

Artificial Intelligence and Creativity Under Interrogation



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Abstract Given the increasing ubiquity of artificial intelligence (AI) in all human activities, it is not surprising that artists, designers, and other creators in the field of culture and creative economy are making use of AI capabilities in their productions. Avoiding the controversial debates about the benefits on the one hand and the negative externalities of AI on the other, this chapter will focus on the specific modes of incorporation of AI by artists. The chapter argues that placing AI as a current resource in the historical context of the development of the technological arts is a well-founded way of entering the debates that the topic may arouse. Thus, the framework of photography, followed by electronic and computational resources, and the plethora of possibilities opened to the artist by the digital universe constitute assumptions of continuity for the understanding of the technological partnerships that artists have sought over at least two centuries and that today culminate in artificial intelligence. This does not mean seeking a point of arrival that minimizes the importance of discussions around the topic, but rather raising arguments that can bring the discussion to the specific field of the new challenges that are presented to human creativity.

Keywords Creative AI · Semiotics · Creative process · Radical art

1 Introduction

Researchers working in the Artificial Intelligence (AI) development centers, especially in the United States and China (the two countries that are taking the lead in this newest race of capitalism), are unanimous in assuring that we are only at the dawn of AI: weak AI as it is called. This already indicates that it is at the beginning of its development. Nevertheless, AI is already acting, almost always invisibly, in nearly all fields of human activity. When the topic starts to appear on websites, newspapers, and magazines for the general public, it means that it has already found a home

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in the most capillary tissues of human society. In fact, art and questions related to creativity could not be absent from this capillarity. Thus, it is the questions related to the specificity of the modes of incorporation of AI by artists that this chapter aims to put on the agenda.

1.1 The State of the Art of AI

AI studies began in the 1950s when John McCarthy quoted the term at a seminar at Dartmouth University in the United States. However, the English mathematician Alan Turing came before that. He gave a lecture on it in 1947, and he is also taken to be the first to decide that AI was best researched by programming computers rather than by building machines. In 1950, Turing published the study “Computing Machinery and Intelligence” in which he presented the *Imitation Game* also known as the *Turing Test*: a set of questions in which it is possible to discriminate whether the respondent is human or machine. By that time, the seeds in the field of AI had already emerged as being strongly associated with the area of genetics in biological sciences.

For a few decades, research on AI in the context of cognitive science has gone through ups and downs until it found its promising path a few years ago. This is explained by the convergence of several factors: the exponential increase in computer processing capacity and the gigantic growth in the speed, volume, and variety of data gathered in the networks, which, together with the functional increment of neural networks, led to the explosion of AI, an explosion which is being transformed into an implosion of previous human productive and cognitive configurations.

To get started in the field of AI, especially where it is today, the first step is to find a definition of intelligence that is reliable. There is some consensus among experts that AI means the simulation by computer systems of human intelligence processes. It is a branch of computer science aimed at creating intelligent machines. This implies the machinic development of skills such as learning, knowledge, acquiring information including the rules for using it, reasoning used to reach definite or approximate conclusions, self-correction, problem-solving, perception, linguistic recognition and processing, planning, and the ability to manipulate and move objects. To accomplish these purposes, the computer needs access to objects, categories, properties, and relationships. With this in mind, AI is today an umbrella for an ever-increasing multiplicity of applications.

Undoubtedly, AI’s resources today spread across a variety of human activities. Intelligent personal assistants organize routines, document “automatizers” assist with a variety of tasks, software analyzes online behavior, algorithms are able to predict the success of audio-visual narratives, advanced software is aimed at perceptual recognition, and deep learning is employed for medical diagnosis and machine learning for health treatments; there is software for autonomous aerial systems and also robots with human faces, who talk sympathetically. The advances do not stop

there. However, the aim of my chapter does not go in that direction. My point of departure coincides with Broeckmann's (2020):

AI is not a unified phenomenon, a *something* to be handled, understood, addressed, but rather a conceptual construct, a discursive tool that both facilitates communication about the technoscientific phenomenon, and over-simplifies it. The current urge *to get to grips with AI* is understandable, given the radicality with which the related technologies challenge an established understanding of technics that presumes tool-like passivity, rather than active techno-logical agencies, which co-determine what humans can do in the world. But such skewed terminologies, which claim monolithic notions of "intelligence" or "learning" and pitch "human" against "machine", affirm mythical conceptions of technology and the related schemata of human subjectivity, rather than open them up to new and alternative narratives.

Thus, my discussion does not go in the direction of the disturbing or rather shocking occurrence which Bogost (2019) called the "AI-art gold rush" when the "New York auction house Christie's sold *Portrait of Edmond de Belamy*, an algorithm-generated print in the style of nineteenth-century European portraiture, for \$432,500." It is not this narrative and others concerning the commercial aspects of AI and art that matter to this chapter. Rather, it is of my interest to show that, in the field of arts, we are testifying the emergence of a new mode of creative and artistic production that has been incorporated by artists and has aroused the interest of theorists and critics of culture and the arts. My aim is again in tune with Broeckmann (2020) when he says that

the art world participates in this discourse through a flurry of exhibitions and public debates, with a noticeable emphasis on the technical and the social, rather than the particular aesthetic and artistic aspects, placing an awkward, and at times, playful or dilettante-like focus on the technical medium. Art criticism perpetuates this tendency when it highlights the societal concerns instead of engaging with the artworks and their aesthetic affordances.

For him, the emergence of AI and art "deserve, and require, critical scrutiny not only as reflections on a technical paradigm, but as artworks in their own right", since "they develop their own scenarios, projecting their own rules and raising their own, hard questions." In fact, these are thorny questions, which this chapter aims to face, without any desire to exhaust the subject, but only to bring some contribution to the debate.

2 AI as an Adjunct to the Creative Process

Far from being a bizarre and astonishing phenomenon, the relationship between art and AI brings a type of creation perfectly tied to the already secular history of technologically inseminated arts, trends that were progressively accentuated after the digital revolution, in a multiplicity of developments such as net art, web art, digital art, computational art, algorithmic art, interactive art, robotic art, and so on. The art that is produced today through the artist's creative sharing with AI resources, in particular machine learning (ML) and deep learning (DL), is not an isolated phenomenon.

If we abandon the addiction to what may be called “presentism,” as if recent trends and explosions in both the sciences and the humanities had fallen by parachute—there from some unknown height—directly onto today’s culture, it will be possible to see that culture is continuous and that new scientific, technical, artistic, and cultural phenomena gradually open up their space until their clear emergence in the present occurs. According to Liu (2018):

Technological revolutions have brought crucial influences in the history of mankind. Our understanding of technology and our relationship with machines are also changing. McLuhan famously defines technology as media, and media as the extensions of our senses and bodies. Our relationship with machines in this light is not simply instrumental, since ‘we shape our tools, and thereafter our tools shape us’ (McLuhan 1964). In an age of machine intelligence, the ubiquitous machine-learning-based products and services are augmenting various aspects of our lives. Our relationship with intelligent machines is evolving, given that machines are increasingly moving away from the role of passive objects into the position of active subjects.

This is what is happening with AI especially in its creative production face. In fact, since 1968–69, when the first computational art exhibitions took place, at the Howard Wise gallery in New York and at the large-scale exhibition *Cybernetic Serendipity* in London, more than 50 years have gone by in the development of this kind of art. The beginnings can be found in the 1950s in the work of some artists and designers who were using mechanical devices or analog computers to carry out their work.

Coincidentally or not, in the mid-1950s, the cognitive sciences began to blossom, having as one of its scopes, among others, the development of AI. Such development never failed to attract the attention of artists working in partnership with computational algorithms, so much so that, while research was faltering, artists were already incorporating what they had at their disposal, genetic algorithms. There are remarkable examples of works that used these resources in the 1990s as the one that became famous for its ingenuity, *A-Volve*, 1993–94, by C. Sommerer and L. Mignonneau. Therefore, since then, artworks that incorporated AI resources have followed *pari passu* the technical development of this field. In the last ten years, research in AI has exploded and at the same time, of course, artistic works have started to project themselves more and more in this field.

It is not my intention to explain technical issues of AI, nor will I limit myself to the presentation of works and artists who are producing works that use AI algorithms. What I intend to discuss are the aesthetic questions that this type of art is raising.

2.1 *The Aesthetic Debate*

Artificial intelligence methods open up new possibilities both in art and in the creative economy and even in entertainment, allowing for rich and deeply interactive experiences (Santaella 2021). As AI opens up new fields of artistic expression, AI-based art itself becomes a fundamental creative and research agenda, raising and answering aesthetic questions that would not have arisen without the advent of AI.

Creativity is a fundamental feature of human intelligence and functions as a challenge to AI. According to Boden (1998), AI techniques can be used to develop new creative proposals in three ways:

- producing new combinations from existing productions
- exploring the potential of conceptual spaces
- making transformations that allow the generation of forms, images, and ideas that would be otherwise impossible.

There is no lack of questions and concerns about the nature and fate of AI. In discussions far from consensus, the most frequent questions are as follows: *But what is intelligence? Is there a solid definition of intelligence that doesn't depend on relating it to human intelligence? Does AI aim at human-level intelligence? Which aspects of AI cannot compete human capacities?* and so on.

When uncertainties about the conditions and fate of AI are transferred to the field of art, aesthetic questions of all kinds are intensified, especially issues concerning creativity and the status of art, when the artist finds in AI a partner for his/her creative abilities. What questions does this bring to our traditional conceptions of aesthetic creation? The most common among them are as follows: *but will a true artificial artist ever exist? Can we foresee that one day aesthetics will be generated entirely by the machine, without any design commanded by a human agent? Will AI ever have an aesthetic of its own?* (Nakazawa 2018).

Bogost states that “Given the general fears about robots taking human jobs, it’s understandable that some viewers would see an artificial intelligence taking over for visual artists, of all people, as a sacrificial canary” (Bogost 2019). This is how the advance of ML is recreating old debates about how to define not only what art is, but what creativity is as well. Similar debates took place during the rise of the YouTube generation, when anyone could suddenly be a creator. Now, new generations of AI are raising the question: What is the role of the artist? If a machine can make visual art, edit a movie, write a script (Sunspring) or compose a song (Daddy’s Car), what is the artist’s value? What about the creative ability that has always characterized the artist?

Creativity is a skill that we generally consider uniquely human. Throughout history, we have been the most creative beings on planet Earth. Birds can make their nests, ants can make their hills, but no other species on the biosphere comes close to the level of creativity that we humans demonstrate. In recent decades, and in the wake of an exploratory tradition that belongs to art, we have acquired the ability to do amazing things with computers and their substitutes such as robots. With the AI boom in the 2010s, computers can now recognize faces, translate between all languages, receive calls for you and beat players in the world’s trickiest board game, to name a few. Suddenly, we must face the possibility that our ability to be creative is not unrivaled in the universe. So, creativity is no longer an exclusively human trait? Can AI be creative? (Kulpaki 2018).

It is not necessary to return to the post-Duchamp debates about what is art and what is not art, because, if we take as a reference the growing pluralism and heterogeneity of the arts throughout the twentieth century, such debates become tedious. Given this,

the argument I defend is that the historical development of the technological arts suggests a good path to understand the current aesthetic phenomenon of creativity in AI. After all, the issue of creativity in connection with the computer has been transforming the traditional conceptions of aesthetics for some decades, so that there should be no surprise in relation to the creativity that today finds a valid supporting role in AI.

2.2 *Creative Amalgamation Between Humans and Machines*

Since the advent of images that Flusser (2019) calls *technical*,¹ that is, images that, since the photographic camera, are produced by the mediation of a machine, art has started to develop creative amalgamations between the human and the machine. Without going that far, when the computer became our ally in a multiplicity of tasks, the possibilities of creation via technologies multiplied, causing a continuous growth of heterogeneity. Examples of this can be found in the production of images in 3D modeling, in cyber installations, in works in telepresence and telerobotics, in network art, and in the creation with databases, in addition to works in virtual reality and those produced with artificial life algorithms, besides genetic art and transgenic art in their use of genetic engineering techniques linked to gene transfer (natural or synthetic).

It is a fact that heterogeneity and multiplicity came to command the vectors of artistic production to the point where being technological or non-technological, being digital or non-digital, art is no longer a matter of order. The trend toward heterogeneity, boosted by hybridity, has increased due to the convergence of technologies, cultures, knowledge, and forms. It is a convergence of such an order that it blurs the boundaries between techno, games, movies, the spoken word, dance, literature, music and sound design, theater, visual arts, the sciences of perception, architecture, physics, psychology, sociology, biology, religion, and medicine. Virtually, all fields of knowledge are contributing to this convergence that energizes human creativity.

Creative multiplicity appears in innumerable types of production. A few examples are enough to prove this statement: alternative reality games, augmented reality, mixed reality, virtual reality, gestural interfaces, live cinema, interactive books, connected immersion, video mapping, and generative art. It is in this context and preserving its continuity that creativity in AI is installed today.

Many examples can be listed, such as the robot works by Ken Rinaldo, or Eduardo Kac's genetic art, to prove that it is not—and has never been—the role of art to slip into conservative and frightened tendencies. Art is risk, exploration of yet unknown territories, and adventure along the paths of estrangement for the transfiguration of human sensibility. While the camera extends the human capacity to see, stimulating the eye to perceive what escapes distracted attention, while productions with mixed, augmented, and virtual realities multiply sensory experiences with possible worlds,

¹ I prefer to call these *technological*, since the camera is already a technological and not only a technical artifact.

artificial intelligence introduces a new alliance that increases the human cognitive potency. When starting from a multifaceted view of cognition, it is not difficult to see the crucial cognitive role played by imagination in human creativity. What consequences can the imaginative partnership with AI bring to the creative capacity of artists and what are its implications for the re-accommodation of our being in the world?

After all, mechanical, electronic, and digital arts have been transforming traditional concepts of aesthetics for over a century. Although art may seem disruptive, it in fact continues a tradition of ruptures that the arts have always provoked. We find ammunition for this proposal in the initiative of the International Society for Arts, Sciences and Technology, *Leonardo*, which, in collaboration with the Open University of Catalonia, dedicated, in 2020, an entire issue of the *Node Journal* to more than a dozen chapters focused on the theme of creation in AI in the context of culture.

2.3 *The Voices of Experts*

The number and ingenuity of the chapters written by artists and specialists are impressive and very illustrative of the state of the art in AI. The axis of the discussions is aimed precisely at critical questions about ML that, far from being based on theoretical abstractions, are based on the teachings provided by concrete examples. For the organizers of the issue (Burbano and West 2020), there is no way to ignore the exponential growth of ML applications in all areas of the arts (visual, sound, performance, spatial, transmedia, audio-visual, and narratological). Activities in this field are growing so fast that publications cannot keep up. Seeking to meet this growth, the authors of the chapters question the crucial problems involved in authorship and ethics, autonomy, and automation, by exploring not only AI's contributions to art, but also the reverse, to what extent art contributes for AI.

Also included in the discussions are algorithmic biases, control structures, machine intelligence in public art, new formalizations of aesthetics, the production of culture, sociotechnical dimensions, relations with games, and the democratization of creative tools based on machines. Despite the diversity of issues, they end up revolving around the backbone of the volume's proposal: Machinic creativity in arts and design represents an evolution of artistic intelligence or is it either a metamorphosis of creative practice that generates forms and distinct modes of authorship? For the editors, the complexity of this situation is not a symptom that the world is changing, but that it has already changed (Burbano and West 2020).

Fundamental to thinking about the democratization of tools for creation in collaboration with ML is the chapter by Mazzone and Elgammal (the latter is the director of the Artificial Intelligence and Art Laboratory, in New Jersey). In the chapter, the design for an easy-to-use Web-based system is presented, similar to digital imaging applications. What is sought is to allow ML to be used as easily as filters or the digital composite for 3D imaging. Interviews with various artists, using the system

while in beta, provide information on ways to work with the design, called *Playform*, while discussing unresolved issues inherent in the recent emergence of ML in its nature as a creative content generator in the visual arts, texts/narratives, and musical composition. The question remains: Is ML a *medium*, a tool, or a creative partner?

Caldas Viana (2020), in turn, mapped some important issues of neural networks within the framework of the generative art tradition, emphasizing the emergence of a paradigm shift in creative procedures. Idárraga (2020) questions the neutrality of databases, delegitimizing the automatism of algorithms and even criticizing the assumptions embodied in their functioning. Faced with this, he proposes that, in the field of AI, art builds places where one can think and create other realities. Galanter (2020) discusses the relationship between ethics and AI in art and culture. For Forbes (2020), creative AI consists of a range of activities at the intersection of new media arts, human–computer interaction, and AI. Technics of ML introduce a new contribution to bring meaning to the world from the judicious choice of examples and definition of mappings that enable applications for new forms of creative expression.

Forbes is the director of the Creative Coding Lab at the University of California, Santa Cruz. This laboratory incorporates an interdisciplinary team of researchers and artists affiliated with the Computer Media department. The focus of the works is on applied research in interaction and visualization, and on the exploration of experimental and creative works based on current techniques of human–computer interaction, scientific and information visualization, graphics, computer vision, immersive environments, and ML. A core philosophy of the laboratory is that, by incorporating research methodologies from media arts, design, and computer science, new solutions to interdisciplinary problems can be developed. Furthermore, it is believed that creative results generated at the intersections of artistic and empirical research can significantly elucidate issues in science and technology relevant to contemporary culture. The lesson that remains from this and other advanced research and creation laboratories is that ML and DL procedures did not suddenly fall by a miracle from the skies, but are intruding and incorporating themselves into a tradition of capable art, science, and technology innovations able to illuminate essential cultural issues.

In his chapter entitled “Creative AI,” Forbes (2020) clarifies that creative projects in the laboratory he directs are developed by imitating existing data, mapping resources found in one database to another, or mapping inputs to outputs in unusual ways, visualizing or otherwise probing the inner workings of the algorithm and analyzing or speculating on the social impact of ML systems. These activities can enable new types of generative works of art that replicate or incorporate existing works of art, or they can create entirely new artistic productions. In doing so, other ways of analyzing and experiencing cultural artifacts and data are introduced. Finally, the ML algorithm—its computational architecture, the input it requires and the resulting output, and the analysis structure of which it is a part—can be thought of as a cultural artifact in itself, enabling new forms of critical investigation.

Discussions about various aspects of AI inside and outside academies have been frequent in Brazil. For example, in the field of AI and art, Venâncio Júnior (2019) published a chapter on “Art and artificial intelligences: implications for creativity.” This chapter proposes a reflection on works of art endowed with AI, stressing issues

such as autonomy and creativity. First, some works are offered as examples, to discuss the problem of creative autonomy under which these initiatives are commonly interpreted. References from evolutionary algorithms and cybernetics culminate in a particular model for analyzing works in terms of syntax, semantics, and pragmatics. Such a model offers possible segmentation of the spectra of human creativity, while clarifying some challenges for the development of creative machines. Finally, an artistic proposal is presented that uses AI resources to generate drawings, bringing a situation in which the machine influences, interferes, and redefines a creative process that dilutes the artist's intentions.

At UNESCO's invitation, I, (Santaella 2021) published a policy chapter on "Artificial Intelligence and Culture. Opportunities and challenges for the Global South," in which I argued that the impact that AI provokes on culture, art, and the creative economy is of great proportions. The first impact comes in the form of the challenge facing the hegemony exerted by gigantic data companies or big techs over the functioning of culture on a global scale, with strong repercussions in Latin America and the Caribbean. As a necessary counterpoint to this impact, in the Global North there is a growing mobilization of AI in alternative creative and value chains, which brings to the culture of Latin America and the Caribbean a second challenge that is added to the first: the risk of deepening a digital divide between the North and the Global South. With this in mind, my chapter discussed the implications of the identified challenges and presents recommendations regarding possible strategies to face them.

Undoubtedly, the development of renewed critical thinking is one of the demands that the advent of AI is bringing to the agenda of discussions. A critical thinking that is capable, above all, of freeing us from the dysphoric and gloomy litanies about AI that have taken over the debate and which do nothing to contribute to the multifaceted understanding of the nefarious forces and counterforces that are at play. As always and as expected, it is the artistic creations that are at the forefront of the counterforces.

3 The Variety of Artistic Productions with AI Mediations

While theorists, historians, and critics debate, artists do what is their role to do: They create. There is a wide variety of artistic productions that make use of AI. Apparently, artists seeking AI collaboration are not imbued with competitiveness. It is, above all, an exploratory search for the development of a new expansive form of human creativity. The variety of productions begins with works that fall within the tradition of pictorial arts and are distributed in the following types.

3.1 Style Transfer

Experiments can be as simple as teaching machines to understand and replicate human-made art. This technique is called style transfer. It uses deep neural networks to replicate, recreate, and mix art styles. One of the examples, which went viral, was performed by Chris Rodley in a work that, thanks to algorithms, managed to mix dinosaurs and flowers in a single syntax (Sukis 2018). Another example, a little more complex, makes use of existing paintings that are mixed in an unprecedented fusion. This type of transfer can also be applied to videos and music, when musical genres are mixed with more mathematical compositions such as those by Bach, whose work has a very consistent structure of patterns, which facilitates replication by AI (Sukis 2018). Also, according to this author, there is still a form of imitation similar to style transfer, but in this case the algorithm convincingly changes the appearance of a photo or video, allowing users to edit the context of the image according to the time of the day, the season, or the weather.

3.2 From Transfer to Collaboration

The next step in complexity goes from mere transfer to collaboration. In this case, AI enters as a partner in the ideation of the work and the process, when an algorithm, which is constructed to generate an artistic result, becomes an art form in itself. AI does not just come in as a collaborator by processing images and sounds through mathematical equations. It can equally “inform and inspire artists who want to come up with new insights, connections, or patterns through a huge set of data points” (Sukis 2018).

3.3 From Collaboration to Creation

The works that are developed at the Art and Artificial Intelligence Lab in Rutgers, New Jersey, give us an idea of the meaning that can be extracted from AI as a creator on its own. In this laboratory, researchers created an AI system for art generation that does not involve a human artist in the creative process, but rather involves human creative products in the machine learning process. The director of the laboratory, Ahmed Elgammal (undated), when interviewed about the work being carried out there, argues:

We’re trying to show the world two things: first, what the machine can create by itself. Second, that these are creative partners for artists in the future. I think this is analogous to the creation of photography in the 19th century, because when it was invented the definition of art back then was depicting the world on canvas, but then you have this device that can capture the world for you with the click of a button. So, what’s your job as an artist? The definition of art changed as it was influenced by photography. Art focused more on the

conceptualization and abstraction of the world rather than just depicting it. We now have a tool that can create things for you. It won't take the jobs of artists away. It can explore a space of possibilities for you as an artist. You're framing it in terms of what details to feed to the machine, what you want to do with the data. Your job as an artist is the same — to control the process — but now you have a partner.

One of the works carried out at the laboratory, for example, consisted in presenting to a group of people, on the one hand a mixed set of images created in the laboratory with a communicative and inspiring visual structure, and on the other, images created by artists. The hypothesis was that human subjects would rank art created by human artists on higher scales. To great surprise, the results showed that the images generated by AI received higher ratings (Sukis 2018). On the face of it, that AI will be able to create original artwork seems quite possible. However, at the point of its current development, it must be considered that AI production is completely guided by what humans consider art. This is because, to produce images considered artistic, the machines are powered by a profusion of examples of works of art made by humans. This does not quite minimize the fact that the advance of machine learning is recreating, under a new tone, old debates about how to define art.

However, AI brings a new complication to the issue, such as when intelligent algorithms work like parasites, using source materials from a millennium of human creativity to find patterns and samples that are remixed and blended into something contemporary. Given this, some argue that this process is similar to what artists already do when taking advantage of past collections. In fact, in his laboratory, for artistic AI creation, Elgammal uses the WikiArt database, and the results generated turned out to be extremely similar to those performed by humans (Sinclair 2018a, b).

3.4 *More Complex Projects*

Current artistic achievements using AI resources are not limited to the imitation or transfer of pictorial and imagistic works of art. According to Sinclair, artists Tara Shi and Sam Kronick, for example, hope that the art they produce can help explain the mysterious workings of artificial neural networks. Likewise, the Splinter art group is incorporating neural networks into their work in order to help the public better understand this technology that is increasingly part of our lives and making decisions for and about us and the world around us.

Artist Memo Akten developed the project *Learning to See: Hello World!*, a series of works that use ML algorithms as a means for us to reflect on ourselves and how we make sense of the world. For the artist, the image we see in our conscious mind is not a mirror image of the outside world, but a reconstruction based on our own prior expectations and beliefs. *Learning to See* is an interactive installation that uses live cameras to demonstrate how ML works. Using a deep neural network, the machine quickly compares patterns and produces an image of its own. But beyond the technique, the work aims to show that this artificial neural network, weakly inspired

by our visual cortex, looks through cameras and tries to make sense of what it sees. Of course, she can only see what she already knows, just like with us (Atken 2017).

A similar example was created by Shi and Kronick in which the artists fed the AI program with 3D scans of natural matter (e.g., rocks). The program maps the contour of rocks, learns to recognize this type of matter, and generates an artistic image of nature. By taking AI to produce art from nature, the intention of the artists was also to discover the limits of computational creativity, in the current state when the work was produced. To do this, they used a neural network, that is, a computer program loosely modeled on biological neural systems like the human brain. A given neural network needs to be trained on data; in this case, data could be the shape of many rocks, a huge collection of Google images, or hundreds of thousands of search terms, depending on how the neural network will be used. So basically, the machine thinks in layers, with each layer working on a different aspect of what the network is analyzing, in this case identifying rocks. Thus, an algorithm can try to find the texture of a rock, other different colors on its surface, and so on, layer by layer until it arrives at a convincing result (Chiel 2016).

Another type of AI project is the *New Dimension in Testimony (NDiT/New Dimension of Testimony)*, aimed at storytelling. The project made use of an advanced natural language algorithm that allowed an audience to verbally interact with a 3D image of a holocaust survivor. Powered by a complex algorithm, the hologram responded to the audience's questions in real time, giving the impression of a realistic conversation. This form of AI can be used in many ways, leading us to imagine conversations with holograms of family photos, including our transport to related immersive environments (Sinclair 2018a, b).

More and more, artists are embracing the new challenges AI is bringing to artistic creation. Reflections, analysis, and evaluations are also beginning to appear on the way to the constitution of a theory of art in AI.

There are several Brazilian artists who are experimenting with ML techniques. Among them, it is worth mentioning the work called *Sentimentos da virada*, by Marília Pasculli and André Gola (2021). Animations of the character 'Suadinho' by the artist André Gola are used to represent the emotions of the inhabitants of São Paulo. Emotions are inferred through the use of an AI that analyzed Instagram photos with geolocation in São Paulo. The "selfies" and corresponding animations were projected on a large scale on urban buildings in three city districts during the cultural turn. The main idea of the installation was to reflect on how we demonstrate our emotions through social networks and how this flow of data that we generate when posting it also ends up influencing the way we see the world and ourselves.

To make this work possible, a bank of images of faces was used, separated according to the seven categories of emotions proposed by Paul Ekman (anger, disgust, fear, joy, sadness, surprise, and neutral). This bank was used to train a neural network (NN) capable of inferring the emotion associated with the image of a face. Once the NN was trained, it analyzed approximately 10,000 georeferenced selfies posted on Instagram in the city of São Paulo in order to obtain a kind of measure of the distribution of feelings in the set of posted images, in addition to projecting the

analyzed faces themselves along Suadinho’s animations, which interacted with the selfies.

Due to their complexity, Cesar Baio’s works in collaboration with Lucy HG Solomon stand out, as their proposal was explained in the chapter “An Argument for an Ecosystemic AI: Articulating Connections across Prehuman and Posthuman Intelligences.” (Baio and Solomon 2000) As an art collective Cesar & Lois develop projects that examine sociotechnical systems, attempting to challenge anthropocentric technological pathways while linking to intelligences sourced in biological circuitry. In their role as artists, they imagine new configurations for what we are led to understand as (social, economic, technological) networks and intelligences. With this ecosystemic approach, they consider the possibility of an AI that supports well-being in a broad sense, accommodating relationships across different layers of living worlds and involving local and global communities of all kinds. The artists grounded their thinking on interdisciplinary researches, including communication and media theory, microbiology, anthropology, decolonial studies, social ecology, sociology, and environmental psychology. “At a time when human beings and their ecosystems face grave threats due to climate change and a global pandemic, we are rethinking the basis for our AIs, and for the resulting decision making on behalf of societies and ecosystems.” Hence, their work provides alternative conceptual models for thinking across networks, reframing the artists’ and potentially viewers’ understanding of what motivates and shapes societies.

4 Conclusion

In the end, as we stand today, the issue to remember is that AI is just taking its first steps. Prognostics say its destiny is to grow in complexity. This means that artists will have many new horizons ahead of them that open up to be explored with the artists’ own insight: their sensitive wisdom.

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