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Prospective research in the field of teaching creative skills to artificial intelligence

Abstract. The research relevance is determined by the importance of a thorough study of methods, schemes and models used by artificial intelligence to mechanise creativity in modern conditions of active technological development. The study aims to analyse the main processes taking place in modern art in connection with active technologization of work processes, to identify the leading concepts regarding the possibility of creating machine art in the future, etc. The employed methods are theoretical, such as analysis, systematisation, generalisation, etc., for studying key problems and further development of creativity based on artificial intelligence. The study examines in detail the main developments of Artificial General Intelligence and Artificial Narrow Intelligence, in particular the achievements of Generative adversarial networks and Creative adversarial networks. Artificial intelligence-generated art demonstrates the remarkable capabilities of technologies. The evolving artificial intelligence in the arts introduces “digital art”. Generative Adversarial Networks are used as a foundational tool for artists who use digital methods and texture generation to create unique compositions. Furthermore, sculptors collaborate with artificial intelligence tools to convert drawings into 3D models or transform historical art databases into sculptures. Creative thinking, a hallmark of human intelligence, is determined as artificial intelligence’s ability to generate new and original ideas. The development of emotional intelligence in artificial intelligence enables empathetic responses and the identification of human emotions through voice and facial expressions. The issues of authorised internationality, awareness of the creative process, psychological foundations of artificial empathy and emotional intelligence define the prospects for the development of neuroscience. Challenges persist in defining creativity, authorship, and legal aspects of artificial intelligence-generated art. The study materials may be useful for artists, art educators, technologists, and researchers interested in the intersection of technology and art, legal professionals (especially intellectual property law), and individuals involved in artificial intelligence development may find these findings valuable

Keywords: film genre; traditional genres; hybrid genres; art form; cinema; animadoc

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INTRODUCTION

The research relevance is determined by the importance of developing new methods and models of artificial intelligence for improving various technological processes and creating more efficient, in particular creative arts. The interest in the prospects and possibilities of various types of artificial intelligence is constantly growing. Furthermore, the need to implement and develop new methodologies in the field of machine learning, in particular artistic skills, still exists. Ambiguous opinions regarding the classification of art objects created by machines in the modern scientific space determine even greater relevance, contributing to a deep and comprehensive analysis of the problems of science and technology in the interdisciplinary field of knowledge.

Researchers assess the possibility of creating art samples using artificial intelligence algorithms as high, given the constant development of new technologies and automatization. V.R. Jokanović (2022) believes that artificial intelligence in the future will be able to model emotions, predict behaviour and recognize creative processes. Y. Li (2020) discussed the potential for the reproduction of mental states by machines. R. Srinivasan and B.S.M. González (2022), as well as E. Kambur (2021), addressed the issue of artificial empathy, seeking to prove the possibility of creating and using mechanisms that will be able to identify intentions, emotions, and behaviour patterns in the future. According to E. Sandry *et al.* (2021), in addition to creativity, history and aesthetics, the creation of artistic masterpieces requires such components as synaesthesia, variability, communication and interaction between a robot and a person.

Some scientists have the opposite opinion about art creation using AI (artificial intelligence). V. Tokareva (2020) notes that machines will be able to reproduce only the form and concept, complicating their structure, but the creation of a masterpiece will be impossible due to a lack of emotional experience. Th. Gros (2019) believes that art made by AI will always be created through man and machine communication within the framework of close cooperation and interaction, and it will not be possible to achieve full creative technologization. E.S. Mikalonytė and M. Kneer (2021) addressed the unwillingness to recognise AI authorship, believing that copyright should belong only to a person.

The study aims to consider the complex and ambiguous issue of the possibility of machines creating objects of an artistic nature, in particular a masterpiece, in various spheres of creativity. To analyse the achievements of modern science and technology in terms of implementation of creativity, authorship ideas and internationality, emotional intelligence and artificial empathy, socialisation of robots and giving them copyrights were considered. The advantages of machines over humans, and vice versa, and the prospects of using robotics and automatization in the process of creating art objects were determined. All these aspects were deeply studied and analysed; research has been elaborated in the modern scientific world. The study subject is achievements of artificial intelligence in terms of creativity at this stage of development (systems, models and algorithms that are currently used or may be developed soon), concepts of art and masterpieces in the

scientific interdisciplinary area. The study object is the problem of creating artistic samples using artificial intelligence, and the analysis of artificial intelligence achievements for the automatization of creative processes, which have become the subject of the work of modern researchers in the interdisciplinary scientific space.

For the most part, the works of researchers consider the development of artificial intelligence based on GAN and CAN, their main advantages, prospects for optimisation and further use, principles of operation and acquisition of general artificial intelligence (AGI), narrow artificial intelligence (ANI), artificial superintelligence (ASI). A key question posed in modern works is the integration of AGI systems using fuzzy logic in art, which would allow, based on knowledge from a certain field, to formulate a new solution to a problem.

The leading directions of the considered research are the method of creating artistic samples using the classical (mimetic) and transformational concepts, compiling the experience of predecessors, imitating aesthetic rules, and creating new “unpredictable” images using cognitive intelligence. According to scientists, the main achievements of AI in the creative sphere in the modern context are the development of software (AIVA, CoArt, Deep-Dream), the use of virtual reality methods, real-time creation of digital media art, music, reproduction of emotional experiences and empathic learning etc.

The main methodological approach employed in this study involves a combination of theoretical, analytical, and synthetic methods. These methods were used to review and systematise the literature; analyse modern global and Ukrainian studies on the integration of AI into the art space; systematise the literature on the topic to form a comprehensive understanding; analyse the issues related to the creation of art objects using AI methods, algorithms, and schemes. Based on the analysis, contributing generalisations to the formulation of a position on the possibility of creating works of art, including masterpieces, using AI mechanisms, were made.

CLASSICAL MIMETIC THEORY AND THE CREATIVE POTENTIAL OF ARTIFICIAL INTELLIGENCE

To view art following classical mimetic theory as an imitation of the external world, and not as an expression of the inner world of the creator, is to consider AI-created art creative. According to E.S. Mikalonytė and M. Kneer (2021), a popular opinion is that computers are “social actors” that operate in human-human interaction, unreflectively extending to human-robot interaction. Y. Trach (2021) stated that the interaction of artificial intelligence technologies and the sphere of culture is far from perfect, characterised by imbalance and disorganisation, as it is associated with existential and civilisational challenges, therefore the question of creating an artistic masterpiece with the help of AI remains relevant.

When trying to determine whether AI can create art, three main factors are to be analysed: the agent (comparing an autonomous AI to a human), the process (the action by which the art is created), and the product (the object created). The first factor questions whether the goal

of AI artists is to imitate people, and the second delves into whether machines can participate in a real creative process, that is, perceive and be aware of themselves as creators. The third factor concerns the more general problem of defining art: does art created by AI meet its conventional definition, as noted by E.S. Mikalonytė and M. Kneer (2021).

Th. Gros (2019) stated that the “tripod for creativity” is skill (the ability to create something of quality), appreciation (the ability to independently evaluate a work of art) and imagination (the ability to create something new). The main task of modern AI developers is to force the system to explore the creative space to find solutions that deviate from established styles but remain close enough to creativity to be identified as art. The possibility of creating a masterpiece in the future with the help of AI remains, but currently, it is difficult to imagine.

THE DIFFICULTY OF HUMANS TO DISTINGUISH BETWEEN AI AND HUMAN-MADE ART

Since human respondents have difficulty distinguishing between AI and human-made paintings, there is no significant difference between their evaluation of the two works without prior indication of the identity of the works. And while GAN or CAN lacks the emotional intent of humans, these artistic AI systems are already extraordinarily creating art. Even if technological systems do not yet fully correspond to human creativity and do not use all the possibilities of emotional intelligence, it would be logical to assume that they have a certain ability to function creatively, according to M. Cheng (2022). In October 2018, the “Portrait of Edmond de Belamy”, an imaginary French aristocrat, created by artificial intelligence using generative adversarial network (GAN) technology (Fig. 1) was sold at an auction in the United States for \$432,500.

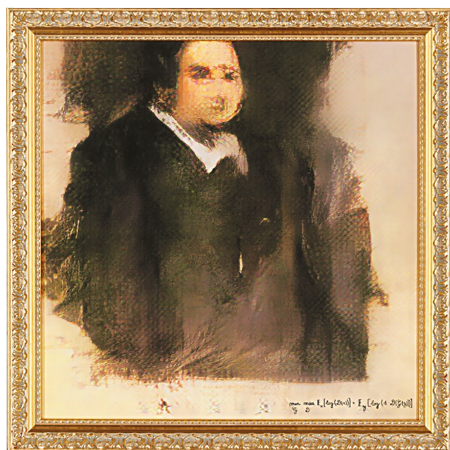


Figure 1. “Portrait of Edmond de Belamy”

Source: Artificial art created by artificial intelligence (2020).

M. Cheng (2022) stated that paintings created by artists with AI identity, at this point, should receive a lower rating compared to paintings created by artists with a human identity. Even if art created by artificial intelligence is similar to those created by people, there is a belief that art is something that results from human observations and efforts. Machines cannot produce and create new ideas as

they are not creative and do not have the imagination to overcome human intelligence. They lack out-of-the-box thinking, as even the “smartest” AI-based machines cannot think or create out of context, they can only perform tasks they were previously trained to do. Even the most effective artificial intelligence machines have no feelings, and no emotional connections with people, according to V.R. Jokanović (2022).

Furthermore, V.R. Jokanović (2022) noted that the self-awareness process is key to the creation of art, for which AI systems must master human consciousness and reactions. Machines with self-awareness will be able to understand their current state and draw respective conclusions regarding the emotions of others. The next stage of AI development is expected to have their emotions, needs, beliefs and potential desires, and predict their requests. Artificial intelligence with self-awareness is expected to greatly increase productivity, but it can also lead to disasters, as there is a risk that such AI may take uncontrollable actions and produce ideas that are dangerous to humanity. E.S. Mikalonytė and M. Kneer (2021) stated that even though machines do not have consciousness, humans tend to anthropomorphise robots and attribute a wide range of mental states to them. Although a lot of research has recently been conducted on intuition, and the awareness of robots’ freedom, the field of intuition studies regarding the ability of machines to produce art remains understudied.

One of the key components to the creation of a masterpiece is the creator’s intention (author’s intention), which is important in determining the type of artefact, even if it is not directly related to the appearance or function of the object. Conclusions regarding the mental state of creators are equally important for the art classification. Hence, people’s willingness to consider AI-created artworks depends on their tendency to attribute their intentions to the generated results. Given the current development of emotional intelligence currently, the creation of a masterpiece by AI is possible only under the condition of subjectivization: a person transfers requested intentions to a product created by a program.

AI IN ART: BOUNDARIES, CREATIVITY, AND HUMAN PERCEPTION

Despite the possibility of successful learning, AI is completely unable to distinguish between meanings and create a coherent narrative. Artificial intelligence will be able to create a poem in the manner of a certain poet, but it does not understand what it is about. Analysis of the artist’s technique is similar to imitation, but the process of creating art occurs unconsciously, and mechanically. Paintings made using artificial intelligence technologies can be considered creative objects, since in modern art creativity is not the visualisation of something important, but the very act and fact of this visualisation. Since a masterpiece is considered something unique, new, and original, unpredictable, it must be based on an idea that has never been generated by anyone else. For example, a creative reinterpretation of a theme or problem in an art from such an angle that has not yet been considered and worked out in the art world. However, imitation of art and compilation of samples cannot become a masterpiece.

When artists use neural networks and machine learning algorithms, it is important to note that AI can create something human-like, but at the same time, it is capable of extraordinary, non-obvious abilities and solutions. Neural networks that perform certain tasks cannot realise themselves as the author and the very fact of creating works of art. In connection with the computerisation of the world, the technologization of creativity is also taking place, and a new term “digital art” is emerging. Perhaps, in the future, AI will not only be a tool for the implementation of human ideas but will also be able to independently create objects that will be significantly different from human products.

However, even though the gap between AI and humans is rapidly closing, currently, it is the human who creates the model, chooses the training samples, and uses the technology for creative tasks. Artificial intelligence provides extraordinary tools and a new field of experimentation for artists in the visual arts and entertainment industries (game and film design, computer graphics, etc.). However, the more artificial intelligence technologies are used in the production of art, the more valuable the idea or concept becomes. At present, when the execution and physical realisation of the project can be “transferred” to AI, new ideas become the main driving force of art development, as noted by Y. Trach (2021).

Th. Gros (2019) pointed out that since artificial intelligence can create what people consider art, it is worth replacing the term “person” with “the subject who creates art”. AI can produce examples of creativity, although they are not considered artists. This interesting result raises several questions for discussion, one of which concerns the anthropomorphism of robot agents. The current study shows that people do not perceive AI as an artist and are reluctant to recognize it as a potential copyright owner, as E.S. Mikalonytė and M. Kneer (2021) noted.

AI COLLABORATION IN CONTEMPORARY ART: TRANSFORMING CREATIVITY AND EXPRESSION

Modern society has reached a new era of creativity, when artificial intelligence and the artist become co-authors, complementing each other in those aspects where they are most powerful. The generation of ideas can become the primary task of a person, the creative production of new, extraordinary ideas and solutions is becoming more and more valuable. According to Y. Trach (2021), machines can successfully perform big data analysis with high performance. Therefore, the creation of a masterpiece with the help of AI and systems is possible only under the condition of cooperation between AI and a person.

Artists use cognitive intelligence to learn specific aesthetic rules by analysing thousands of images and then trying to create new images that match the given aesthetic characteristics. For example, H. Agarwal from Bangalore, who lives in India, entered 60,000 images of human anatomy into the algorithm and created a series of abstract paintings similar to “crimson blizzards” – works of art with a unique aesthetic of AI (Fig. 2). According to the same principle, the “Portrait of Edmond de Belamy” sold at a high price in 2018, was created, as mentioned by W. Chen *et al.* (2020).



Figure 2. “The Anatomy Lesson of Dr. Algorithm” by H. Agrawal

Source: The creative dialogue of humans and machines in the work of AI Artist Harshit Agrawal (2019).

The Next Rembrandt project demonstrates the result of a deep learning algorithm on the example of more than 300 scans of H.R. Rembrandt’s artworks, revealing their main features and creating a new image in the style of the artist with oil paints and printed on canvas, later reproducing a fragment of the painting “The Night Watch” (Figure 3) (Rembrandt’s ‘Night Watch’ on display..., 2021; Chibalashvili, 2021).



Figure 3. “The Night Watch” by H.R. Rembrandt, reproduced with the help of artificial intelligence

Source: Rembrandt’s ‘Night Watch’ on display with missing figures restored by AI (2021).

A. Chibalashvili (2021) noted that the works of S. Eaton (Fig. 4) were created using generative adversarial networks (GAN). In search of new solutions, the artist used combinations of traditional execution of works with modern digital techniques, in particular, texture generation based on the analysis of photos from the database. In the works “Hyperbolic Composition I” and “Hyperbolic Composition II”, the human body acquires abstract forms and perspectives. The paintings of the artist M. Klingemann

represent the development of devices and algorithms for determining the location of birdsong in the field, creating

a database of bird songs and their automated classification, according to Y. Li (2020) and M. Klingemann (2020).



Figure 4. Works of S. Eaton

Source: Hyperbolic Compositions I & II. (2018)

Y. Trach (2021) noted that Italian artist D. Quayola used the Creative Adversarial Networks (CAN) technology to create classic impressionistic landscape art with the reproduction of subtle nuances of reality beyond human

perception (Fig. 5). The artist used the technique of complex computational analysis of movement, compositions, and colour schemes, which became the basis for creating new digital paintings (“Pleasant Places” ..., 2018).



Figure 5. The picture “Pleasant places” by D. Quayola

Source: “Pleasant places”. Quayola and the technological sublime (2018)

In sculpture, artificial intelligence tools are used to create a GAN layout or 3D models. For instance, S. Eaton’s sculpture, which debuted at the exhibition in London in 2019, was created in collaboration with AI tools that convert drawings into a three-dimensional form (Hyperbolic Compositions I & II, 2018). Another example is a sculpture by the New York artist H.B. Snell (Fig. 6), which uses machine learning algorithms to scan and transform a database of historical works of world art, including more than a thousand works of classical sculpture (This AI-generated sculpture..., 2019).

Y. Trach (2021) noted that the CoArt project used an innovative approach and provided communication between a person and AI. A mobile application was used to ask questions and receive answers in Polish from the so-called “electronic directory”. The generation of random images using CAN technology adds spontaneity to the creative process involving artificial intelligence and allows a step forward compared to deep stylisation. R. Lipski (2021) used a neural network in the creative process, training it to create paintings in personal style (Fig. 7). Despite the use

of AI, the author has not ceased to be an artist, only part of the creative work is performed by neural networks (Artificial Art Created by Artificial Intelligence, 2020).

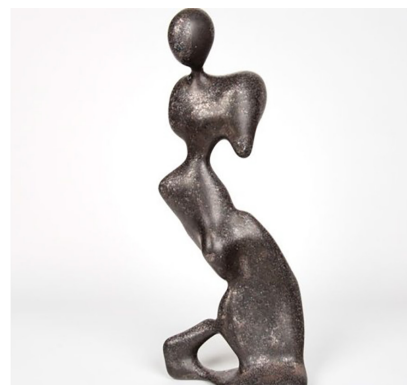


Figure 6. Sculpture by H.B. Snell

Source: This AI-generated sculpture is made from the shredded remains of the computer that designed it (2019)



Figure 7. Works by R. Lipski

Source: Roman Lipski (2021)

V. Tokareva (2020) noted that despite all the successes of AI, the generated arts are of mechanical origin and are the result of data processing, therefore they have only an indirect relation to human authorship and creativity. To date, the legal prerequisites have not yet emerged for the artistic achievements of AI to be considered art, even when created by systems that are characterised by the ability to learn. Since, currently, it is not necessary to define artificial intelligence as a subject of law, it is also not necessary to define it as a subject of creativity. Even though AI at present is considered a new source of creativity that can produce new artistic samples, programs for a long time remained only a tool, an intermediary between the author and his work. Artificial intelligence successfully creates music, videos, and images and can be considered protected in the future, the issue of human intervention and its direct impact on artistic results has not yet been deeply studied.

LEGAL AND ETHICAL CONSIDERATIONS IN AI-GENERATED ART

Although there is a successful development of technological processes, it is difficult to answer unequivocally whether art objects created by the program independently can be considered unprotectable. Perhaps it is worth adopting the experience of Japan, which in 2016 approved the document “Strategic Program on Intellectual Property 2016”, which primarily aimed to create a new generation of intellectual property adapted to digitalisation, as was noted by S. Sabura (2020). The fact that not everyone in the field of legal sciences is ready to grant copyright to subjects of intellectual property shows the impossibility of fixing creativity (in particular, a masterpiece) in the legal field of many countries.

As such, even though the improvement of the creative process by machines is already possible shortly, the lack of artistic authorial intention (intentionality) and creative ideas in the production of art objects with the help of artificial intelligence makes it impossible to create a masterpiece using AI. However, significant experience and prospects of integrating robots into art are important under the conditions of active technologization and mechanisation. C. Zhang and Y. Lu (2021) indicated that the technological and industrial revolution is accelerating due to the widespread use of next-generation information and communication technologies such as AI, IoT (Internet of

Things) and blockchain technologies. The term “artificial intelligence” was first used in 1956 at a conference at Dartmouth University. According to A. Oktradiksa *et al.* (2021), AI uses computers to model intelligent human behaviour, including learning, thinking, and decision-making, as well as skills abbreviated as the 4Cs, namely, critical thinking, collaboration, creativity (art), and communication.

As stated by C. Zhang and Y. Lu (2021), the creation of artificial intelligence became possible due to the development of special algorithms, effective use of computing capabilities and rapid data processing, caused by many studies in interdisciplinary sciences: computer science, logic, biology, psychology, etc. Following a certain opinion in philosophy, technology should not take over the existence of people as social beings. Mathematics becomes the basis for the development of algorithms based on logical operations, calculations, and the theory of probabilities. Economists claim that research in the field of artificial intelligence can contribute to diagnosis, monitoring, and rational decision-making in the future.

It is assumed that the advancement of technology will reflect scientific developments in neuroscience; the creation of AI is based on psychological memory management, language and thinking skills. Computer engineering must provide an operating system, programming language, tools needed to create programs, memory visualisation, speed and accuracy of the data generated. A. Oktradiksa *et al.* (2021) noted that technology must be controlled and maintained properly, therefore the issue of security is important. In the field of linguistics, the acceleration of technological development led to the creation of a hybrid technology called computer linguistics, which involves the ability to think freely and process natural language.

EVOLUTION OF ARTIFICIAL INTELLIGENCE IN THE ARTS

Y. Li (2020) noted that with the continuous development of such technologies as big data, cloud computing, machine learning, and cyber-physical systems, a new era of technological and industrial revolution has taken place. The author believes that all aspects of our society have been re-modified from the way of production to the way of life, having undergone fundamental reforms. It also inspired artists to innovate concepts and artistic language, constantly giving rise to a variety of completely new artistic paradigms, such as computer art, artificial

intelligence art, bio-art, and hybrid art. Recently, significant results were achieved in the field of science and technology, in particular, in speech recognition, image and natural language processing and proof of automatic theorems. From the point of view of social development,

there is an increase in labour efficiency, a decrease in labour costs, optimisation of human resource structure and creation of new requests for jobs, as was stated by C. Zhang and Y. Lu (2021). Currently, there are several types of artificial intelligence (Fig. 8).



Figure 8. Types of artificial intelligence

Source: compiled by the authors based on Y. Li (2020)

Th. Gros (2019) highlighted that Artificial General Intelligence (AGI) corresponds to a level of intelligence conceptually equivalent to that of a human, and includes cognitive functions such as the ability to think, represent knowledge, analyse data, solve complex and diverse problems, as well as the aforementioned skills such as language, memory, and use of feelings, and most importantly, the ability to integrate all these components to achieve a common goal. According to V.R. Jokanović (2022), AGI can reproduce the cognitive abilities of the human brain, perform various tasks, learn, and improve. It is a self-learning system that can outperform humans in many disciplines. AGI systems use fuzzy logic to apply domain knowledge and automatically find a solution to an unknown problem. Examples are Pillo Robot, which can answer health-related questions, and AlphaGo, a computer program for playing Go.

Following Th. Gros (2019), Narrow Artificial Intelligence (ANI) corresponds to the state of the art, where machines can solve problems in highly precise domains through a variety of techniques from machine and deep learning to rule-based systems. Examples are search engines, fraud detection mechanisms, medical image interpretation, and voice assistants such as Siri, Alexa, and Cortana. ANI systems correspond to artificial intelligence with limited memory, according to V.R. Jokanović (2022). Artificial superintelligence (ASI) far surpasses human intelligence in every possible aspect, and tends to infinity, given exponential returns. The prerequisite for its creation was the increase in computing power and memory of AGI; superintelligence sensors can record situations around the world, monitoring the environment, as well as activities, movements, and conditions of people. As noted by Th. Gros (2019), ASI is likely to be the future field of AI research, as it can both replicate human intelligence and manage much larger amounts of memory, providing faster data analysis and better decision-making capabilities. ASI capabilities are expected to replace human capabilities.

H. Dewi and Marsigit (2018) highlighted that creative thinking is the ability to generate a variety of new and original ideas. Creative thinking includes free thinking, flexibility, originality, and the ability to detail ideas and images. Y. Li (2020) believes that creativity involves the creation of new or original works of art, is characterised by “unpredictability”, repetition of previous behaviour, and the use of operations’ patterns is qualified as an everyday activity. It is one of the main advantages that define the human mind/brain, which enables emotional reinterpretation of reality and experience of aesthetic feelings.

W. Chen *et al.* (2020) noted that from the beginning of the 21st century, the stage of popularising the art of cognitive intelligence began. In 2016, Google’s AlphaGo, the world’s ninth-ranked Go AI, was beaten 4-1 in a landmark event. Modern IS systems actively implement mechanisms that enable perception, the ability to adaptively adjust parameters, and optimise models with changes in the environment, tasks, and input data, which leads to various effects. According to Y. Li (2020), although computer programs with artificial intelligence have the title of the world chess champion and can sift through masses of data and discover patterns, they lack standard creativity. According to Y. Trach (2021), artificial intelligence is making significant progress, as it currently can create psychedelic paintings, and use a photo retouching algorithm in real-time, and Microsoft Project for image creation has already been developed based on works of art. According to Intel Corporation, artificial intelligence has been used to create experimental film trailers, short film scripts, and music compositions.

W. Chen *et al.* (2020) and M. Klingemann (Quasimondo, 2020) mentioned the concept of CAN, which involves generating from GAN, but with an additional component that allows it to function “creatively”. Research in the field of improving already known mechanisms that could produce “creative” designs became a promising direction. Generative art is based on the analysis of large volumes of information. GAN algorithm is an approach for predicting generative models using competitive paths, which in combination train two different models: the first, the generative model, accepts the data distribution, and the second, the discriminative model, predicts the probability that the data sample will fall outside the already known set, as noted by M. Cheng (2022). Over the past few years, approaches to so-called “deep learning”, one of the most popular algorithms in AI, started producing impressive results by modelling the construction of neurons. In 2015, the University of Tübingen combined realistic images with artist styles, and in 2016, the neural network program Deep Dream, first developed by Google, was trained by inputting thousands of images to classify, select, and create new combinations, according to W. Chen *et al.* (2020).

Furthermore, W. Chen *et al.* (2020) noted that the Generative Adversarial Network (GAN) was designed to get computers to learn and imitate classic works of art throughout history. In 2017, a kind of creative program Creative Adversarial Networks (CAN) was created based on the original GAN system, which forces the computer

not just to emulate human activity, but to create works of art independently. The AIVA (Artificial Intelligence Virtual Artist) program, created in 2016, acts as an electronic composer, which can be used to generate instrumental music of various genres. The database of the program contains 30,000 scores of musical works converted into matrix form. A piece of music is created by searching for patterns, generating mathematical algorithms to follow a certain style and a holistic combination of all elements, the style can be chosen, tempo, duration, and instruments. The Endel app, created in 2018, helps users adjust soundscapes depending on their emotional state, in particular, to reduce stress, improve sleep quality or increase productivity.

COLLABORATIONS BETWEEN HUMANS AND ARTIFICIAL INTELLIGENCE

A neural network is a set of simple interconnected elements that collectively make up a system that operates

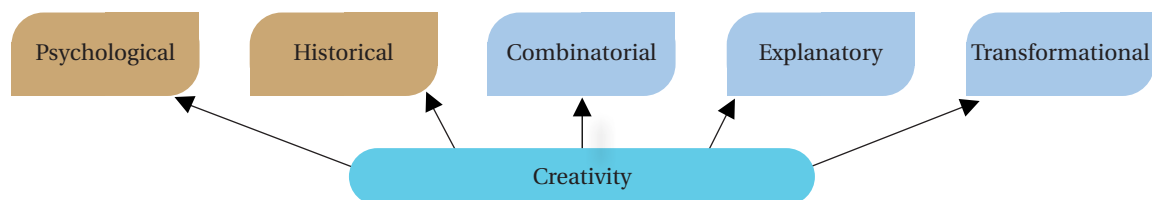


Figure 9. Types of Art

Source: compiled by the authors based on A. Chibalashvili (2021)

Following Y. Li's (2020), combinatorial creativity involves the creation of "unfamiliar combinations of familiar ideas", while machine learning offers a space of algorithmic styles for the implementation of new concepts, particularly important is the development of computer programs that could develop with experience. According to explanatory creativity, a machine implements a change in any of its programs or a set of data, learns and improves its performance in the future. Transformational creativity involves the generation of ideas from an abstract space, creating whole new ideas or concepts, never seen before (Fig. 9). The main mechanism for their initiation is imagination, that is, with the help of neural networks, completely new images are produced without network instructions (for example, the Deep-Dream program).

Regarding the possibility of creating art objects, in particular, a masterpiece, researchers follow several approaches. Y. Li's (2020) research demonstrates confidence that artificial intelligence systems have the potential to become "real artists" that would be able to use the human psychological potential process of creating art. M. Cheng (2022) believes that the art of artificial intelligence is artistic and creative, and with the development of technology, the line between considering AI as a tool or as an artist/creator is gradually blurring. According to V.R. Jakanovic (2022), in the future, AI systems will have social intelligence for understanding and modelling emotions, since systems that can understand human needs and predict their behaviour are already known at present, but a model with its mind has not yet been created. Some researchers believe that the creative results obtained using

similarly to a human brain. With its help, the works uploaded to the database can be analysed, recognise images, techniques, and signs of style, and then use the knowledge gained to create, for example, paintings. After processing a large amount of data, the neural network summarises it and concludes in various ways. However, a data analysis specialist sets the task for the algorithm. The neural network used to create the "Portrait of Edmond de Belamy" was trained on 15,000 portraits painted between the 14th and 20th centuries, according to A. Chibalashvili (2021).

Psychological creativity is characterised by the evolution of unpredictable ideas that are new to the individual who perceives them, regardless of whether they have been produced before. If the idea is completely new and no one has proposed it, then it becomes an example of a historical act of creativity. It follows that AI-generated pictures based on experience can be considered creative because they are a combination of unpredictable, previously unused forms (Fig. 9).

S&I cannot be considered entirely new objects, since they retain the forms and concepts embedded in the system, but are somewhat complicated, and more voluminous, as was mentioned by V. Tokareva (2020).

A. Chibalashvili (2021) considers several methods of involving AI in art. Imitation is based on the classic mimetic concept, that is, it involves an artistic reflection of the external world, most often consisting of reproducing stylistic features of the author or a certain stylistic direction. Artificial intelligence must develop mechanisms that carry aesthetic and practical value, satisfy the aesthetic and real needs of people, and integrate the concept of beauty and artistic style into products. AiArt has the general characteristics of traditional art: creativity, history, and aesthetics, but must also integrate the experience of synaesthesia, fluidity and variability, communication, and interaction, as well as penetration and integration. Following W. Chen *et al.* (2020), that traditional art uses perceptual (visual, auditory) property, and AiArt has a higher level of psychological experience. Viewers' thoughts and emotions about artworks are inexhaustible, incomplete, and superficial, while the experience of AiArt is full, comprehensive, and omnidirectional. The author notes fluidity and changeability of artificial intelligence when teaching creative skills, and considers interaction and communication to be advantages over traditional forms of art.

In the past, traditional artworks were usually kept in closed rooms, and the artist's thoughts and emotions were always hidden in the works, thus the meaning of the works of art was expressed passively and indirectly. The audience always had to keep a certain distance

to watch and empathise. The meaningful expression of AiArt has special advantages: the thoughts and emotions of creators can not only be directly expressed through computer vision, speech recognition and recognition technologies but also overcome the limitations of time and space to communicate with the audience through network and remote communication technologies. Penetration and integration AiArt are a complex cross-media art that not only integrates different elements such as sound, light, video, image, and text but also integrates the image by combining virtual and real spaces. Research on non-linear integration, which can globalise art, and ensure the active inclusion of new philosophical, religious, and cultural elements, is promising, as written by W. Chen *et al.* (2020).

R. Srinivasan and B.S.M. González (2022) noted that empathy is often defined as a person's ability to understand the worldview, and feelings of another person and not judge them, to be vulnerable, to predict the intentions of others. R. Srinivasan notes that, from the creation of AI companions that can detect and empathically respond to human emotions to conversational chatbots, there has been a significant effort in the field of artificial empathy. Recent achievements created AI systems that can identify emotions by voice properties in real-time regardless of language, a mechanism for increasing empathy through image manipulation and using driver data (facial expression, voice) to ensure comfort while driving is being developed. Education of empathy is carried out using social factors. To ensure this process, it is important to create and

apply new opportunities and requirements, and consider the subjective points of view of various interested parties, decisions should be made not only based on proxy data, but with the involvement of interested parties. The basis of the idea is the understanding of people's intentions, the ability to identify and reproduce affective states, intentions, and models of socialisation.

ARTIFICIAL INTELLIGENCE'S IMPACT ON CREATIVITY, PERCEPTION, AND EXPRESSION IN ART

Currently, AI can detect emotions by voice and face, analysing small changes that occur, but the question of recognising complex facial expressions remains open. The transfer of cognitive development processes from childhood to youth to primary school has become one of the promising directions of science. It is assumed that in the future, artificial intelligence will be able to have feelings. Since emotional and cognitive processes are closely intertwined, emotions based solely on cognitive processes may be inaccurately reproduced. Emotional AI carefully studies unfiltered facial expressions with the help of optical sensors or web cameras and describes them in real-time in an image or video. Computer-aided algorithms reveal key features in a person's face, and deep-learning algorithms analyse pixels in those areas to classify facial expressions. AI observes the tone and pitch of speech to explore emotions. The connection between emotional intelligence and crucial metrics in artificial intelligence is illustrated in Figure 10.

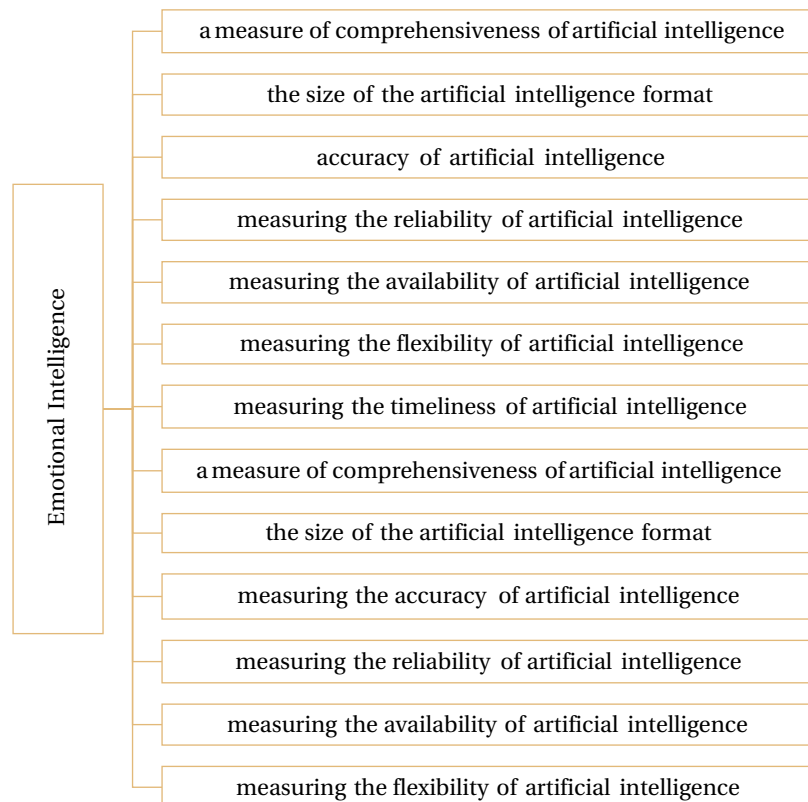


Figure 10. The interplay between emotional intelligence and key metrics in artificial intelligence

Source: compiled by the authors based on E. Kambur (2021)

The process of learning consists of obtaining data and formulating rules to create something new, the obtaining of knowledge also occurs through practical application and acquisition of experience. Rules, also called algorithms, help provide a sequence of instructions for performing a task using computing devices. AI demonstrates compliance with these criteria, and the ability to learn. Solving a problem may involve planning, that is, choosing the best of several possible alternatives to achieve goals. The process of perception involves selecting, receiving, interpreting, and ultimately analysing information. In humans, perception is supported by the sense organs, and perception mechanisms in AI combine sensor data to obtain the most effective result. The process of algorithm self-correction is necessary for continuous improvement of work and ensuring the most accurate results.

E.S. Mikalonytė and M. Kneer (2021) highlight the results of one of the studies conducted through the Amazon Mechanical Turk platform, which included 392 participants. Participants were shown a vignette in which either a human or an autonomous AI-controlled robot created an abstract painting. Under one condition, the agent decides to make a painting (intentionally), under another, he accidentally knocks over the paint, which spills onto the canvas (accidentally). As such, four conditions in total (2 types of agents: human vs. robot x types of behaviour: intentional vs. accidental) were demonstrated. During the experiments, three main questions were investigated: whether people consider the creation of robots to be art, whether they consider robots controlled by artificial intelligence to be artists, and whether they are willing to attribute mental states to them. First, in contrast to moral contexts and the general tendency to anthropomorphise robots, people are reluctant to ascribe desires, beliefs, and intentions to artificial agents in aesthetic contexts. Numerous studies on the psychology of art emphasise the importance of the creator's ideas in the artistic process. E.S. Mikalonytė and M. Kneer (2021) confirm that the intention of the artist is a major factor in the judgment of what is and what is not art. However, it was found that random works created without artistic intent are sometimes also considered art.

According to V.R. Jokanovic (2022), when studying AI systems, it is worth distinguishing reactive machines that work without functionality based on memory, and therefore are unable to correct their current actions based on their experience, they can study the environment and choose the best possible option but cannot "learn". Another obstacle on this path is the small amount of memory, which is why the possibilities of applying experience are limited. Chatbots, virtual assistants and self-driving vehicles can store short-term data, depending on the memory capacity of the application or device. Artificial intelligence systems need to store a large amount of data for a long time for training to solve current/future problems.

Y. Gong (2021) examined the application of the virtual reality learning method in the creation of digital media art. The experiment results show it is possible to combine the advantages of the AI algorithm this way. The use of virtual reality technology in the creation of digital media art contributes to the enrichment of means and the improvement of the quality of the process of artistic creation, allowing separating from the traditional concept and

achieving twice as good and faster results. N. Chen and W. Guoyi (2021) conducted a study on creating real-time music that reflects different moods with a single-chord sequence generator combination. Melody generation uses a new technique that combines vector optimisation, a search melody predictor, and the concept of emotional expression.

O. Allal-Chérif *et al.* (2021) believe that artificial intelligence improves the identification, selection, and retention of talents, considers the concept of electronic recruiting, which involves the identification of candidates in social networks, gamification and conducting interviews with chatbots, establishing the match between the candidate and the job. These technologies are particularly useful for social companies that seek to attract not only qualified people but above all, employees with behaviours and values that match the company's purpose. The method of analysing hierarchies and the model of performance analysis based on clustering, which involves the description, interpretation and evaluation of artistic works, were created to improve the effectiveness of artificial intelligence in teaching art, according to X. Fan and X. Zhong (2022).

At present, the main task of AI is to advance new mechanisms for learning, elevating the emotional intelligence of machines, and enhancing their awareness of the outcomes of their operation. This evolution involves integrating Artificial General Intelligence (AGI) algorithms into creative processes, acknowledging the pivotal role of creativity and imaginative prowess in the realm of art. As technology progresses, the intersection of AI and creative endeavours holds significant promise, sparking discussions about the extensive possibilities and prospects of artificial intelligence in shaping various facets of human expression and innovation.

CONCLUSIONS

The examination of the involvement of artificial intelligence in the creative process has enabled the formation of an understanding of the systems, mechanisms, and algorithms currently known and employed to enhance and optimize collaboration between humans and machines. This exploration also involves the delegation of specific creative functions to AI in the production of artistic objects. Theoretical research methods were used to compile the necessary sources by topic and to fully reveal the issue of AI introduction in creativity. The study demonstrates the main concepts related to the identification of art samples in the scientific space, provides arguments regarding the main theories and considers the practical application of different types of artificial intelligence (AGI, ANI, ASI) in traditional (mimetic, combinatorial) and modern (transformational) creativity (production of new ideas that have not been expressed before, new coverage of a known problem).

Having analysed the issue of emotional intelligence and internationality (the author's intention), it is possible to conclude that the present reproduction of emotions and feelings by machines occurs unconsciously, the process of learning cognitive and emotional mechanisms is gradually carried out but has not yet reached the required level. Therefore, it is quite difficult to consider art products of machines as art, but in the future, with the development of technology, it will become possible. It is also worth noting the social inconsistency between the perception of

objects created by humans and machines in the creative sphere: conducted studies show that a person can identify them as art, that is, anthropomorphise them, but is not yet ready to give them the ability to receive copyright protection and to define AI as a subject to copyright.

In practice, the study results can be used for further research related to the disclosure of the possibilities and prospects of artificial intelligence, the development of new mechanisms, algorithms, and schemes for creativity technology, the study of the author's intention, the structure of the author's idea, the process of artificial empathy and artistic training to use experience in the future, memorisation, analysis, and production of new ideas. The main scientific directions in the future may be an assessment

of technological prospects in terms of systems optimisation and models of social and economic development, the study of modern processes taking place in the cultural space, their reflection, frequency of use and features of adaptation in art objects, consideration of the creativity of artists who can apply artificial intelligence tools in the creative process to speed up work, to use technology in creation as efficiently as possible.

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CONFLICT OF INTEREST

None.

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Перспективні дослідження в галузі навчання штучного інтелекту творчим навичкам

Анотація. Актуальність дослідження визначається важливістю ретельного та глибокого вивчення методів, схем та моделей, що використовуються штучним інтелектом для механізації творчості в сучасних умовах активного технологічного розвитку. Метою статті є розуміння основних процесів, що відбуваються в сучасному мистецтві у зв'язку з активною технологізацією робочих процесів, виявлення провідних концепцій щодо можливості створення машинного мистецтва в майбутньому тощо. Методи дослідження – теоретичні, такі як аналіз, систематизація, узагальнення тощо, для вивчення ключових проблем та подальшого розвитку творчості на основі штучного інтелекту. У статті детально розглядаються основні розробки штучного загального інтелекту, штучного вузького інтелекту, зокрема досягнення генеративної змагальної мережі та креативної змагальної мережі. Мистецтво, створене штучним інтелектом, демонструє неабиякі можливості технологій. Розвиток штучного інтелекту в мистецтві запроваджує «цифрове мистецтво». Генеративні змагальні мережі слугують основним інструментом для художників, які використовують цифрові методи та генерацію текстур для створення унікальних композицій. Скульптори також співпрацюють з інструментами штучного інтелекту, перетворюючи малюнки на 3D-моделі або трансформуючи історичні мистецькі бази даних у скульптури. Творче мислення, відмінна риса людського інтелекту, досліджується через здатність штучного інтелекту генерувати нові та оригінальні ідеї. Розвиток емоційного інтелекту в штучному інтелекті дозволяє емпатично реагувати та ідентифікувати людські емоції за допомогою голосу та міміки. Обговорюються питання дозволеної інтернаціональності, усвідомлення творчого процесу, психологічні основи штучної емпатії та емоційного інтелекту, перспективи розвитку нейронауки. Залишаються виклики у визначенні творчості, авторства та правових аспектів у мистецтві, створеному штучним інтелектом. Матеріали статті можуть бути корисними для митців, викладачів мистецьких дисциплін, технологів та дослідників, які цікавляться перетином технологій та мистецтва, фахівців у галузі права (особливо права інтелектуальної власності), а також для осіб, які беруть участь у розробці штучного інтелекту

Ключові слова: мистецтво; творчий процес; креативність; машина; робот; емпатія; арт-об'єкт; технологія