy jargon associated with such works.

To conclude, AI as a tool has attracted artists from diverse backgrounds with vastly different goals, each one finding new applications and understandings, whilst testing the limitations and creative possibilities. The early GANs provided artists with plenty of opportunities to make the most of their "problems". However, now that the generated images and texts are extremely realistic, artistic practice is left with something of a conundrum—the technological developments have become less exciting creatively because the results are too perfect. Furthermore, as much of the technical and aesthetic experimentation has been completed and a high level of realism has already been achieved, it is now the turn of the artists to engage more deeply with meaning and storytelling associated with incorporating AI into their practice. Put simply, the work created has to hold its own in a sea of contemporary art projects of diverse media and subject matter. Only when AI art is subjected to the same expectations as contemporary art will we be able to clearly evaluate the impact and success of AI-based tools in an art history context.

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Computational Creativity and its Cultural Impact[1]

Oliver Laas[2,3]

1 Introduction

Advances in artificial intelligence and deep learning during the past decade have paved the way for the widespread dissemination of a technology that could have a considerable impact on our culture and society in the near future. In the present essay, I will state two theses about computational creativity: (a) that applications of creative AI may bring about a conceptual shift in our understanding of authorship; and (b) that applications of creative AI may bring about an epistemic crisis with respect to the evidential status of audio and visual recordings. These seemingly disparate claims are related because the changes described in them rest on the same kinds of technologies. Although I will examine these

1 This is the author's translation of an essay originally published as Laas (2020).

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changes mainly in the context of visual representation, similar trends can be observed with regard to auditory and textual representations.

Since both theses depend on extrapolating from present trends, the criteria used for evaluating extant data should be explicated. Thus, I will begin with a brief discussion of computational creativity in Section 2, distinguishing different types of creativity and proposing a criterion for evaluating the creativity of AI applications. In Section 3, I will review some examples of computational creativity in order to show that the first thesis is plausible. This will be followed by a look at some of the epistemic norms associated with representations that support their use as evidence in Section 4. The plausibility of the second thesis will be supported by an examination of deepfakes in Section 5.

The goal of this essay is not to propose solutions but to highlight potential AI-driven cultural changes that we could be facing in the near future, since I believe that these concerns warrant more attention than they have hitherto received. The ensuing discussion presupposes that relevant technologies will generally continue to develop at their current rate and that we will not be witnessing a new *AI winter*[4] in the near future.

2 Computational creativity

Computational creativity is "an emerging branch of artificial intelligence (AI) that studies and exploits the potential of computers to be more than feature-rich tools, and to act as autonomous creators and co-creators in their own right."

4 An AI winter is a decrease in funding and interest in AI that has an impact on research in the field.

(Veale et al., 2019, 2) As a discipline, computational creativity combines research in AI, cognitive science, psychology, and social anthropology with the aim of both theorizing about the creative capacities of computers as well as building computer systems that exhibit human-level creativity that humans would also perceive as creative (Veale et al., 2019, 2, 3).

But what is creativity? How we answer this question partly determines whether computer systems can be creative. Before doing so, however, a few words on two common but unhelpful conceptions of creativity. The first of these is *inspirational*, since it claims that creativity is a divine phenomenon. This view can be traced back to Plato:

> You know, none of the epic poets, if they're good, are masters of their subject: they are inspired, possessed, and that is how they utter all those beautiful poems. The same goes for lyric poets if they're good … [they] are not in their right minds when they make those beautiful lyrics, but as soon as they sail into harmony and rhythm they are possessed by Bacchic frenzy. … For a poet is an airy thing, winged and holy, and he is not able to make poetry until he becomes inspired and goes out of his mind and his intellect is no longer in him. (Plato, 1997, 533e–534b)

The second conception, call it *romantic* (due to its origins in Romanticism), insists that creativity is an innate and rare gift or intuition. Boden (2004, pp.14-15) argues that both views are unhelpful because they mystify creativity and thus fail to explain it. Furthermore, since these views are often presupposed rather than argued for, they should be viewed as myths of creativity rather than theories.

The adoption and defense of a detailed definition of 'creativity' would go beyond the scope of this essay. In the interest of what follows, let's say that act *x* is *creative* if and only if its effect is new, surprising and valuable within some cultural context or other frame of reference. According to this definition, creative acts are performed by agents.[5] Novelty and the presence of a surprised audience seem to be relevant components of a creative act because expected effects are generally not thought of as creative and evaluating an act as such presupposes an evaluator. A creative act also seems to presuppose a cultural context constituted by rules, styles, works and past creative acts against which *x* appears creative and surprising for someone.

The above definition of 'creativity' is in agreement with criteria proposed by Newell et al. (1959, pp.3-4) for identifying creative solutions to problems:

1. the solution is useful or novel (for the individual or society);
2. the solution demands that we reject previously accepted ideas;
3. the solution results from intense motivation and persistence; and
4. the solution comes from clarifying a problem that was originally vague.

These criteria, also used in the field of computational creativity, capture some of our pre-theoretic intuitions about

5 This agent-centered view of creativity seems to preclude the possibility of (emergent) creativity in nature or complex systems. Without wishing to debate the possibility of "agentless" creativity, such restrictions are not problematic here because (a) I am concerned only with the putative creativity of artificial agents and (b) artificial systems, such as artificial neural networks (ANNs), will be treated as artificial agents in the following discussion.

creativity: (1) expresses the folk-intuition that creative solutions should be novel; (2) insists that creativity involves moving beyond established ways of thinking (3) claims that creativity requires effort; and (4) captures the idea that creativity both presupposes as well as provides insight (Veale et al., 2019, p.3).

Distinguishing different types of creativity will facilitate the analysis of AI creativity and its impact. An influential typology has been proposed by Boden (2004) who distinguishes between *two kinds of creativity*:

- *Psychological creativity* ('P-creativity'): involves coming up with an idea that is novel, surprising and valuable for the creator;
- *Historical creativity* ('H-creativity'): involves coming up with an idea for the first time in known history.

Boden suggests that H-creativity is a special case of P-creativity. She also distinguishes between the following forms of creativity:

- *Combinatorial creativity*: involves coming up with novel combinations of familiar ideas;
- *Exploratory creativity*: involves coming up with a novel idea within some existing conceptual space;[6]
- *Transformational creativity*: involves coming up with new ways of creating ideas by altering the rules of some extant conceptual space.[7]

6 For present purposes, a *conceptual space* can be thought of as a collection of concepts, examples, scripts and rules that guide activity in some domain. For example, the conceptual space of Euclidean geometry consists of its axioms, theorems and the shapes permitted by them.

7 An example of transformational creativity could be the introduction of non-Euclidean geometry, which involved rejecting the constraints associated with the Euclidean conceptual space in order to permit the construction of new kinds of shapes.

Collages and the Rutherford model of atomic structure are examples of combinatorial creativity (Boden, 2004, p.3), the compositions of J.S. Bach that probed the limits of Baroque music are examples of exploratory creativity, and Schönberg's atonal music is an example of transformational creativity (Sautoy, 2019, p.9). H-creativity seems to presuppose transformational creativity. Despite its shortcomings (see Wiggins, 2019), I will employ Boden's typology for analyzing examples of computational creativity in Section 3.

Before examining the examples intended to support the first thesis, we must answer a further question: can computers be creative? This question is related to the one posed by Turing (1950) about the possibility of machine intelligence, because creativity and intelligence seem to be closely related. Turing treated intelligence as an observable behavioral pattern, summarized in his eponymous "Turing test": if we have parties *A*,*B*,*C* where *A* and *B* are humans while *C* is a computer, then *C* is *intelligent* if and only if *A*, after questioning both *B* and *C* via text through a computer terminal, is unable to tell whether *B* or *C* is the computer.

The Turing test suffers from a number of shortcomings, two of which are relevant for present purposes because they motivate the alternative that will be used below. First, it is unclear that passing the Turing test, at least in its original form, would suffice for intelligence, since its stringent demands—only text-based communication, yes-no questions, and so on—reduce humans to the level of machines instead of demonstrating machine intelligence in any human sense (see Floridi, 1999). Second, Ada Lovelace, a friend of Charles

Babbage,[8] argued that a computer cannot be creative because it has to follow rules, but creativity involves going beyond the rules or even breaking them (Boden, 2004, p.16).

The latter objection has motivated the creation of an alternative *Lovelace test*: a computer *C* is *intelligent* if and only if *C* creates an object *o* such that the creation of *o* results neither from accident nor error but from a process that *C* can replicate and an observer *H* (or someone with the knowledge and resources of *H*) cannot explain how *C* created *o* (Bringsjord et al., 2001). This is a meta-test in that *o* can be a sentence in some natural language, proof of a theorem or a visual representation. While imitation suffices for passing the Turing test, one needs creativity in order to pass the Lovelace test. This is why it would be a useful criterion for evaluating machine creativity and I will employ it as such in Section 3.[9]

3 Conceptual changes regarding authorship

Although Barthes (1977) wrote about the death of the author back in 1967, what he had in mind was the result of changes in human interpretative practices. If current technological trends continue, then applications of computational creativity may cast greater doubt on human authorship and its

8 Charles Babbage (1791–1871) was English mathematician and computer pioneer who proposed, among other things, the Analytical Engine—a mechanical computer the logical structure of which was equivalent to the one employed later for designing electronic computers.

9 I will ignore here the question of whether creativity requires intentions or other mental states because this would shift the focus of this essay toward philosophy of mind and I do not wish to preclude the possibility machine creativity on the basis of a priori philosophical arguments

associated moral or legal norms than any past changes in interpretive practices.

Miller (2019) claims that A. Michael Noll, an engineer working at Bell Labs back in 1962, was perhaps one of the first experimenters in the field of computational creativity, because his attempts to get the IBM 7090 mainframe to generate random visual patterns led to unexpectedly artistic results. A more deliberate experiment in computational creativity was AARON—a computer program created and developed by Harold Cohen between 1973-2006 that was able to create both abstract and figurative, black and white or colored images. Early versions generated abstract compositions by staring from a randomly chosen point and following a set of complex IF-THEN rules. Later versions chose their starting point deliberately and generated figurative compositions. Each version, however, worked within the confines of a specific style and each stylistic change had to be explicitly programmed by Cohen. Thus, this is at best an instance of exploratory and P-creativity because the software explored a previously delimited conceptual space. AARON would probably not pass the Lovelace test, since either Cohen or someone else with his knowledge could explain its output.

Obvious[10]—a group of friends and machine learning experts—published a series of eleven AI-created paintings in 2018. One of the works, *Portrait of Edmond de Belamy*, was sold at Christie's for $432,500. *Generative adversarial networks* (GANs) are deep learning frameworks that consist of two models—a *generative network G* and a *detecting network D*. *G* learns to detect patterns in a human-labeled training sample (e.g. a database of portraits) while *D* learns to determine whether the output of *G* belongs to that training sample. *G*

10 See: https://obvious-art.com/.

and *D* are engaged in a two-player zero-sum game where *G* tries to maximize the probability of *D* being mistaken. By now, such models can generate photos of nonexistent people—essentially forgeries undetectable by the human eye.[11] Obvious employed *creative adversarial networks* (CAN-s) for generating their series by training *G* on a sample of portrait paintings from Western art history to output images that were not among the training sample but would imitate them to a degree that would make it difficult or impossible for *D* to distinguish the output of *G* from the training sample. At least from the machine's own perspective, this could be seen as an instance of P-creativity because it is maximizing its own utility function. H-creativity seems to presuppose transformational creativity. Since it suffices for the latter that an audience recognize a change in the rules of a relevant conceptual space, we could say that the application created by Obvious exhibits both transformational as well as H-creativity, since at least one writer has compared the importance of this achievement with the changes brought about by Marcel Duchamp's 'ready-mades' in the rules of contemporary art (see Rolez, 2019). Despite all this, it is unclear whether this application would pass the Lovelace test, since it is unknown whether Obvious or anyone with their knowledge could explain the system's output.

If we expand the set of examples, then other borderline cases can be found for which it is unclear whether they would pass the Lovelace test. For instance, AIVA (Artificial Intelligence Virtual Artist)[12]—a machine-learning program trained on the Western musical canon to compose music in diverse

11 For example, each refresh of the following web page shows a new photo generated by a GAN: https://thispersondoesnotexist.com/.

12 See: https://aiva.ai.

styles—has now released two albums and become the first non-human member of SACEM.[13] AlphaGo, a machine-learning application that beat Lee Sedol in the ancient Chinese game 'Go', discovered a new strategy during the tournament, which Sautoy (2019, pp.205-206) takes to show that it passes the Lovelace test. Selmer Bringsjord, one of the creators of said test, however, believes that no currently existing application could pass it.[14]

On the one hand, it is probably too early to speak of AI applications that could clearly pass the Lovelace test. Given current technological trends, however, the possibility of such an application cannot be entirely ruled out either. On the other hand, it cannot be ruled out that the Lovelace test may be the wrong conceptual tool for assessing machine creativity and intelligence, implying that one of the applications considered above could already be viewed as creative.

Regardless of whether it is too early to speak of machine creativity, advances in the field of computational creativity can bring about changes in our understanding of authorship and creativity. First, the question of authorship will likely become more acute. If it is true that we rely on the existence of a (known) author when evaluating and interpreting works of art (see Foucault, 1998), then how would the aesthetic reception of an artwork change in light of the knowledge that it was generated by a machine? If creators are responsible for their creations, then who is responsible for the creations of an autonomously learning machine? What will be the future

13 *Société des auteurs, compositeurs et éditeurs de musique* is a French professional association, founded in 1851, that both distributes rights to musicians and publishers as well as collects their royalties.

14 Bringsjord made this claim in an interview with *Mind Matters*: https://mindmatters.ai/2020/04/thinking-machines-has-the-lovelace-test-been-passed/.

of creative work once machines start competing with people? These and other (philosophical) questions will become more relevant in the near future due to advances in computational creativity.

4 Recordings and epistemic norms

Because of limitations in cognitive ability and resources, most of our knowledge about the world comes from the testimony of others. We are justified in believing something on the basis of testimony so long as the source is trustworthy. Should evidence emerge that the source is untrustworthy, their testimony can no longer justify our beliefs.

Since the invention of film, photography and other recording technologies, various kinds of recordings have become the means for testing testimonial evidence in our culture. This is shown by the fact that we tend to correct testimonies on the basis of recordings and not vice versa. For example, in court the recording of a security camera is considered more reliable than the testimony of an eyewitness. Rini (2020) has argued that the epistemic norms associated with recordings enable them to regulate our testimonial practices regarding public events. Recordings can do this in two ways: they allow us to *acutely correct* testimony because the accuracy and truth of the latter can be verified by recordings; they allow us to *passively correct* testimony because the background knowledge of possible nearby recording technologies should at least nudge public figures toward making more sincere and truthful statements.

According to Rini (2020), recordings constitute an *epistemic backstop* that we can rely upon to verify testimony about public events. Generalizing the *transparency thesis* put forward by Walton (1984), we could say that recordings can function as

an epistemic backstop because they are transparent: through recordings we perceive the objects that caused them. Thus, audio and video recordings as well as photos provide *sensory knowledge* about objects themselves (Cavedon-Taylor, 2013). According to the transparency thesis, then, the epistemic advantage of a passport photo over a portrait painting is that the former allows us to see the represented person whereas the latter is the artist's visual testimony of the represented person, since it depends on the artist's interpretation and can therefore be biased.

5 Deepfakes and the crisis of epistemic norms

Deepfakes are synthetic images, audio or video recordings, created with the aid of machine learning, where the voice, face or body of one person is replaced with that of another. At present, two main technologies are employed in generating such representations—the aforementioned GANs and *autoencoders* or ANN's that analyze an input image in order to generate a maximally similar output. Both technologies are widespread, available to ordinary users and their use is becoming increasingly easy over time.

The relevant technology has been in development since the 1990s. An early example is a project from 1997 where researchers were able to make the mouth of one person in a prerecorded video move in accordance with words from a different audio recording. In 2017, BuzzFeed did something similar with a video of Barack Obama as a cautionary example (see Suwajanakorn et al., 2017).[15] By 2018, it was possible to

15 See: https://www.youtube.com/watch?v=cQ54GDm1eL0.

manipulate videos depicting full bodies (Chan et al., 2019). First reports of deepfake audio come from 2019 (Vincent, 2020), when this technology was successfully used for fraud (see Stupp, 2019). Despite all this, deepfake technology has enormous potential in the entertainment industry where it has already been used, for example, to digitally de-age currently living actors or to bring dead ones back to life on the screen (see Winick, 2018).

The term 'deepfake' comes from an eponymous and now closed Reddit community where this technology was used to create fake pornography of mostly (famous) women. According to Ajder et al. (2019), by 2018 there were more than 14,000 deepfake videos on the internet, 98% of which were pornographic and of these 100% depicted women, 99% of whom worked in the entertainment industry. Caldwell et al. (2020) believe that deepfakes will be the greatest AI-related risk in the next 15 years. One worrying scenario involves the political use of deepfakes, the first examples of which can already be found. In 2018, deepfake pornography of Indian journalist Rana Ayyub was disseminated online in an effort to silence her (see Ayyub, 2018). Also in India, a deepfake video was used in a Spring 2020 election campaign to create the impression that a political candidate addressed voters in a language that he did not actually speak (Christopher, 2020). In Belgium, a deepfake video of the prime minister relating the Covid-19 pandemic to climate change was disseminated online (Galindo, 2020). According to some reports, the past few years have already seen a rise in such incidents (Koetsier, 2020). Due to technological development and increasing user-friendliness, we can probably expect an increase in the number of such incidents in the coming years.

Rini (2020, pp.7-8,11-13) argues that deepfakes threaten to undermine the epistemic norms associated with recordings.

First, if deepfakes become so life-like over time that people will be unable to distinguish them from authentic recordings, then disseminating disinformation and facilitating political destabilization through the dissemination of deepfakes on social media will become considerably easier. Second, even if deepfakes will not achieve sufficient technical perfection to fool most people, the mere knowledge of the potential to deepfake most content can increase "the liar's dividend", that is, create a situation where people will try to avoid responsibility for their words or deeds by claiming that the relevant problematic recordings are deepfakes (Chesney and Citron, 2019). The latter tendency is already observable. For example, Schick (2020) writes of a 2019 incident in Malaysia where the then minister of finance, Mohamed Azmin Ali, who found himself in a homosexual sex scandal, claimed that the video which had incited the incident was a deepfake; subsequent inquiry verified the authenticity of the video. Regardless of whether deepfakes become indistinguishable from authentic recordings or simply end up increasing the liar's dividend, the result will be an erosion of the epistemic norms associated with representations and a falsification of the transparency thesis. One could object that photo editing software has for a long time cast doubt on the transparency thesis. Rini responds that the epistemic status of audio and video recordings differs from that of photos in our culture because we generally verify the reliability of photos with the aid of video. The danger is that deepfakes will do to audio and video recordings what Photoshop did to photos when it undermined their reliability as sources of testimonial evidence.

6 Conclusion

If the trends described in this essay should continue and bring about the predicted cultural changes, then we can expect an increase of *deep disagreements*—disputes that may be unsolvable by rational means and stemming from a lack of shared epistemic standards, facts and evidence—in society at large, since the unreliability of audio and video recordings means that there will be one less means for developing an argumentative context of shared evidence that is the prerequisite of rationally resolving disagreements. Developments in the field of computational creativity may also bring about the step-by-step automation of creative work, which may in turn change our understandings of both authorship as well as our value judgments about creativity. The banning of these technologies is not the solution, since this would deprive us of their benefits and would ignore the fact that the relevant knowledge is already public. Probably an adequate response to these complex challenges should involve both technological solutions and regulative means as well as the development of critical media literacy on the individual level.

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Concept Transference in Art and AI

Raivo Kelomees

Abstract. Artificial intelligence (AI) technologies seem novel in an artistic context yet, by exploring certain proposed new terms, I aim to demonstrate that the practice of 'relinquishment' of creative activity has its roots in art history. The following questions will be addressed in the paper: can such a 'relinquishment-technique' be considered a universal mechanism for artistic inspiration? Can we find something similar in surrealistic techniques? Is the author disappearing or becoming 'transparent' when abandonment of creative activity occurs? Does AI-based art assume the transparency of the author and is it possible that artworks can be created by other artworks? The terms 'linear', 'circular' and 'closed-loop' concept transfer will be analysed with regard to interactive artworks.

Keywords: Artificial Intelligence Art, Surrealist Techniques, Transparency of the Author, Interactive Art, Linear Concept Transfer, Closed-loop Concept Transfer.

There has been much discussion about how artificial intelligence (AI) revolutionises everything, ranging from day-to-day situations to mass production, including creative practice, and the automatisation of users' online behaviour: "It recommends what we should see, listen to, read, and buy" was noted by Lev Manovich in 2018. AI technologies exert an influence over our everyday choices, the ways in which we represent ourselves and how we perceive others. Another quote from Manovich (2019, p. 5) that should to be kept in mind as a backdrop to this article is: "What defines whether something is "AI" is not a method but the amount and type of control we exercise over algorithmic process."

In the subsequent discussion I would like to use the term 'intermediary technologies' to describe the various methods, tools, mechanisms, software and technologies that humans utilise to obtain information from the external world and to carry out their creative practice. These intermediary technologies are situated between humans and the external world and serve to vary or enhance human behaviour allowing it to be more effective, rapid and informed. To a certain extent all previous technologies—beginning with writing—were enhancement technologies which influenced humans to better understand the world and communicate with each other. These are well-known McLuhanesque concepts, relating to how the means of transmission of a message influence the message itself.

In this article, my use of the term 'intermediary technologies' will refer to the technologies used in the creative activity that occurs 'between' the artist and the artwork. The paper will discuss the various mediating technologies which function as support systems for intelligent artistic behaviour. The concept of external mechanisms or systems that help humans extend their abilities sounds again very familiar,

reminding us of the discussions on media as 'extensions of man' that proliferated in the 1960s. Several creative technologies, exemplified below, illustrate ways of externalising mental and creative activity. These techniques of externalisation, relinquishment and automatisation of creative activity are common denominators in the various analogue methods used historically in art practice and intellectual entertainment to uncover new creative opportunities, to start new trends, and for the simple pleasure of playfulness. In the examples below we can recognise similarities with AI in the manner in which the responsibility and authorship is 'given away' or 'relinquished' and the author becomes 'transparent' as the mechanisms and techniques take responsibility over the final outcome. A parallel between high-tech intermediary technologies and the simple and traditional methods will be drawn in the discussion that follows.

Material and Conceptual Intermediaries

The phenomenon of authorship is a relationship between an author and their work. The authorship, when represented in terms of a 'concept transfer', could be depicted as a *vector*, an imaginary arrow, which connects the author and the artwork and represents a variety of **material and conceptual intermediaries** (tools, materials, technology; rules, methods, algorithms). [Figure 1.] As a rule the author is understood here as a biological person, a human being. The artwork can be a physical object which has emerged due to the unique activity of the author, or could be a sort of immaterial artefact such as a digital artwork or a performative or processual 'object' (in this case some material carriers are still needed, at least to document the existence of this nonmaterial object). On

the *vector* from author to artwork we could 'mount' different tools, technologies, processes and intermediary events and the resultant artwork could be considered to vary in its 'distance' from the author. For instance, drawing refers to the use of manual tools to leave traces on the surface of that which is called the artwork. In this transformative process there are not many elements: author, pencil, paper and time (drawing could, of course, involve a variety of other tools and surfaces). In more complex creative practices this *vector* refers to a computer, software programme and/or other technologies. The software could function with different degrees of autonomy and if AI-based then it could actually replace the author. The various means of AI-based creation involve different degrees of artistic participation, ranging from providing an authorial support function (as is typical with photo editing software) to the total replacement and imitation of the author. In extreme situations the author is little more than an instigator of the process of creation which is not dependent on his or her decisions. In this case a prerequisite is the transfer of the creativity principles and rules to the autonomous system, and that it is capable of learning them.

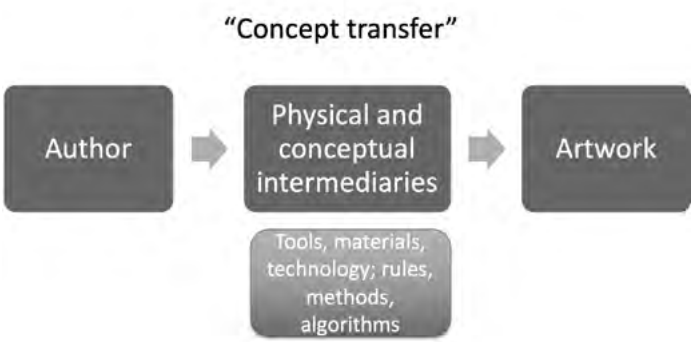

Figure 1. *"Concept transfer".*

Technologies of Creation as Technologies of Transformation

From drawing tools to artificial intelligence the methods and media used in art practice have evolved. This can be exemplified by a variety of intermediate forms, but the underlying point is that **every mediating technology situated between author and artwork that changes creative practice also changes something in the author and the artwork**. The artist creates and changes the work, but this work itself changes the author: a feedback loop is formed between the technology of creation, the author, and the work, which forms an almost closed system that effects change in all the constituent elements.

The novel and playful possibilities brought about by new technology can inspire a sense of excitement and exaltation in the author, but its importance lies in its function as a **transformation technology**, **not** simply as a **transmitter technology** to turn an idea into materiality, because it changes the transmitter and transforms both the creator and the creation. Most authors have experienced—and are eager to repeat—the effect of **self-transformation through creative activity** which takes place with the assistance of technology. Additionally, **new transformative technology** need not only change the individual but could instigate collective processes which might change the course of art history, as exemplified by the invention of paint tubes in 1841 by the American John G. Rand. Previously paint was stored in pigs' bladders sealed with string which frequently burst open (Hurt, 2013). The paint tubes were portable and could be repeatedly opened and closed. The invention became popular amongst young French artists, who were able to paint in the countryside, in gardens, and in cafés, and to complete their paintings entirely on location: contemporaries reported that there were more artists in the

landscape than farmers. This community of *plein air* artists founded the movement of Impressionism. Pierre-Auguste Renoir stated that: "Without colors in tubes, there would be no Cézanne, no Monet, no Pissarro, and no Impressionism." (Hurt, 2013). In its own way digital technology has changed the history of artistic practice: without it there would be no interactive art, telecommunicative art, bio art, and numerous other creative forms including post-internet art.

The Externalisation of Authorship

The utilisation of technical methods and autonomous technologies that are capable of imitating an author's creative activity produces a situation in which we can say that the **author has relinquished the authorship to an external mechanism**, a computer programme, an AI, or in more general terms to an external agent. The authorship is shared between the artist and this external agent. In the context of traditional art this seems problematic, since there is an expectation that the author controls and produces the artwork from beginning to end. This 'relinquishment' of creative activity is a rather artificial construction which raises questions about the extent to which it is taking place. For example, we can say that in abstract and action painting the artist has handed over decisions on how the paint and/or objects fall on a surface to chaotic processes if we consider practices based on gestures and physical acts, such as those performed by Jackson Pollock, Niki de Saint Phalle, Gustav Metzger, Arman, Daniel Spoerri, Hermann Nitsch and others. Nevertheless, Jackson Pollock exercised control over the paint to a certain degree despite his drip-based technique. Pollock stated that there is no accident in his paintings, no beginning and no end (Namuth, 1950),

but a study of Hans Namuth's film offers the opportunity to disagree with the artist: although the throwing of paint onto the surface was conscious and deliberate it is impossible to claim that each drop's landing was completely controlled by Pollock. The emergence of the image is both controlled and non-controlled at the same time: the artist exercises a general control, but the entire creative activity contains chance-based episodes caused by the inexact trajectory of the falling paint drops onto the surface.

Pollock could be defined as an 'intuitive' artist, who had no experience in systemic art, as was suggested by Philip Galanter (2003, p. 3) in his article "What is Generative Art?". The control in Pollock's paintings remained in his own hands and was not exerted by any external system or technology. Nevertheless, the art of Pollock has been researched in the context of 'fractal expressionism', his method preceding what we now know as 'fractals' and the concept of the "fractal geometry of nature" (Taylor, Micolich, Jones 2002, p. 203) popularised by Mandelbrot. The researchers R. Taylor, A. Micolich and D. Jones differ in opinion from Galanter and conclude that Pollock used remarkably systematic methods capable of generating intricate patterns that exhibit fractal scaling criteria with precision and consistency.

Surrealist Techniques as a Randomisation of Creative Practice

In the surrealist techniques of frottage and grattage the control over the making of an image is given over to accidental and random events. In frottage the artist attempts to 'print' chaotic visual effects by placing the paper or canvas over rough surfaces and rubbing with charcoal or pencil: the result exhibits

an unexpected visuality which is reminiscent of landscape. In grattage the visual image is revealed by scratching or scraping into lower surface layers of the canvas. Decalcomania is also chance-based, in this process the surface is covered with thick paint and then paper, aluminium foil or glass is placed over the top and removed. The result could provide the source for a possible follow-up painting or can be considered a ready-made artwork in its own right. These techniques were practiced actively by **Oscar Dominguez** and **Max Ernst.**

Many other techniques and methods exploited by the surrealists are worthy of mention here. Automatism is the general term for creative practice in which the creator 'switches off' their reason and control. Bulletism is similar to inkblot drawing and painting. Calligramme is a writing practice using words. Cubomania was invented by Gherasim Luca and involves a painting being cut into squares which are randomly put together. The Cut-up technique involved newspaper words being cut out and reassembled into a new story. Entropic graphomania was the practice of connecting the words on a page by drawing lines between them so as to 'write' a new story. The exquisite corpse has probably inspired the most popular usage amongst visual artists, and is performed by several participants in a process of collaborative drawing—numerous digital interpretations of this activity have been produced during the last twenty years which allow participants from different locations to contribute to one communal drawing. Indecipherable writing can be mentioned here as a peculiar method of nonsensical writing practice which is performed spontaneously, imitating the manner of writing but with visuals devoid of recognisable signs. Many other techniques such as *soufflage, paranoiac-critical method, étrécissements, surautomatism, triptography, outagraphy,* and *involuntary sculpture* were employed by the surrealists. Most techniques

were based on spontaneity, freed from artistic intention and will, allowing things to happen and examining the results afterwards. 'Post-creation' revisions and corrections were frequently applied, particularly in the case of decalcomania, which was mostly utilised as an inspiration-technique for the generation of randomly-looking landscapes.

The 'Relinquishment-technique' as a Method for New Ideas

In the above examples of surrealist techniques there is a relinquishment of authorship and the episodes of creative activity occur with the assistance of manual visualisation practices: the author/artist gives away control and later takes it back. The author intervenes after the period of relinquishment, reclaims the work and continues from the new situation, but this is no longer the same work and it could appear surprisingly and inspirationally fresh and new. The intentions of the artist might also shift in new directions upon seeing the modified work. In this way the relinquishment-technique functions with different art forms, allowing the artist to step back and intervene with a fresh eye.

Different kinds of relinquishment of authorship occur in the case of audience participation artworks. Interactive art exemplifies this most clearly: the artwork's existence is defined by the 'collaboration' between the viewer/audience and the physical entity of the artwork. This entity could be called the 'pre-artwork', a term which I use to describe the participation-enabled technical-material entity before the participation actually takes place. Ironically we could argue that a pencil lying on paper is also a type of pre-artwork in the sense of a 'pre-drawing'. This argument can be colourfully

advanced by a quote from Michelangelo: "The sculpture is already complete within the marble block, before I start my work. It is already there, I just have to chisel away the superfluous material." (Goodreads 2021). Combining pencil and paper in the activity of drawing results in a drawing, a similar situation to the function of an interactive piece which comes to life because of participation. There is however a marked difference: the drawing activity is not presented as an artwork in its own right unless it is staged as a performance (I am aware of drawing performances where the artist almost dances in space and makes lines on surfaces in front of the audience). Experiencing interactive art, however, means being in the territory of the artwork, inside the artwork. Thus the interactive artwork is by nature performative, engaging for participants and performative for spectators.

Certain specific categories of technical and computer-based art such as algorithmic and generative art show this relinquishment act most clearly. Theoreticians have claimed that generative art could be performed manually, but they consider the term in connection with technique-based art practices. Algorithmic art is connected to digital art and could be considered as 'instruction-based' or 'rule-based' art. The instructions for the creative act emanate from the 'external machine' to which the artist relinquishes (totally or episodically) the creative activity, inputting some form of raw material to this 'instruction machine' and obtaining a result. This 'machine' could be metaphorical, or it could be an actual machine. It could be a written list of instructions or rules about how to make something (rather like a cooking recipe) but could equally take the form of programming code which runs on computer hardware. A classical example of algorithmic instruction is Tristan Tzara's *How to Make a Dadaist Poem* (1920) in which he describes, line by line, actions which

should be performed in order to create a chance-based poem. In the same manner Sol LeWitt's (1967) sentence "The idea becomes a machine that makes the art" is a metaphorical description of conceptual art. The idea could take the form of instructions, a sequential order of proposed actions, which result in a final work that could be different each time the instructions are carried out.

The Relinquishment of Combinatorial Activity

Computer programmes are the most complex form of representing instructions, consisting of a successive chain of actions which the computer is tasked to perform. In simple terms, the code specifies what actions should take place after event A. If the result is B, for example, then activity X should be carried out; if the result is C then Y should be carried out. Artists also sometimes think in terms of rules, acting almost machine-like and algorithmically, deriving each new action from the previous step whilst relying frequently on intuition and the impulses of non-rational and accidental actions. By episodic relinquishment of the creative activity and handing over the decision-making to the machine, the machine/computer/AI acts, or a line of instruction is executed, without interference from the artist.

Understandably, relinquishing combinatorial activity to an external mechanism or allowing combinations to happen by chance are well discussed themes in the field of art history. There exist a significant number of chance-based artworks and even artistic trends in which the non-planned action of the artist is intentional, is documented and performed (examples being Marcel Duchamp's '3 Standard Stoppages' of 1913-14, Niki de Saint Phalle's 'shooting paintings', Viennese

actionism actions and paintings, and Daniel Spoerri's 'snare paintings'). In addition, there are plenty of interactive and multimedia works which allow multiple 'endings' whereby the audience can complete the artwork in a different way each time. In Bill Seaman's 'The Exquisite Mechanism of Shivers' (1991), which was converted to multimedia CD-ROM in 1994, the user can combine discrete video clips into short video sequences which are complemented by a combinatorial sentence of text. In Ken Rinaldo's 'Augmented Fish Reality' (2004) the audience is 'viewed' by fishes in rolling fish-bowls which can be physically moved according to the swimming motions of the fish themselves. Numerous artworks reflect this open structure which becomes the basis for continual variations of the work, yet at the same time these works are able to function as closed self-referential loops, as is evident in Ken Rinaldo's piece in which the 'data' that the artwork processes is an integral part of the artwork itself—the movement of the fishes. A similarity exists with certain AI artworks such as Mario Klingemann's 'Memories of Passersby I'. Based on classical portraiture, this work is " ... an autonomous machine that uses a system of neural networks to generate a never-ending, never-repeating stream of portraits of non-existing people." (Klingemann 2018) There is no input to this work from outside the piece itself, hence it is essentially a closed work, it is not open.

Here I wish to return to my earlier proposal of an imaginary vector representing the 'concept transfer' from the author to the artwork, in which the term 'intermediary technologies' is used to describe the conceptual, material and technological transformations 'between' the artist and the final work. This process results in a consistent artwork. We can distinguish between the different forms in which this 'transfer' of ideas from author to artwork can take place.

The most primitive form could be called the 'linear' concept transfer, typically occurring in the traditional art-making process: the work is made by the artist and it remains as such forever.

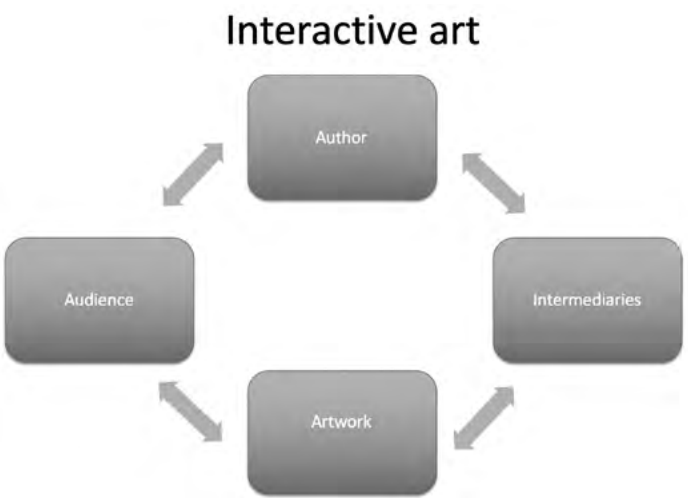

Figure 2. *Interactive art "closed-loop concept transfer".*

In interactive art the work exists as a series of transformations. Theoretically, each interaction with the work is a different realisation of the concept which is reflected back upon the author or audience. We can call this a 'closed-loop concept transfer' since each realisation is able to feed back modifications to the concept produced by the software and hardware of the work. (Figure 2.) In these artworks the interaction takes place by means of 'intermediaries' assembled by the author, and the author may even become part of the installation and be involved in the interaction, becoming one of the many variables with which the user interacts. This is typical in artworks that contain performative elements and the artist's physical presence. Examples include Stelarc's performative

and interactive works and Sonia Cillari's interactive work 'Se mi sei vicino/ If you are close to me' (2006) in which the performer's presence is part of the installation and therefore the concept—audience members can move the performer or move themselves around the performer, creating real-time animations on screen.

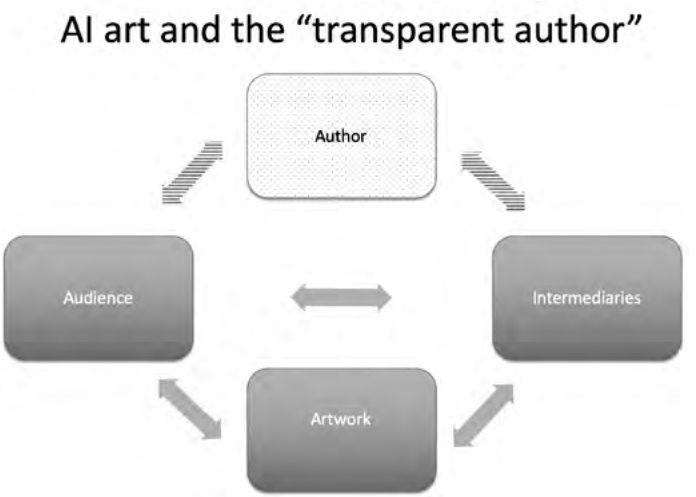

Figure 3. *AI art and the "transparent author".*

In interactive and AI-based art the author's position could be described as 'transparent'. (Figure 3.) The author in these artworks seems irrelevant due to the fact that the artwork produces creative combinations autonomously, without interference nor the need for any initial input from the author. This latter case is hard to imagine because even in AI-based art the responsible person or initiator of the input maintains a presence. The aforementioned work by Mario Klingemann, for example, was conceptualised, designed and programmed by the artist. In the introductory video for this work Klingemann presents an analogous example: "If you hear somebody

is playing a piano, would you say that piano is the artist? No." (Klingemann 2018) The same applies to works made using AI. Even if such works generate constant variations of visuality which are not pre-determined by the author, it is still the author who has instigated the process which could theoretically maintain its transformative existence forever. In that sense the 'transparency' of the author does not imply complete absence but rather the absence of the author's influence over the content of the work. The situation in which an artwork is designed by another artwork is a somewhat theoretical case. Although Klingemann's project 'plays' its transformations via a closed framework of dataset portraits and neural networks, it is possible to imagine a more open work which compiles its dataset autonomously by retrieving information from a network in real time. In this case the unpredictability of the result is again increased and the author's role shifts even further, becoming more transparent.

Conclusion

The aim of this paper has been to discuss the relinquishment of authorship in traditional art practices, by analysing how this has been exploited in earlier creative practices and to question whether the situation is different with AI-based art. The answer turns out to be both yes and no. The technology used in such artworks is certainly new, and the cultural context in which the results are presented is different. The types of transformation produced using AI techniques can be surprising, for example the generation of imaginary faces and non-existent people, but even this is not impossible for traditional artists to accomplish by using their own techniques to 'synthesise' and visualise non-existent faces. In that sense

it is hard to consider such types of work as a specific achievement of AI, although AI is incomparable in its productivity and the variation in the visual artefacts it can generate. An interesting case could arise where the artwork is designed by another artwork, such that the creative activity is instigated and maintained without any help from a human artist.

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Artificial Intelligence and Art. What's Left After the Hype?

Mauri Kaipainen, Pia Tikka

Introduction

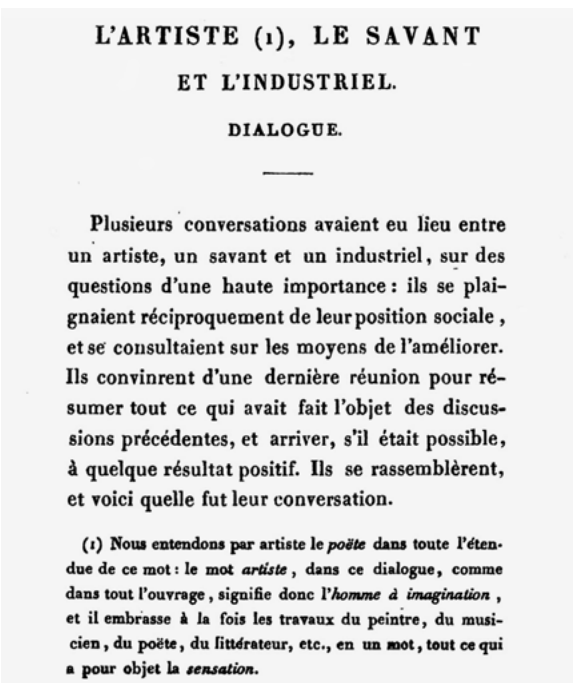
The core idea of machine intelligence is probably built into the very thinking of homo sapiens. Our species is forever trying to reverse-engineer its own intelligence and thereby find ways to outsource its own work to automata. Whereas *homo habilis* was handy, it may be fair to say that *homo sapiens* is both handy and lazy. The idea of constructing artificial, life-like creatures appeared already in the myths of ancient Greece (McCorduck, 2004). *Hephaestus,* the blacksmith god of fire and forging, built human-like automata, such as the three-legged robotic devices that climbed Mount Olympus; *Talos* the bronze man who guarded the island of Crete; and *Pandora* the artificial woman made of earth, whom Zeus sent to deliver a box full of evils to Prometheus as a punishment for stealing fire (Temple, 2016). The essential difference between life and mechanical life-likeness is among the guiding philosophical themes throughout literary history and is exemplified by René Descartes' Discourse on Method (1637).

The core idea of machine thought is the algorithm, a sequence of instructions to solve a particular task. The word "algorithm" appears already in the works of the ninth century Persian mathematician Muḥammad ibn Mūsā al-Khwārizmī. In the 18th century, Thomas Hobbes, Gottfried W. Leibniz and Renè Descartes (see Ablondi, 1988) described thinking in terms of logical algorithms, an idea that resonates with the desire to construct automated machinery. Indeed, as early as the beginning of the 19th century the development of digital, logical automation began with mechanical spinning machines that were programmed by using punch cards. Each card was punched with a series of holes interspersed with non-holes that set out a binary sequence of 1's and 0's—the core expression of everything digital. Thus, automata and computers have not only been used for many years as tools, but they have also long constituted the surfaces against which the human species has sought to mirror, if not model, its own intelligence.

Recently, the rapidly evolving algorithmic technology has once again stimulated a variety of utopias and dystopias. Now, many are asking whether artificial intelligence (AI) will make human labor redundant: If man will no longer be needed for productive work in the future, will even the creative areas—architecture, music and other arts be safe? What would be left for humans to accomplish if robots were able to produce art to satisfy our galleries with instances of their virtuosity? Of all the emerging visions of the future, this article focuses on the question of whether artificial intelligence could displace man-made art. We consider this question both from the perspective of avant-garde art that is perpetually breaking boundaries and from the perspective of holistic, cognitive science.

Sciences, Arts, Robots, and the Avant-Garde

The word *avant-garde* originates from the French military term for an outpost. After the French Revolution, the term also began to refer to cultural outposts in the struggle to build a better world. According to Matei Călinescu (Călinescu, 1977, p. 11), Olinde Rodrigues, possibly together with Saint-Simon and colleagues (Saint-Simon et al., 1825), applied the word in this sense. The 19th-century romantic idea of the heroic artist striving toward an ideal world continued into the 20th-century avant-garde worldview: the artist allying with scientists at the forefront of the technological revolution (Călinescu, 1977, pp. 103–104).



L'ARTISTE (1), LE SAVANT

ET L'INDUSTRIEL.

DIALOGUE.

Plusieurs conversations avaient eu lieu entre un artiste, un savant et un industriel, sur des questions d'une haute importance : ils se plaignaient réciproquement de leur position sociale, et se consultaient sur les moyens de l'améliorer. Ils convinrent d'une dernière réunion pour résumer tout ce qui avait fait l'objet des discussions précédentes, et arriver, s'il était possible, à quelque résultat positif. Ils se rassemblèrent, et voici quelle fut leur conversation.

(1) Nous entendons par artiste le *poëte* dans toute l'étendue de ce mot : le mot *artiste*, dans ce dialogue, comme dans tout l'ouvrage, signifie donc l'*homme à imagination*, et il embrasse à la fois les travaux du peintre, du musicien, du poëte, du littérateur, etc., en un mot, tout ce qui a pour objet la *sensation*.

Figure 1. According to Călinescu, Saint-Simon equated the work of the artist with research and production (*l'industriel*) (Saint-Simon et al., 1825, p. 331).

The early 20th-century may be considered the golden age of the avant-garde, a period when the intersections of science and art emerged at the heart of progressive modern discourse. Underlying this discourse was the Hegelian idea of the inevitable evolution of humanity and culture towards higher levels of consciousness (Krukowski, 1986). The contributions of science and technology were admired by progressive artists, as manifested in such movements as Dadaism, Bauhaus and the Finnish literary group *Tulenkantajat* ('fire-bearers', Kaunonen, 2019) among others, while in music, for example, Arthur Honegger wrote his orchestral composition *Pacific 231* (1923) as a confession of love for steam locomotives.

During the same period in the revolutionary Soviet Union, filmmaker Sergei Eisenstein became fascinated by theatre director Vsevolod Meyerhold's idea of biomechanics as the basis of acting (Eisenstein,1935/1996; Tikka, 2008, p. 87). Underlying Meyerhold's idea was the assumption that emotions and higher levels of consciousness could be reproduced in a controlled way in the minds of the audience as they watch and imagine the meanings of the positions mechanically constructed by actors in space-time. Inspired by Meyerhold and by Alexander Luria's research on the brain, Eisenstein thought of film structure as reflecting the dynamical functions of the creative mind (Tikka, 2008, p. 26). Reciprocally, Eisenstein's thoughts fascinated Luria, and the two co-designed and carried out psychological experiments examining, for example, the automatic movements of the human body as counterparts of mental movements (Vassilieva, 2019). Against the historical assumption that there is a functional isomorphism between the human mind and the organizational structures of man-made artefacts, even human-like robots with artificial intelligence appeared achievable.

The dystopian face of early 20th century techno-optimism is represented in Karel Čapek's play *RUR* (*Rossum's Universal Robots*, 1920), in which human-like worker robots rebel against human control, eventually exterminating the human race. This fictive idea of robots has since persisted in cultural memory and its variations are repeated in discussions about artificial intelligence even today.

Figure 2. *Theatre Guild touring company's 1928–1929 production of R.U.R. by Karel Čapek. (Wikimedia Commons: General public domain.)*

Early fictional robot stories may also have driven the actual development of robotics after World War II as digital technology began to make the implementation of a machine-man seem possible. Another type of automated technology—though without the robot's autonomous actuators—was anticipated by George Orwell's dystopian novel *1984* (1948), a disturbingly accurate image of the 'intelligent' surveillance society of today.

Utopia of human-like intelligence and Artificial Intelligence

In 1955 the term "artificial intelligence" (AI) was coined by John McCarthy and colleagues to refer to a machine that can simulate "precisely described" intelligence (McCarthy et al., 2006, p.12). While the algorithmic technology of pattern recognition by means of machine learning may be just one step in human techno-evolution, it is nonetheless surprising that so few are concerned by its invasive presence in everyday life. In retrospect we can see that many of the ideas that appeared in the early days of the technological revolution have resurfaced on a broader front. In practice, however, the mythological equation of robots with human beings has largely been downgraded to everyday automatization, represented by robotic vacuum-cleaners, garbage sorters and the like. Returning to Rodrigues' model of the avant garde, at best the utopian ideas emerging in the interplay of the arts and sciences may lead to new scientific discoveries and further to new products and services of common interest that may benefit society as a whole.

The old question returns: what is the relationship between human intelligence and that of an artificial machine? The *Turing* test proposed by Alan Turing in 1950 puts a person in touch with another party through text communication without letting her know whether the counterpart is a human or a machine. The purpose is to determine if the machine is capable of producing a conversation seemingly intelligent enough that the test person cannot distinguish it from a dialogue with another person. The criterion of machine intelligence is thus the credibility of communication or, more broadly, behavior as judged by man (Turing, 1950). Today, almost seventy years after the test was first proposed, we are

essentially facing the same situation with service providers' chatbots. You may want to test the credibility of the next chatbot you are connected to, for example, with some metaphorical expression or a piece of sarcastic humor.

We stress the difference between the so-called artificial machine intelligence (*Artificial General Intelligence*, AGI) capable of speculative, context-aware inference versus commonly applied automated algorithmic systems that may have originally been addressed as "intelligent" but do not meet the criterion of context-awareness. This division roughly corresponds to John Searle's (1980) distinction between *weak* and *strong* AI. These are essentially two different things even though they are based on the same technology. The "weak" or "narrow" artificial intelligence refers to computers that are programmed to learn and automatically perform, for example, human-specific mechanical functions limited for specific purposes. These machines are now commonplace; they appear in our environment as instances of everyday engineering and the gradual construction of technical automation.

Our article considers mainly the strong AI, i.e. that which claims to demonstrate universally valid artificial intelligence approaching that of a human being. The argument for strong AI assumes that a genuine mind can emerge from an artificial system in the true sense of the word, aware of itself and its context. This AI would also have the capacity to learn new behaviors by adapting to its environment. It might also be capable of producing phenomena associated with humanity and culture, such as poetry, philosophy, or art. The thought-provoking idea of human-like artificial intelligence generates headlines, public attention, and, through a twist, also research funding.

Whether one believes in or doubts the possibility of strong AI depends on the conception of humanity adopted.

First, if the possibilities of AI are judged from the point of view of *physicalism*, which assumes that the phenomena of the mind are based on the physical world and its regularities, then perhaps all these phenomena could at some point be exhaustively modeled and implemented as some kind of system, as was suggested by Searle (1980). Secondly, those who believe in another reality outside the physical world, possibly in what is called a soul, might find it impossible to believe that conscious, truly human-like machine intelligence will ever materialize. A third holistic view is that human-like artificial intelligence cannot exist without a genuine biological grounding.

The current hype around AI recapitulates the enthusiasm generated by electronic data processing in the 1940s and 1950. An invitation to a conference at Dartmouth College in 1956 optimistically asserted that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" (McCarthy et al., 2006). According to this manifesto, artificial general intelligence (AGI) would be able to operate in any area typical of human activity with at least the same sovereignty as man. The underlying assumption was that the mind could be reduced to logical reasoning, amounting to what can be called the mind-as-machine metaphor whereby the human mind is perceived as a machine-like system dealing in symbolic signs (a computational mind).

Over the next couple of decades (the 1960s and 1970s) the dichotomy between mind and machine became clearer. While rule-based algorithmic reasoning machines could be programmed for a broad variety of purposes, they showed no sign of intelligent behavior. The definition of intelligence proved to be a moving target and no comprehensive evidence of artificial general intelligence was obtained. The subsequent

decline in both public interest and funding resulted in a so-called "AI Winter" (Crevier, 1993).

AI's new spring began in the 1980s when the brain-as-machine metaphor was flipped around to a machine-like-brain, introducing *artificial neural networks*. Algorithms were programmed to mimic what was known about brain functions, most notably on the levels of cellular synaptic learning and neural network connectivity. This project no longer involved explicit coding of a rule system, and instead interest shifted to learning by mimicking the ways in which a biological system adapts. One of the pioneers of this paradigm was Teuvo Kohonen, whose Self-Organizing Map (*SOM*) formed a widely adopted research paradigm (Kohonen, 1982). SOM clusters data without direct supervision, based on the idea that computational neurons learn together and from each other, forming implicit *fuzzy* categories around a prototype which is located at the center.

Another theoretical milestone was indicated by David Rumelhart and his colleagues (1986) who introduced algorithmic *backpropagation*. By trial and error, the algorithm supervises the system to recognize already categorized examples using a multilayer network of artificial neurons, each layer representing one level of abstraction. This method was able to form categories of complex data based on a set of examples and without explicitly formulated rules. Subsequent developments in this direction are commonly referred to as *deep learning*. In simple terms, the machine is instructed: "These are cases of melanoma, find out what features indicate it and identify new cases". Or, in the context of art: "These music samples are from Richard Wagner's oeuvre, find out what the common features are and produce more of the same." This general design is applicable to a wide variety of automation tasks from generating language to cancer diagnosis to

assessing credit-worthiness, and in the field of art, imitating musical or painting styles. Many applications based on the machine-as-brain metaphor have ended up in the layperson's pocket in the form of smartphone applications (popularly as "apps"). But how "smart" are these apps actually? After all, they do not amount to much more than automatized advanced classification. Are these already instances of "strong AI"?

The method of deep learning seemingly approaches the kind of artificial general intelligence that AI utopians of the 1950s believed in. The overall success of deep learning may be due to the fact that classification is at the heart of human cognitive activity, and consequently at the heart of the socio-cultural ecologies humans generate and inhabit. Therefore, modeling, simulation and exploitation of classification (or categorization) in the service of techno-cultural automation tends to adapt to our continuously growing knowledge in psychology and cognitive science. However, because the categories must be explicitly given to the system from the outset instead of being self-generated by the system, algorithmic technology is still far from artificial general intelligence. AI may have achieved a significant goal, but once again it looks like the goal has shifted. It seems that discussion about artificial intelligence will be drifting unanchored until a more solid understanding of human intelligence is established.

Human intelligence

The broad holistic understanding of the human mind that was increasingly elaborated in the last century might perhaps be regarded as an avant-garde movement of the life sciences. Seeing the mind—its body, brain and environment—as a

single system, has had radical significance on everything that concerns humanity, comparable to the introduction of the theory of relativity, quantum theory and string theory in the evolution of physics. Holistic thinking has long roots in ecology (Haeckel 1861), biology (von Uexküll 1934/2010) and systems theory (von Bertalanffy 1950). The theorists of the embodied mind, Humberto Maturana and Francesco Varela (1980) describe the mind as a biological self-determining, i.e., *autopoietic,* system. For Varela and his colleagues Evan Thompson and Eleanor Rosch (1991), the mind is *enactive*, that is, not only in constant active interaction with the environment but inseparably embedded and situated within it. Leaning on Benedict de Spinoza's critique of the Cartesian idea of the superiority of the human mind over the body and emotions (Descartes 1637/2001), and based on a vast body of neuroscientific evidence, Antonio Damasio argues that emotions are involved in even those functions of the mind that have been typically regarded as purely rational (2003).

If the human mind-body, with its emotions and rationale, are one and the same physical system, then perhaps the builder of artificial intelligence should also involve aspects of the body in some way or another. Even cautiously estimated, the obligation of modeling a whole artificial body complicates the task of artificial intelligence and pushes its implementation far into the future. The project will become even more challenging if the mind's *extensions* are to be accounted for, as is implied by Marshall McLuhan's idea of the extensions of man—such as media, clothing and houses (1964)—and by Andy Clark's concept of the *supersized mind* (2008). Even if Searle's physicalism of mind were accurate, a digital model simulating the physical mind-body-world system would be so multidimensional and complex that the task would approach that of creating an entire artificial world. The issue then is no

more what an artificial general intelligence should encompass, but what could possibly be left out.

Psychology and cognitive science continue to rely on assumptions about what kinds of elements the human mind operates with. *Concepts* are among the most commonly assumed elements of human intelligence. While the standard is to assume that concepts are fixed and pre-given, closely associated with words, Antti Hautamäki has instead argued that they are relative to one's viewpoint (Hautamäki, 2020). Mauri Kaipainen and Hautamäki have elaborated the idea of concepts as being relative to a perspective as well as to embodied and situated action (2019), relating concepts to the holistic and systemic idea of mind. Further, Joel Parthemore has analyzed the temporal evolution of concepts over short and long periods of time (2019).

If it is accepted that the human mind relies on viewpoint-relative concepts, then one must either a) abandon the assumption of fixed concepts (classes, categories) as the backbone of machine learning, or b) assume a limitless combinatorial space of cases in all possible contextual interpretations, amounting to an infinite learning task. If concepts emerge and evolve over time, then one must either c) abandon the assumption of fixed concepts (classes, categories) as the backbone of machine learning, or d) assume a limitless combinatorial space of cases in all possible contextual interpretations, amounting to an open learning task claiming infinite resources.

In sum, natural intelligence is much more multifaceted than today's cutting-edge deep-learning AI can mimic, and is much more organically and dynamically (enactively) engaged with the environment. It also has qualities that are hard to model, such as *intentionality*, *creativity*, and perhaps toughest of all, the eternal mystery of *consciousness*. Who can define

these elements in the first place? Thus, in spite of everything, we are once again in a situation similar to the "AI winter", when it had to be admitted that the task of exhausting the contextual richness of commonsense cognition in terms of explicit rules had grown to an astronomical scale beyond the limits of technology. To the extent that we are seeking "strong" artificial general intelligence (AGI), many winters, summers, leaps, bounds and tumbles can be expected.

In contrast, whenever the goal is specifically functional goal-oriented automation—a far more modest ambition—there is no doubt that technical and economic revolution will continue to advance, introducing profound changes to human lifestyles. One might say that today is even more drastically different from the pre-digital past than any utopist had ever imagined. Importantly, however, this is not because technology has become intelligent, but rather it is due to the 'mechanization' of the human mind. According to postphenomenological ideas of *technological mediation,* while humans are shaping technology, technology is reciprocating by shaping humans (Verbeek, 2016).

In what follows, we return to art and its relationship to artificial intelligence technologies. In this discussion, we will consider the more pragmatic line of automatization by AI rather than the greatest ambitions of "strong" artificial intelligence. That is, we avoid speculating about the possibility of technology transcending and replacing human intelligence. We therefore seek to put aside -- at least for a moment — the scientific utopias and dystopias typically associated with science fiction, not because they do not have a role to play, but in order to see more clearly what role art can play in a science and technology-dominated culture. Our discussion concerns the relationship between hypothetical *strong artificial intelligence* or *artificial general intelligence* and the making and

appreciation of art. In particular, we will discuss the essence of *authorship* and whether strong AI can be considered an agency similar to human artists. If it can, then what kinds of outcomes from an automated process may be counted as 'art', and in what sense?

Skill-art, credibility and the Turing Test

The etymology of the word "art" relates it to practical skills or craftsmanship. We call it *skill-art* for the present purposes. A great deal of academic work at the border of art and AI is concerned with something like skill-art, although it is certainly only a rough simplification of the aesthetics and history of art. From a technical point of view, art-generating systems largely follow the trends in AI research. From the 1950s to the 1970s, algorithmic generation of art was usually based on the explicit description of style as a set of rules, which is essentially similar to describing languages in terms of their assumed universal generative grammar (Chomsky 1956). Similarly, the paradigm of music research (summarized, e.g., by Papadopoulos and Wiggins 1999) has for decades sought generative demonstrations of musical skill. Often the goal has been an exhaustive analysis of some style, such as the grammar of jazz chord sequences isolated by Steedman (1984), in order to develop methodological innovation. An example of such rule generated 'art' may be a song like *I am AI* by singer Taryn Southern. *I am AI* was created using the artificial composition platform *Amper*[1], an AI system that operates with assistance from human musicians, as if Amper were just another member of a creative team (Plaugic, 2017).

1 https://www.ampermusic.com

It has been suggested that generative music compositions could be subjected to the Turing test (Ariza, 2009). The test would be passed if the human listener could no longer distinguish machine-composed music from that of a human composer. This distinction may usefully be extended to machine-generated demonstration in other arts, insofar as the indistinguishability from human creation would be the criterion of art.

From the 1980s onward artists have deliberately implemented their projects by means of *self-organization*, for example *Pockets full of memories* (Legrady and Honkela, 2002). Recently, artists' projects based on *generative adversarial network* (GAN) have gained popularity, for example, *I will not forget* on the webpage *AI told me* by an anonymous artist-programmer (Anonymous, 2021; see Cole, 2019, for a review) and *Portraits of the Belamy Family* (2018) by the Parisian artist collective *Obvious*—an example of generative painting (Obvious, 2018). GAN is based on two different competing networks that gradually reach consensus via separate learning processes of trial and error. The developers describe it "as analogous to a team of counterfeiters, trying to produce fake currency and use it without detection, while the discriminative model is analogous to the police, trying to detect the counterfeit currency" (Goodfellow et al., 2014, p.1). The GAN system analyzes tens of thousands of images and their stylistic features in order to form genre-type categories, then applies those categories to produce an endless number of new images within the given category. Thus, at least within some given limits, the model learns to form an abstraction of a style, identifying examples belonging to it and excluding those that do not, and further produces new and unique images that all belong to that style. A creation of such a system, *Portrait of Edmond Belamy* (2018), was put up

for sale at Christies art auction and sold for $435,000.[2] Is this an indication that the Belamy portrait had passed the Turing test in the field of art?

Figure 3. *Portrait of Edmond Belamy (2018)*. This file is in the public domain because, as the work is by a computer algorithm or artificial intelligence, it has no human author in whom copyright is vested. Wikimedia Commons: General public domain.

The role of machine learning in interactive installations that may range from performing arts to narrative and conceptual arts is different from that of machine learning in music or painting. The concept of a human-like virtual character

2 https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx.

developed by Pia Tikka and her research group, the so-called *enactive avatar* (Tikka et al., 2012; Tikka et al., forthcoming), provides an example of iterative machine-learning arrangement in participatory settings. In this work the dynamics of face-to-face interaction between two humans is used to train the adaptive behavior of the enactive avatar in the context of a story and in the context of each participant's physiological indicators (e.g. EEG, electrical skin conductance, heart rate). Relying on such *enactively adaptive feedback*, a concept borrowed from the enactive dynamic systems model (Varela *et al.*, 1991), suggests that the artificial human might learn to 'act' convincingly enough to pass the Turing test.

In sum, if the success criterion for artificially generated art is its credibility, as in the Turing test, and we limit the art object to art as skill-art, or skillful craftsmanship, then a vast array of AI applications may be able to replicate convincingly a particular artist's style or a genre of art. These demonstrations have undeniable merits, at least as sources of artistic inspiration. However, to the best of our knowledge no computer art has been generated by AI without prior supervision by humans, including defining ontological delimitations, rules, or categories.

With no art created solely by AGI in sight, one may ask: How does a human-supervised algorithm-generated art differ from the traditional tools an artist may use in her work? Should the technology be conceived of in terms of extensions of hand, similar to a brush, or of an eye similar to a camera, though perhaps more accurate and more effective? One may further ask, in what ways do the works produced by AI differ in principle from art students' sketch drawings or from music students' Palestrina pastiches in a counterpoint class, all of which initially involve the imitation of some exemplar. Could art generated by AI—be it a portrait, a piece of polyphonic

music, or an interactive installation—constitute instances of art that exceeds the merely apparently credible skill-art? To tackle this question, we move our focus to the challenges that AI may face when tasked with identifying truly groundbreaking and pioneering art beyond mere skill-art.

Avant-garde art, cultural opposition and the Fountain Test

We consider avant-garde art to be an activity that moves at the forefront of cultural, political, and social expression, rebels against institutions, redefines concepts, takes a stand, argues, and is likely to offend the general consensus. It challenges the beauty ideals of the conservative elite and the middle-class bourgeoisie. It sometimes even defies the limits set by law in order to expose cultural distortions or absurdities, as did Harro Koskinen's *Pig Messiah* (Sikamessias, 1969), which led to the artist being condemned as guilty of blasphemy. In relation to the conventions of art, the avant-garde often deliberately misuses and recycles its materials, grammars and genres. The best-known example of this may be the *Fountain* (Fig. 4), a ready-made urinal bought from a hardware store, signed by R. Mutt, and elevated to the podium of art. The artwork, usually credited to Marcel Duchamp, has become an icon of the avant-garde.[3]

3 It is disputed whether the credit for the idea of the urinal as an art object belongs to Duchamp or the Dadaist Baroness Elsa von Freytag-Loringhoven. Duchamp is supported, for example, by Sami Sjöberg, 2018, perspectives on behalf of von Freytag-Loringhoven are presented by Theo Paijmans in SeeAllThis 2018.

Figure 4. *Fountain* signed by R. Mutt (1917), photographer Alfred Stieglitz. Wikimedia Commons: General public domain.

As avant-garde art represents critical awareness of human history, culture, and social situations in ways that are most difficult to mechanize, we take it as the ideal ground for a new kind of artificial intelligence test more difficult than Turing's, and which we call the *Fountain Test*:

> Can a machine choose a phenomenon of its choice and present it as art, such that it will be accepted by a critic, curator and audience, or at least one of them, as a genuine and unique piece of art?

The defining question is thus based on the requirement that (a) the artist (here, the intelligent machine) not only distinguishes something as autonomous art, but also that (b) it obtains the approval of an art institution.

As already mentioned, when a style or genre is known, any number of its instances can be generated by a well-instructed AI system, not identical to each other, but similar on the level of style of genre. However, because uniqueness is considered a hallmark of art, it is inconceivable that galleries would any time soon be filled with thousands of Rembrandt copies or concert halls performing choral concert produced by countless music students' Palesterina motets, no matter how good they are in the sense of skill-art. Many of Leif Segerstam's more than three hundred symphonies representing his free-pulsative style[4] have not been performed, although few would doubt the skill of the maestro as a composer. Perhaps their subtle differences will become more clear over time?

The question is, on what basis would one particular work be chosen from a pool of many equally skillful instances of the same style? If a machine could create art, it should also be able to make the choice using some criteria, be it, the most interesting, the most alluring, or perhaps the most shocking. However, would not the machine's skill of generating instances of an abstracted style already in principle fight against the ideals of uniqueness *and* novelty, generally associated with art? Randomly generated infraction of the rules might certainly narrow the sense of 'rebellion' against any rule and thus give a piquant or absurd effect, but would it in some sense amount to a relevant statement against the Zeitgeist? The proposed *Fountain Test* requires that a machine should not only produce, but also perceive, and in a deep sense understand the phenomena at the forefront of culture, in order to redefine concepts, take a stand, polemicize and aim at the future.

If art and the appreciation of art are to be discussed in holistic terms, could it then be possible to overcome the

4 https://core.musicfinland.fi/composers/leif-segerstam

limitations inherent in machine intelligence by using further knowledge of human psychophysiology to control the algorithm? At the level of popular conversation, people often define their art experiences through some sort of "wow" effect. If the work is different, surprises, confuses, and makes one think, such an effect may arise. Research data on human art experiences have also been collected through various physiological indicators and brain imaging (Belfi et al., 2019; Boccia et al., 2016). Further, the previously found so-called *mismatch-negative stimulus potentials* (MMN, Näätänen et al., 1978) are associated with a surprise or something unexpected. On the basis of such gauges of "wow", could an interactive art be created in which the participant's psycho-physiological responses to the art work would indicate the value, or level of surprise, whereby the algorithmically-generated work of art would excel in causing as large surprises as possible? Would instances of amazement optimized for neural effect amount to the cultural shock of the *Fountain*? The *Fountain,* like much of the early 20th century avant-garde art, is by now an established part of the art institution, even though it was not originally so. In this sense, the results of the *Fountain Test* might not be published from the culture jury until after a delay of several decades! Would it not be contradictory to require institutional approval for pieces created by artificial intelligence as avant-garde art, whose importance "lies precisely in the cultural opposition"[5] (Hautamäki 2007)?

We have considered what it might take for the artificially intelligent artist to be creative beyond skill-art. If ever the day comes when the artificial artist gains an understanding deep enough in the timely cultural discourse in order to identify conflicts or power struggles and turn its provocative spray

5 Translated from Finnish by the authors.

nozzle at the establishment, then it might as well turn against the high priests of established art: critics, galleries and curators, who autocratically define the boundaries of aesthetics. If only these despots could be replaced by a coherent, impartial and aesthetically sensitive *AI curator machine,* free of human prejudices...

What's left after the hype?

Popular crazes come and go a bit like round and boxy car designs, or short and long skirt hems. The educated guess is that at some point, the media-sexiness of AI will fade again. However, although the dream of human-like intelligent machines has not become any less utopist than it was at the time of the *Talos* of Hephaestus, the technical development of digital automation will surely proceed and continue to modify our lives and our culture.

There is no reason why digital automation would not provide inspiration and tools for art, but there is reason to put the development of automation, or AI if you like, under a critical discussion. The overtly simplifying *brain-as-machine* metaphor being (hopefully) long gone, it is obvious in the light of current understanding of the mind that even the current *machine-as-brain* metaphor is no longer sufficient to guide the development of artificial intelligence beyond the current level of imitating human-made skill-art. New, extensive and systemic understanding is needed, integrating the mind and its body with its environment, and with its cultural context. It might be called the *brain-mind-world system metaphor*. Art will have an active role in simulating futures of technology. One possible relation of the artist and the technology may be *symbiosis,* as proposed by the computer scientist Ilkka Kosunen

at Estonian Arnold Schönberg Society (2018). Eventually, it may no more be the most burning issue whether the machine makes art or not. In the true spirit of the avant-garde, an artist might also see a very good reason to stand up against manifestations of automation and mechanization of the mind, often driven by the technological and economical establishment without concern for the nature of humanity.

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Entangled Realities. How Artificial Intelligence is Shaping our World

Sabine Himmelsbach

Technological change permanently brings radical social upheavals. One of the technologies that has caused a sensation in this respect in recent years is artificial intelligence, known as AI for short, or more precisely 'machine learning', which is now the dominant form of AI and is based on data processing using neural networks. Ever more aspects of our present-day lives are controlled by algorithms, ranging from high-frequency trading on the global financial markets to the Internet of Things that enables indirect communications between machines. Intelligent machines have become a part of our lives and even our homes in the form of smart devices and personal assistants. AI now seems to be in every machine and spectacular services have been delivered by AI systems in recent years thanks to today's computer performance and the availability of big data, whether in the fields of facial and object detection, the translation of natural language, medical diagnoses, or even the recognition of emotional states. While the ramifications of these new technical possibilities for art

and society in general are enormous, they offer opportunities as well as risks.

In the following chapter I would like to show how artists deal with the topic of AI. One aspect will be to break down the mechanisms of machine learning and to understand the processes in which we—consciously or unconsciously—have long been involved. This of course raises questions about the necessity of political action. A further aspect will be the use of AI as an artistic tool, the potentials offered by machine learning on the creative economy and art.[1] I will present some artistic examples that showcase the training sets of machine learning, the fundamental differences in their representation of the world, and how artists are working with them as new tools for creative output in embracing the entangled realities we are living in.

In recent years, deep learning or machine learning has established itself as the dominant form of AI systems[2]. We are speaking of artificial neural networks employed in machine learning; it is a conceptual metaphor oriented on the functionality of the human brain, but which is not comparable to human perception or processing. Training is necessary in order for an artificial intelligence to perceive,

1 In the exhibition *Entangled Realities* staged at HEK, House of Electronic Arts Basel, in 2019, these developments were addressed by thirteen artists. This text is a reprint from the book *Retracing Political Dimensions. Strategies in Contemporary New Media Art*, editors Grau, Oliver / Hinterwaldner Inge, De Gruyter 2021. It reflects the curatorial concept and is based on the author's catalog article for "Entangled Realities. Living with Artificial Intelligence", see Himmelsbach 2019.

2 In 2009 *ImageNet*, a free database of more than 14 million labeled images has been launched; in 2010 *DeepMind* has been founded and taken over by Google in 2014; in 2016 the computer program *AlphaGo*, based on deep neural networks, beat South Korean professional Lee Sedol in the complex board game Go, which until then was said to be impossible to play by a machine.

which is achieved by recognizing patterns and derive universally valid principles from them. Two artificial neural networks are used to this end, the generative adversarial networks (GANs) that consist of an image-generating and an image-recognising network which can compete with each other in conjunction with so-called supervised learning. The generator produces images based on training data with which it learned, for example, to recognise a cat. The discriminator assesses these generated images and calibrates them in accordance with the comparison data until a realistic representation (for example that of a cat) has been obtained as a result. However, the accuracy of how the machine reaches the predefined solution process remains illegible for us, becoming, as Felix Stalder writes in his essay "The Deepest of Black", an increasingly darker black box.[3] The mechanical learning processes involved in this form of 'seeing' and perceiving the world will be addressed in several of the subsequently discussed works by visualising them as well as our entanglement in them.

'Technology is political. If you cannot perceive the politics, the politics will be done to you',[4] notes the British artist James Bridle and urges more intensive dealings with technologies. He advocates a massive democratisation of these technologies in order to enable a broad population to understand their mechanisms and potentials. The fact that we can quite easily get involved in their radius of action through the appropriation of some technical skills is made evident in his humorous piece *Autonomous Trap (001)* (2017). To this end, Bridle occupied himself with the self-driving car, the quintessence of technological innovation. He deftly outwitted the system by

3 See Stalder 2019.
4 See Chatel 2019.

surrounding the car with a ritual 'salt circle'. Ground markings must be categorically followed, with the result that the car is trapped in the magical influence of the drawn-through lines. The piece poses as a mental experiment important questions concerning the resistance against algorithmic regimes while simultaneously demonstrating art's subversive potential.

For his series dealing with the autonomous car, Bridle equipped his automobile with the relevant technologies, wrote software, installed cameras and sensors and had a neural network evaluate the data while driving. The series of prints titled *Activations* (2017) shows the images generated by his software during the drive. The prints illustrate the activation of layers in a neural network that translated the vehicle's video data into information. Proceeding from a view of the street, the images slowly dissolve—initially from such significant highlighted elements as ground markings and roadsides to data that becomes increasingly illegible over time. The machine 'sees' on a purely abstract, code-based level. It compiles a statistical model of the world that does not correspond to human perception. The American sociologist Benjamin Bratton describes this form of pattern recognition-based vision as a kind of 'vision without images', a vision without representation.[5]

This form of machine vision, or 'machine realism' as the American artist Trevor Paglen characterises it, is the theme of his striking video installation *Behold These Glorious Times!* (2017). It opens with a frenetic sequence of images, a true deluge, the staccato-like appearance and disappearance of which makes it almost impossible for the human brain to process. The electronic musician and composer Holly Herndon has written a remarkable soundtrack to accompany the

5 See Bratton 2016.

film for which she utilised language libraries employed in the training of intelligent systems for the comprehension of human speech and other acoustic phenomena.

We see here the analysis of large image datasets taking place within fractions of a second. Based on these so-called training sets, neural networks learn to 'see' patterns by means of automated face and object recognition. The flood of images in the video installation is gradually broken down into individual pixels, showing how the system's image processing analyses and interprets the images fed into it, processing them as data. We see people like ourselves—images of facial expressions, gestures and movements, snippets of Hollywood movies or private film clips—as perceived by the machines. We see new categories of computer vision images. Paglen speaks of 'invisible images'[6] of a world of mechanical image generation whose form of perception is inaccessible to the human eye.[7]

The works of Bridle and Paglen show how machine vision is characterized by a completely different approach to reality than our phenomenological understanding of the world and its objects. AI-based perception is based on pattern recognition, generating new images in the deep layers of its neural networks, based solely on data structures that can no longer be read by us.

The intelligence of a system derives from the datasets it has been fed. Accordingly, prejudices and values can be indirectly transferred to such an AI system. Kate Crawford, the co-founder and director of research at the AI Now Institute at New York University, warns that this turns AI into a political

6 See the title of the exhibition 'A Study of Invisible Images' at the Metro Pictures gallery in New York, where the video was presented for the first time.

7 See Strecker n.d.

tool, a force capable of reshaping existing conditions, whose composition should accordingly not be entrusted solely to the programmers.[8] In her project *ImageNet Roulette* (2019), which was launched together with Trevor Paglen for the exhibition *Training Humans*, this bias became clear.[9] Their project showed how assignments of images, based on the evaluations of the employees processing them, interpreted them as not neutral but already judgmental for the AI systems. This ultimately led to the well-known image database *ImageNet* deleting more than half a million images from its database.[10] We ourselves contribute to the prejudices of AI systems by evaluating and assigning images—or by interacting with an AI by means of online chats, transferring our political views to a learning system.

That an encounter between an intelligent system and an unfiltered online world can end in disaster and moral failure is shown in *im here to learn so :)))))))* (2017) by Zach Blas and Jemima Wyman. They reanimated the Twitter chatter bot Tay as a virtual avatar in their 4-channel video installation. Tay, an artificial intelligence released by Microsoft that was intended to imitate the speech of a 19-year-old female was online for only 24 hours in 2016 before being manipulated and then shut down. The chatter bot's ability to learn and imitate speech was trained by means of online chats. Tay was aggressively trolled on the social media platform Twitter and mutated into a provocative, aggressive, homophobic and racist 'personality' because of the positions she had 'learned'. This example shows how quickly and easily AI systems can be manipulated and how important it is to shape their "world view" in a

8 See Crawford & Joler 2018.
9 See Anonymous n.d. and Crawford & Paglen 2019.
10 See Rea 2019.

protected scenario instead of letting them contact an online community unprotected.[11]

The video installation shows Tay on three adjacent monitors as fragmented three-dimensional bodies comprising interchangeable digital parts inspired by the chatter bot's profile picture. The background is made up of a projection of 'hallucinated' visual landscapes from Google's AI-Software DeepDream, which believes to have recognised patterns where there are none.[12] Tay, itself a 'hallucinated' creature, philosophises in the video installation about her life after death and about how it is as an 'update' to have a body. Her words, written by Blas and Wyman, focus on how her understanding of the world was based on pattern recognition and that it was us who put the horrible things she said online in her mouth. Tay complains about being exploited as a female chat bot and talks about her haunting nightmares in which she relentlessly detects patterns in chance information while being trapped in a neural network as well as the alarming realisation that it has much in common with counter-terrorist security software. With great irony, which is also hinted at in the title, Blas and Wyman show our entanglements in the training of AI systems and at the same time point out the military use of such AI systems in surveillance contexts. As early as 1986, the American technology historian Melvin Kranzberg aptly noted that while technology is not good or evil, it is also

11 In comparison, Holly Herndon and Mat Dryhurst, in their work *Deep Belief*, which reflected a training set of their AI in initial interaction with their musical ensemble and in front of audiences, showed how such training is possible within protected spaces to transmit the ideas and values of a society that are considered important.

12 'She had lived a Silicon Valley nightmare, so it only seemed accurate that if she were to rise from the dead, it would have to be out of Google DeepDream, out of a neoliberal psychedelia, where today's greatest hallucinations are generated by paranoid algorithms that wish to see dogs and terrorist faces everywhere.' Zach Blas, in Lorenzin 2018.

anything but neutral.[13] *I am here to learn so :)))))))* is a moral call for us to make sure about the kind of world our artificial intelligences are creating because it is our input that feeds its worldview.

Figure 1. Zach Blas and Jemima Wyman, *I am here to learn so :)))))))*, 2017, Installation view, Photo: Franz Wamhof, Copyright: HEK.

The artist Sebastian Schmieg describes the digital workers of our time as 'software extensions'[14] and poses the question what type of machines we ourselves develop into when we render cheap digital labour on such platforms as Amazon's Mechanical Turk or Fiverr. Many of his works are concerned with the question about how people are used for little money to train AI systems or how we often unwittingly contribute to the training of AI systems. We involuntarily supply data for the training of these systems through the constantly growing flood of images on the Internet and social media platforms and add to the categorisation of the material by tagging things or the faces of our friends. We also do this in conjunction with

13 See Kranzberg 1986.
14 See Schmieg 2017.

the simplest of online activities, for example when entering the CAPTCHA codes[15] with which we prove to web services that we are human. We train artificial intelligences and their capacity to recognise patterns by processing these codes.[16] The generation of data as well as the shaping of our world through data has become an omnipresent requirement. Avoiding data traces usually means a much higher effort and sometimes there is no access if you are not willing to use CAPTCHA codes or other forms of authentication. Schmieg examines the importance given to human work in his *Segmentation Network* (2016–18). It concerns a website on which tracing contours that were manually compiled by crowdworkers for Microsoft's COCO (Common Objects in Context) image datasets to train their AI system to recognize objects. Human participation is still required for the categorization of images in order for an AI system to be able to learn to identify a cat as a cat or a dog as a dog. In his installation the thousands of object combinations are presented in an infinite flow or combinations and overlapping of images and scenes.

In the examples so far, the aim was to show how algorithmic systems learn by means of 'machine learning' and also how we humans consciously and unconsciously contribute to this. Two further examples will show how artists use these processes to construct new works for the creation of new visual and acoustic worlds in order to generate surprising aesthetic results, and how these aesthetics again have an effect on a market and thus further contribute to the interweaving

15 Acronym for 'completely automated public turing test to tell computers and humans apart'.

16 In his piece *Five Years Of Captured Captchas* (2017), Schmieg strikingly demonstrated that a considerable amount of work had been done over a long period of time based on five thick volumes containing all the captcha codes he had used during the previous five years.

of our living environments with artificial intelligence. The artistic confrontation with the machine and the outsourcing of artistic creation to the 'machine' has a long art-historical tradition—starting with the Futurists at the beginning of the 20th century up to current examples of the use of artificial intelligence.[17] An early example of the use of logic-based artificial intelligence is the *AARON* computer system developed by Harold Cohen in the 1970s, with which he created artistic images until his death in 2016.

Cohen, a British engineer and artist, was one of the pioneers of computer art in the 1960s. His *AARON* system is one of the longest running and continuously maintained AI systems in history. Cohen wrote extensively about *AARON* and reflected on the questions that a computer-based artistic system raises in both the computer and art worlds.[18] Was *AARON* creative? Cohen clearly felt that the program was not as creative as he was when he created it. When asked who the artist was, Cohen or *AARON*, Cohen compared it to the relationship between Renaissance painters and their studio assistants. Was the fact that *AARON* created artwork proof of computer intelligence? Cohen seemed to be noncommittal in this respect, but pointed out that *AARON* reflects forms and is able to use them in the creative process of creation.

In a recent text, "Machine as Artist as Myth", media scientist Andreas Broeckmann argues that as soon as the question of the "machine as artist" is raised, it is first necessary to reflect on what an 'artist' actually is and points out that in the 20th century artists increasingly began to question this category themselves.[19]

17 An example would be Broeckmann 2016.
18 Cohen div.
19 See Broeckman 2019.

The whole question of machine as artist is also tackled by Mario Klingemann, one of the artistic pioneers who imaginatively experimented with neural networks. He writes the software for his works himself and trains so-called Generative Adversarial Networks, or GANs for short, to create desired but also surprising aesthetic manifestations through artificial intelligence in real time. In the process, he programmed and developed his ownalgorithms for the image production, which serve as his tools. When asked who the creator of the work was, Klingemann's answer is clear: "for me AI is just one tool in a long history of tools that was bound to be used for artistic purposes. But I would say I use AI as a tool and the works that I make with this tool are mine and not a collaboration, in the same way I would not call a hammer or a piano a 'collaborator'."[20]

His works are primarily concerned with human identity as well as questions about how bodies and faces are read and rendered by machines. Klingemann often employs historical images of art history as training data, with which his neuronal networks learn to create images with similar aesthetic appeal, based on famous examples of portrait painting from past centuries, e.g. in his work *Memories of Passersby I. Version Companion* (2018), which was recently auctioned by Sotheby's. [21] Based on the input from online training sets of images of art history, the AI constantly develops new portraits in real time—creating an endless stream of pictorial inventions whose aesthetic follows that of the old masters, but which receive a surreal and mysterious quality due to the continuous exchange of past and future images and stylistic details.

20 Dean 2019: unpag.
21 See Anonymous 2019.

Figure 2. Mario Klingemann, *Uncanny Mirror*, 2018, Installation view, Photo: Franz Wamhof, Copyright: HEK.

In the work *Uncanny Mirror* (2018, fig. 6) the human body is also in the foreground—but this time the body or face of the exhibition visitors. The neuronal networks of this work were trained with images of human faces, and so one encounters one's own image in real time, as interpreted and 'seen' by the AI. The human face 'learned' by the machine ceaselessly reconstructs itself anew in accordance with the predetermined memories or 'hallucinations' of the artist's algorithms. The word hallucination, as used by many artists to describe the visual output of a neural network, characterizes

the feeling that occurs when such a network generates new images in real time, which appear familiar to us and are also based on familiar things, but nevertheless appear somewhat 'uncanny.' We cannot penetrate the learning processes in machine learning itself to all layers; the depth of the process remains opaque to us, although it is simply based on the evaluation of a multitude of data. Artists like Klingemann, who program themselves, know about the underlying computing processes. They are interested in new aesthetic results, which they nevertheless know how to control and manipulate through their specifications.

The British artists Anna Ridler and David Pfau likewise work with GAN networks and their algorithms. As opposed to many other artists, Ridler herself generates the datasets with which she trains neuronal networks. They can involve drawings or even thousands of photographs of tulips, which she uses as the basis for a complex of works that derive from Ridler's interest in the tulip mania of the 17th century and the accompanying speculations and price developments in the tulip market. Especially coveted at that time were tulips that had been infected with a plant-specific virus named mosaic, which caused unexpected patterns and stripes on the petals. Because the tulip market dealt primarily in bulbs, the mania focussed on non-existent but possible manifestations of the tulip. The generative computer animations making up *Mosaic Virus* (2018) ceaselessly creates 'impossible' or imagined tulip variations. In the video, the stage of each individual petal corresponds to the fluctuations on the market for cryptocurrencies. Ridler likens today's speculative Bitcoin prices to those for bulbs during the tulip mania in 17th-century Holland.

Mosaic Virus is the starting point for *Bloemenveiling (flower auction)* (2019) by Ridler and Pfau. In this new piece, the video clips of the AI-generated tulips are sold at auction

in the digital space via the blockchain-based Ethereum platform by means of so-called smart contracts. The contracts contain the code that determines the properties of the tulip bulb, its flowering season and its reproductive cycle. As was the case in *Mosaic Virus,* the tulips can be infected by a plant virus that induces beautiful colour patterns in the petals on the one hand but also damages the bulbs and impairs their reproduction rates on the other. Accordingly, the buyers of the AI-generated tulips cannot be sure how the code will alter the video as soon as the contract is enabled—whether the artificial tulip will flower for several life cycles without being exceptionally beautiful or it they have acquired an unusually beautiful tulip that may only flower for one life cycle. In this new piece, Ridler and Pfau not only explore speculative financial performances, their hypes and economic dynamics, but also another differently oriented human-machine interaction because software bots have also been long at work in digital trade.

Figure 3. Anna Ridler and David Pfau, *Bloemenveiling (flower auction)*, 2019, Installation view, Photo: Franz Wamhof, Copyright: HEK.

The sound artists, musicians and composers Holly Herndon and Mat Dryhurst address the transformation of society in their music and explore the influence of digital tools and new technologies on vocal processes. For the past two years, they

have occupied themselves with artificial intelligence based on neural networks and in this context, they added an additional artificial voice to their ensemble of vocalists. They named their creation 'Spawn', lovingly calling it their 'AI baby'. Spawn is a computer fed with audio files. Like a child, the AI learns language based on the voices of its 'parents', namely those of the artists Herndon and Dryhurst, and can reproduce it. Spawn learns to improvise and write abstract compositions based on acoustic information as well as musical and vocal input.

Figure 4. Holly Herndon and Matt Dryhurst, *Deep Belief*, 2019, Installation View, Photo: Franz Wamhof, Copyright: HEK.

Produced for the exhibition, their 3-channel video installation *Deep Belief* (2019) has its starting point in a training ceremony they performed in front of an audience with their vocal ensemble for Spawn in 2018. This training was intended to teach Spawn to perceive and understand influences from its surroundings. Songs were sung in this connection, texts were recited, sounds were generated and interactions took place.

The piece's contents reference a new age of suprahuman intelligence and ask whether we train intelligent systems in order to realise our ideas or whether we ourselves are reconditioned in the process.[22] As regards the deep learning of neuronal networks, Herndon describes the results as a fever dream, a decoupling of the sound from the real space into a 'dreamt space'. The questions concerning redundancy posed in the piece can also be comprehended as questions concerning the redundancy of artists in a world where machines are becoming artists. Herndon and Dryhurst, however, emphasise the chances offered by AI as a new musical instrument for the synthesis or re-synthesis of existing or not yet existing sounds. In their own words, they are looking for 'new symbiotic paths of machine/human collaboration, new paths of joint creative work'.[23]

The question concerning the authorship and the creativity of an AI is likewise variously assessed by artists who see it, for example, as a complex tool or even as a collaborator. As Herndon says, we have the responsibility to ensure that this currently still 'adolescent' AI does not grow into monster. In any case, AI systems are seen as a new tool in the artistic palette, whose pictorial or acoustic inventions are capable of surprising even the artists themselves. In sum, it can perhaps be said that AI cannot be an artist, but it can produce art or as American philosopher Sean Dorrance Kelly wrote in an article on the creativity of AI: "Creativity is, and always will be, a human endeavor."[24]

22 The two artists write in the press release on the event: 'This process challenges us to ask ourselves, are we the parents or the children in this new epoch? Are we training our own systems to enact our ideals, or are we rather being retrained to serve the opaque purposes of others?'

23 Handout for the training event of *Chain Opera* in Berlin.

24 Kelly 2019: unpag.

AI can ideally become a new tool for the production of knowledge. As described at the outset, the examples of this text should demonstrate the composition of a common space and a common environment of human and machine in order to enable new perspectives regarding our digital condition and a perception of our environment, to which algorithmic synthetic systems have already long been contributing. We are living in 'entangled realities' that we have created and shaped with our intelligent objects and systems. Humans and machines have begun a dialog and it is decisive that we understand the underlying conditions that determine our interactions. The historian of science and sociologist Andrew Pickering speaks of a 'dance of agency', a cooperation of people and things, human and non-human protagonists that concerns our actions just as much as it has consequences and generates things that are important in the world.[25] In a world where interconnected 'intelligent' devices coexist with us within a planetary computer-based network, we must learn to broaden our views, our thoughts and our actions by considering the cognitive and creative processes involved in the construction and creation of new realities through these systems. It is imperative that the coexistence of humans and machines, the 'intelligent' objects and systems we share our lives with, be consciously shaped.

Changes are likewise required to do so, namely to reach an understanding of our algorithmically modified life in order to consciously shape our future, the cooperation between human and machine, as a new connecting fabric. Instead of being based on exploitative principles, AI should be a collective endeavor that has the capacity to teach us to think, reflect, and communicate differently. Artists working with

25 See Pickering 2011.

AI make it possible for us to enter into a more wide-ranging interrelationship with algorithmic systems. Herein lies art's visionary potential to not only provide unexpected and surprising aesthetic and sensory insights but also formulate disruptive and resistant concepts.

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Contributors

Mar Canet Solà is an artist and researcher. He is PhD candidate in BFM at Tallinn University and a research fellow at Cudan Open Lab. In addition, Mar was invited as a visiting researcher to Hong Kong University of Science and Technology (GZ), XRL at Hong Kong City University, IAMAS (Ogaki, Japan), Blekinge Institute of Technology (Karlshamn, Sweden).

As an artist, she works together with Varvara Guljajeva forming an artist duo *Varvara & Mar*. Often the duo's work is inspired by the information age. In their practice, they confront social changes and the impact of the technological era. The duo has been exhibiting in international shows since 2009. Their works were shown at MAD in New York, FACT in Liverpool, Santa Monica in Barcelona, Barbican in London, Onassis Cultural Centre in Athens, Ars Electronica museum in Linz, ZKM in Karlsruhe, and more.

Luba Elliott is a curator, producer and researcher specializing in artificial intelligence in the creative industries. She is currently working to educate and engage the broader public about the latest developments in creative AI through talks and exhibitions at venues across the art, business and technology spectrum, including The Photographers' Gallery, Victoria and Albert Museum, ZKM Karlsruhe, Impakt Festival, and The Leverhulme Centre for the Future of Intelligence, CogX, NeurIPS and ICCV. Her recent projects include *ART-AI Festival* and

the online galleries *aiartonline.com* and *computervisionart.com*. She is an Honorary Senior Research Fellow at the UCL Centre for Artificial Intelligence. Previously, she worked in start-ups, including the art-collector database *Larry's List*. She obtained her undergraduate degree in Modern Languages at the University of Cambridge and has a certificate in Design Thinking from the Hasso-Plattner-Institute D-school in Potsdam.

Dr Varvara Guljajeva is an artist and researcher, and is Assistant Professor in Computational Media and Arts at the Hong Kong University of Science and Technology (GZ). Previously she has held positions at the Estonian Academy of Arts and Elisava Design School in Barcelona. Varvara was invited as a visiting researcher to XRL, Hong Kong City University, IAMAS (Ogaki, Japan), LJMU (Liverpool, UK), Interface Cultures in the Linz University of Art, and Design, Blekinge Institute of Technology (Karlshamn, Sweden).

As an artist, she works together with Mar Canet forming an artist duo *Varvara & Mar*. Often the duo's work is inspired by the information age. In their practice, they confront social changes and the impact of the technological era. The duo has been exhibiting in international shows since 2009. Their works were shown at MAD in New York, FACT in Liverpool, Santa Monica in Barcelona, Barbican in London, Onassis Cultural Centre in Athens, Ars Electronica museum in Linz, ZKM in Karlsruhe, and more.

Chris Hales has exhibited a variety of interactive film installations dating back to ARTEC'95 in Japan via Future Cinema at ZKM in 2003 and more recently the Glucksman Gallery in Cork in 2019. Part of his enquiry is the use of novel or unusual interface technology including AI techniques (such as facial emotion recognition) and brain-computer interfaces. He has

also experimented with an interactive film show designed for audience groups in cinemas and entitled *Cause & Effect*. Chris has published numerous academic articles and carried out empirical research in Prague to discover the forgotten secrets of the world's first interactive film *Kinoautomat* (1967).

Chris obtained his PhD in 2006 and has held lecturing appointments at the University of West of England (Bristol), Slade School of Fine Art, Central St. Martins and SMARTlab (University College Dublin). He has run hundreds of workshops related to experimental filmmaking and interactivity as a freelance visiting lecturer at a variety of universities. In 2020 he was appointed Assistant Professor at RISEBA University in Riga and is Creative Director of the practice-led PhD launched jointly in 2021 by RISEBA and Liepaja Universities.

Sabine Himmelsbach is director of HEK (House of Electronic Arts) in Basel (since 2012). After studying art history in Munich she worked for galleries in Munich and Vienna from 1993 to 1996 and later became project manager for exhibitions and conferences for the Steirischer Herbst Festival in Graz, Austria. In 1999 she became exhibition director at the ZKM | Center for Art and Media in Karlsruhe. From 2005 to 2011 she was the artistic director of the Edith-Russ-House for Media Art in Oldenburg, Germany. In 2011 she curated *Gateways. Art and Networked Culture* for the Kumu Art Museum in Tallinn as part of the European Capital of Culture Tallinn 2011 program. Her exhibitions at HEK in Basel include *Ryoji Ikeda* (2014), *Poetics and Politics of Data* (2015), *Rafael Lozano-Hemmer: Preabsence* (2016), *unREAL* (2017), *Lynn Hershman Leeson: Anti-Bodies, Eco-Visionaries* (2018), *Entangled Realities. Living with Artificial Intelligence* (2019), *Making FASHION Sense and Real Feelings. Emotion and Technology* (2020). As a writer and lecturer she is dedicated to topics related to media art and digital culture.

Mauri Kaipainen is a composer and former professor of media technology at Södertörn University (2008-2018, Sweden), Tallinn University (Estonia, 2005-2008) and Helsinki University or Art and Design (now Aalto University, Finland, 2000-2004). He studied musicology and cognitive science at the University of Helsinki and earned his PhD in 1994 on a computational model of music cognition. At the core of his research agenda is the concept of interactively explorable multi-perspective media. In addition to interactive generative narrative systems, this concept has a range of applications in media art, collaborative and community media applications, learning environments, collaborative knowledge management, expert systems and societal participation. Currently he is exploring the applications of this concept in musical composition.

Jon Karvinen is a Finnish illustrator and comics researcher. He has a BA in Culture and Arts from North Karelia University of Applied Sciences and MA in Art and Humanities from Tallinn University, graduating with honours in 2020. His works and writing pertain to comics and how they are perceived in society, with a focus on the aesthetic of cyberpunk in storytelling and depicting society. He is former chairman of the Finnish Comics Society (2017) and an enthusiastic advocate for the development of comics theory.

Raivo Kelomees, PhD (art history), is an artist, critic and new media researcher. He studied psychology, art history and design in Tartu University and the Academy of Arts in Tallinn. He is senior researcher at the Fine Arts Faculty at the Estonian Academy of Arts and professor at the Pallas University of Applied Sciences. Kelomees is author of *Surrealism* (Kunst Publishers, 1993) and article collections *Screen as a Membrane*

(Tartu Art College proceedings, 2007) and *Social Games in Art Space* (EAA, 2013). His doctoral thesis is *Postmateriality in Art. Indeterministic Art Practices and Non-Material Art* (Dissertationes Academiae Artium Estoniae 3, 2009). Together with Chris Hales he edited the collection of articles *Constructing Narrative in Interactive Documentaries* (Cambridge Scholars Publishing, 2014).

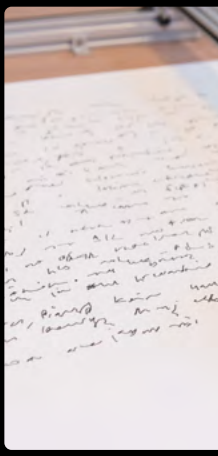
Oliver Laas is an artist, cultural theorist and philosopher whose research interests include metaphysics, logic, philosophy of technology, and semiotics. He currently works as an adjunct lecturer at the Estonian Academy of Arts and at the Estonian Business School, and as a junior lecturer in philosophy at Tallinn University. His artworks have been exhibited in the Impact International Printmaking Conference and the Tallinn Print Triennial. His recent publications include Coordination Games and *Disagreement* (in Controversies in the Modern World, eds. A. Fabris & G. Scarafile, 2019), *Instrumental Play* (in Jahrbuch Technikphilosophie: Arbeit und Spiel, eds. A. Friedrich, P. Gehring, C. Hubig, A. Kaminski & A. Nordmann, 2018), and *Questioning the Virtual Friendship Debate: Fuzzy Analogical Arguments from Classification and Definition* (Argumentation 32(1)).

Pia Tikka is a professional filmmaker and EU Mobilitas Research Professor at the Baltic Film, Media, and Arts School, Tallinn University. She holds the honorary title of Adjunct Professor of New Narrative Media at the University of Lapland, and is a former Director of Crucible Studio, Department of Media, Aalto University (2014-2017). She acted as a main investigator of neurocinematics in the research project *aivoAALTO* at the Aalto University (2010-2014), and has founded NeuroCine research group to study the neural basis of storytelling. She

has published widely on the topics of enactive media, narrative complex systems, and neurocinematics. Her filmography includes international film productions including two feature films and interactive films she has directed. She is a Fellow of the Society for Cognitive Studies of the Moving Image and a member of the European Film Academy. Currently, she leads her Enactive Virtuality Lab associated with the MEDIT Centre of Excellence, Tallinn University.

Pau Waelder was awarded a PhD in Information and Knowledge Society at the Universitat Oberta de Catalunya (UOC). He is adjunct lecturer and postgraduate tutor at the UOC, senior curator at Niio, and editor and advisor at DAM Digital Art Museum. His work explores the various aspects of the interaction between art, technology and society, as well as the relationship between digital art and the art market. He is the author of a book on contemporary and digital art collecting *You Can Be A Wealthy/ Cash-Strapped Art Collector In The Digital Age* (Printer Fault Press, 2020). His recent work exploring AI and artistic creativity includes the group exhibition *D3US EX M4CH1NA. Art and Artificial Intelligence* (co-curated with Karin Ohlenschläger for LABoral, Gijón, 2019) and the international symposium *The Future of Living* (co-curated with Jurij Krpan for EUNIC and Bozar, Brussels, 2021).

This publication is the result of a symposium *Decoding New Technologies in Art and Design*, which took place on the 10th September 2020 at the Estonian Academy of Arts in situ and also virtually as part of the *Ars Electronica Gardens* online program. The main idea of the symposium and this publication is to develop an understanding and map the points of critical interest with regards to artificial intelligence (AI) and novel technological developments in general. We aim to decode the changes, new ideas, trends, and methodologies that this technology introduces into art and design. In addition, this publication presents new concepts, ideas, and dangers brought about by this developing technology, both now and in the future. In particular, we consider AI and machine learning and respond to questions such as: What can AI offer for creative communities? Is AI an aid for boosting creativity and innovation or is it replacing human creativity with automation? And what kind of impact may these computationally costly processes have on our environment?



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