The Meaning of Creativity in the Age of AI

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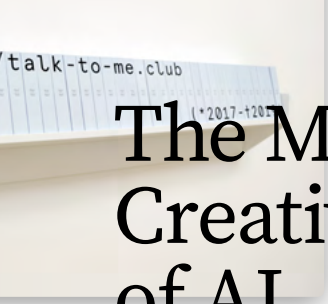

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Entangled Realities. How Artificial Intelligence is Shaping our World

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.

References

Anonymous (n.d.): "Kate Crawford | Trevor Paglen: Training Humans". In: Fondazione Prada Homepage, in: http://www.fondazioneprada.org/project/training-humans/?lang=en (last accessed 08.03.2020).

Anonymous (2019): "The Hypnotic Allure of the AI Art Generator." In: Sotherby's, March 6th, in: https://www.sothebys.com/en/videos/the-hypnotic-allure-of-the-ai-art-generator (last accessed 08.03.2020).

Bratton, Benjamin (2016): "Design, Philosophy and A.I." In: European Graduate School Video Lectures, Saas Fee, in: https://www.youtube.com/watch?v=4TIUVeOO5tk (last accessed 08.03.2020).

Broeckman, Andreas (2016): Machine Art in the Twentieth Century, Cambridge, MA: MIT Press.

Broeckman, Andreas (2019): "The Machine as Artist as Myth." In: Arts 8.1.25, in: https://www.mdpi.com/2076-0752/8/1/25 (last accessed 10.03.2020), https://doi.org/10.3390/arts8010025.

Chatel, Marie (2019): "Name It: Why Established Galleries Already Feature Digital Art But Don't Say So."
In: Digital Arts Weekley, February 15th, in: https://medium.com/digital-art-weekly-by-danae-hi/name-itwhy-established-galleries-already-feature-new-media-art-but-dont-say-so-7e142d8384a6 (last accessed 08.03.2020).

Cohen, Harold (div.): Homepage, in: http://www.aaronshome.com/aaron/publications/index.html (last accessed 10.03.2020).

Crawford, Kate and Vladan Joler (2018): Anatomy of an AI System. The Amazon Echo as an anatomical map of human labor, data and planetary resources, in: https://anatomyof.ai/ (last accessed 10.03.2020).

Crawford, Kate and Trevor Paglen (2019): Excavating AI: The Politics of Images in Machine Learning Training Sets, in: https://www.excavating.ai/ (last accessed 08.03.2020).

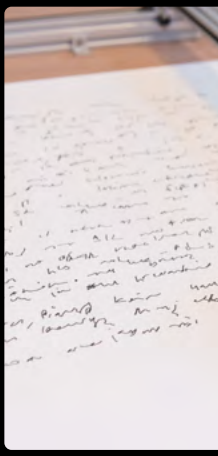
Dean, Martin (2019): "Artist Mario Klingemann on Artificial Intelligence, Technology and our Future." In:
Sotherby's, February 25th, in: https://www.sothebys.com/en/articles/artist-mario-klingemann-on-artificial-intelligence-art-tech-and-ourfuture (last accessed 08.03.2020).

Himmelsbach, Sabine (2019): "Entangled Realities. Living with Artificial Intelligence." In: Ibid. and Boris Magrini (eds.): Entangled Realities: Living with Artificial Intelligence, exh.cat. HEK, House of Electronic
Arts Basel, Basel: Christoph Merian Verlag, pp. 60–75.

Kelly, Sean Dorrance (2019): "A philosopher argues that an AI can't be an artist." In: MIT Technology Review, February 21st, in: https://www.technologyreview.com/s/612913/a-philosopher-argues-that-an-ai-cannever-be-an-artist/ (last accessed 10.03.2020).

Kranzberg, Melvin (1986): "Technology and History: Kranzberg's Laws." In: Technology and Culture 27.3, pp. 544–560.

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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