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A cura di / Edited by
Stefano Brusaporci, Pamela Maiezza, Adriana Marra
Ilaria Trizio, Francesca Savini, Alessandra Tata

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Atti del IV Convegno Internazionale e Interdisciplinare su Immagini e Immaginazione

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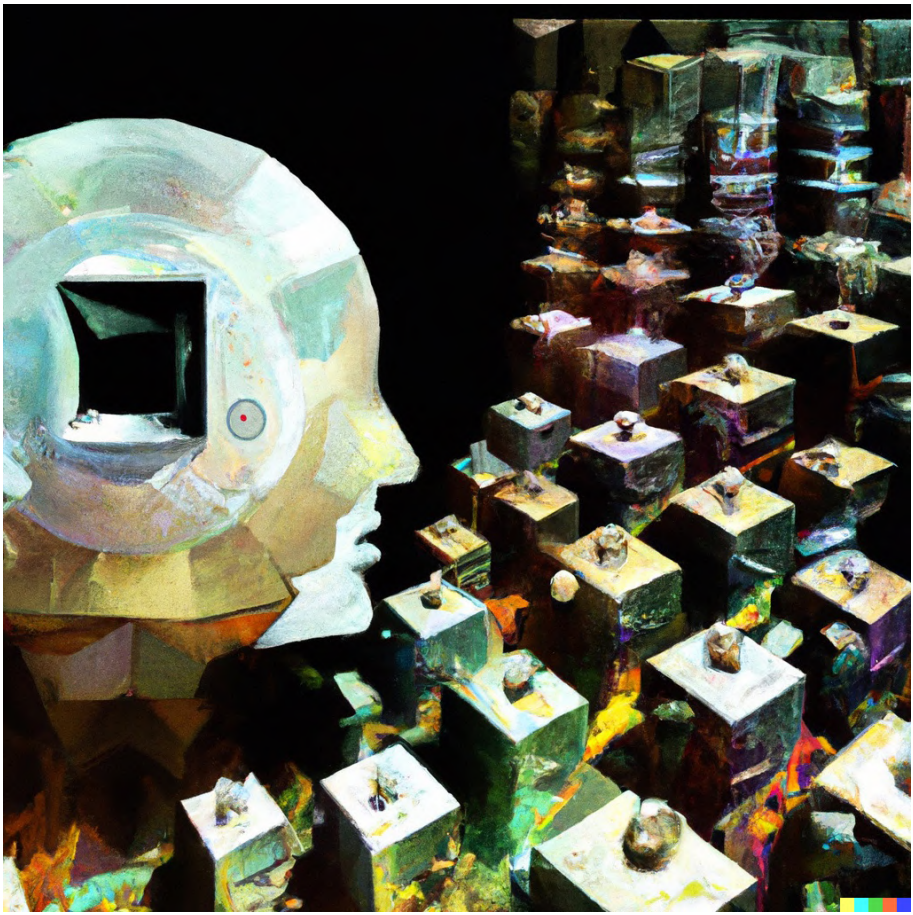


CHIARA PANCIROLI, PIER CESARE RIVOLTELLA

The Cooperation Human-Machine
Educating for Creativity in the AI Age

Abstract

This article's aim is to start a reflection on how creativity can be educated with AI. The starting point is the concept of creativity and the synthetic reconstruction of the history of its relationship with technology. On this basis, we go further analyzing the relationship between AI and creativity, before indicating a possible work path for education. The conclusions concern the role of the author and creative production.

Keywords

Artificial Intelligence in Education, Creativity, Human-AI co-creation, History of Technology, Data Literacy.

A DEFINITION OF CREATIVITY?

The debate on creativity is broad and crosses the different disciplines. Our goal is not to reproduce it, nor to provide an exhaustive definition of creativity, but only to point out some dimensions of it.
First of all, creativity has to do with non-standard use of language and thought. This means: from the point of view of semiotics, forcing and redefining the codes of a language (Maldonado, 1979); cognitively, thinking beyond boundaries and standards.
Second, creativity can be understood referring to the competence of heuristic problem solving. This is the name given to the ability to seek unknown solutions to unknown problems, while our usual way of solving problems - procedural problem solving - consists in applying known solutions to known problems. This difference, as well as being investigated by cognitive psychology, is confirmed by neuroscientific evidences on decision making (Goldberg, 2009).
Finally, it is possible to highlight the close relationship between creativity and some more specific skills. To be creative is being able to perceive what is essential in one's field of experience. To do this, it is necessary to eliminate what is found in excess and which would not allow us to grasp unexpected relationships between the different elements (Berthoz, 2009/2012), or to inhibit what our brain has fixed in routines thanks to the repetition of its experiences (Houdé, 2017).
To do this, means using analogical thinking (Hofstadter & Sander, 2013). And this depends on two more elements: vicariance, that is, precisely on the basis of the analogy, knowing how to use something at the place of something else (Berthoz, 2020); and cognitive transfer, i.e. the ability to import/export concepts and/or constructs from one context of action or thought to another one (Berthoz, 2013/2017).

CREATIVITY AND DIGITAL TECHNOLOGY: A THREE STAGES HISTORY

According to what we said, if we consider technology as a language, then it can be thought as a medium and space for and of creativity, particularly in the case of digital technology. Let's see how this relationship between creativity and digital technology was developed.
The first stage is at the beginning of the digital revolution (late 50s / mid 60s). In those years Vannevar Bush invented the Memex, the "grandfather" of hypertexts and of the Internet. Doug Engelbart (1962), just thinking of Bush's invention, talked about a machine that «would allow the use of a new text composition process (...). New ideas could be integrated more easily and thus continuously harness creativity (...). All this will probably make it possible to develop and use even more complex procedures to put one's talents to use...». Digital technology is used for augmenting creativity.
The second stage is centered on the use of computers to support creation. This allowed the first experiments in the field of computer graphics, animation and artistic works (late 60s / early 80s'). The emphasis is clearly on process and product. We can think, for instance, to Brian Eno and Benoit Mandelbrot who use algorithmic and generative principles to make music (Eno) or to produce images of fractals (Mandelbrot). This is the period of computational creativity (or creative computation).
In the third and final stage (since the 80s to now) we pass from first generation systems (Autocad, Photoshop, Word), which imitate analogic tools with digital methods, to second generation systems, in which humans and machines negotiate together the creation process. The final outcome are third generation systems, thanks to which the creative process results from a conversation between machine and human. Control and decisions are made in cooperation with the system itself. The most meaningful impact lies in freeing up time and energy to deal with higher levels of creative outputs. This is the stage of assisted creation.

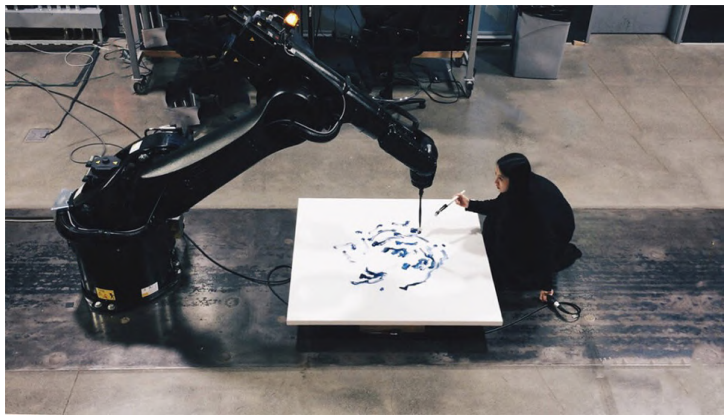
Fig. 1 - The development of interaction between technology and human creativity.

Stages	Years	Technology role
Augmented creativity	Late 50s / mid 60s	Creativity empowement
Computational creativity	Late 69s / early 80s	Creativity support
Assisted creation	Since the 80s to now	Cooperation with human

THINKING ABOUT HUMAN-AI COOPERATION: PRODUCTS AND PROCESSES

There is a close relationship between creativity and cognitive skills, including the development of human divergent thinking in collaboration with machines. We've already mentioned in the first paragraph some of these cognitive skills.
Boden (1998) already tried to synthesize these skills by recognizing 3 ways into which creativity can express itself:
(1) the new combination of familiar ideas;
(2) the exploration of new conceptual spaces;
(3) the development of transformations favoring the generation of ideas otherwise impossible to develop.
Recently she tried to more specifically analyze the contribution of AI to creativity (Boden, 2018; 25). Her hypothesis for the future - however still far from being possible to be realized - is an AGI (Artificial General Intelligence) referring to an interaction among the body (located "here and now" and continuously open to stimuli and perceptions), the mind and the machine. But nowadays, what kind of contribution AI could give to creativity, especially in terms of cooperation?
Cropley & Knappler (2021) suggest that two factors are particularly important in human-machine collaboration: the process and the product.
Creative products are measured in relation to their novelty and effectiveness (Cropley & Kaufman, 2012), where novelty refers to an original idea and effectiveness is the product's ability to achieve the expected result. In recent years, studies on creative product evaluation using AI-based methodologies are emerging. In this regard Cropley & Marrone (2022) demonstrated how AI can evaluate creative solutions using convolutional neural networks. Beaty and Johnson (2021) and Olson et alii (2021) also demonstrate the use of latent semantic analysis to evaluate student responses in terms of creativity understood as a cognitive activity, alternative to the traditional one.
The process, still not so well explored, is defined on the basis of the cognitive mechanisms involved in developing new and effective solutions to problems in which the creative effort arising from the collaboration between AI and human has an increasingly important role.
For instance, we can think of a case of creative process in the artistic field; here we have a robotic arm, trained on artificial neural networks through machine learning techniques, able to detect the artist's recurring patterns; this happens not through making copies of the artist's memorized drawings, but generating synchronous interpretations. In this way, the preset initial data is extended and modified precisely through the interaction and cooperation between the machine and the artist.
Another case is the use of Chat-GPT. In this case a user puts in the software's prompt a first request; GPT gives its response back; the user, starting from it, and collaborating once more with Chat-GPT, puts in the prompt another request; GPT gives one more response back. It could be possible to go on in this conversational activity and it is clear that the user and the machine are really collaborating, suggesting one another creative solutions for going further with their creation.

Fig. 2 - Sougwen Chung's painter robots.



HUMAN-AI CO-CREATION: NEW CHALLENGES FOR CREATIVITY EDUCATION

Educating creativity means teaching people to think with style (Bozzetti, 2011). This does not only mean acquiring the ability to reason with elegance - without redundancy, arguing consequentially, practicing brevitas - but also to do that in a critical and original way. Precisely these two characteristics of the style of thinking - the critical attitude and originality - are difficult to be practiced today.
The critical attitude collides with the huge mass of data: it is a question of control. This data grows on itself at great speed and deprives man of the possibility not so much of being able to manage them (it should be impossible!), but even of producing an approximate map of them. Added to this, there are problems of little or no transparency (the algorithms cannot be seen, it is not sure what kind of use will be made of our data) and always, in the history of Media Literacy, the opacity of a text or a information has been a problem precisely in relation to the possibility of its critical review.
Even originality encounters problems, and above all originality is the trait of thinking with style that affects creativity. The development of consumer computing has sacrificed the transparency of interfaces for their usability. This meant allowing the user to access applications without necessarily knowing their syntax. The use of scripts and style sheets serves this purpose: asking the user to limit himself to inserting content, then letting the application do the rest. The result is that formats can be chosen among a limited number of options, the same for any user: the age of access and usability is also the age of conformity and lack of originality (Lanier, 2010; Toschi, 2011).
In this regard, does the diffusion of AI represent an opportunity, or just another possibility to give up originality, delegating the "creative" work to the machine? Does AI represent the end of human creativity, or conversely a space for its expression? And if so, how is it possible to develop creativity with AI?
The hypothesis we make is based on cooperation and conversation between human and machine and assumes the Human-AI co-creation model as a reference framework (Wu et al., 2021).
The steps of the creative process, in reality, are not 6 but 5, perhaps 3: collaboration, in fact, more than a step of the process, can be considered the meta-logic that underlies it; production and testing, on the other hand, have little interest in the creative moment strictly considered, but AI certainly lowers costs and optimizes yield.
When we try to refine our requests in the DALL-E prompt to generate an image, the feedback we get from the machine helps us to formulate better, change perspective, evaluate the output and understand

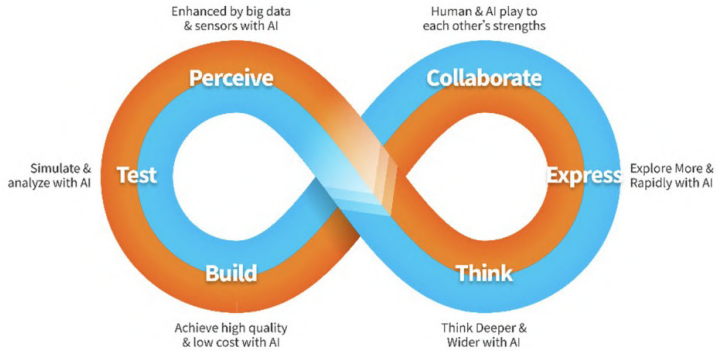


Fig. 3 - The Human-AI co-creation model (Wu et al., 2021, p. 177).

what our request needs to be improved. We can do the same consideration when we use Chat GPT to generate a text. It is true that our intentionality is fundamental, but without the co-authorship of the machine it would not be enough for us.
Based on this awareness, we see how this collaboration takes shape in the 3 steps that we consider crucial in the experience of the creative process.
Perception - As Manovich (2021) has recently shown very well, one of the great pluses of AI is the possibility of making a huge mass of data available, together with the possibility of its visualization. It is precisely visualization that supports and orientates the perceptive process by providing an overview, favoring patternization and, thanks to this, allowing a better understanding of the relationships between phenomena or objects.
Thinking - Processing of huge masses of data and visualization also helps thinking to gain depth, working analogically and using cognitive transfer. Unexpected relationships can be grasped, above all the inhibition of habitual mental patterns can be encouraged by freeing up the opportunity to «think against oneself» (Houdé, 2017).
Expression - The moment of expression, which especially in artistic activity usually requires time and technical skills, can be carried out in compressed times, easily and in many ways without having the technical skills for doing this. In this way, creativity is favored over executive ability.

CONCLUSIONS: RETHINKING AUTHORSHIP AND CREATIVE ACTIVITY

What can be concluded at the end of our analysis is the finding of two provocative research hypotheses.
The first one is that creativity in the case of human-AI cooperation confronts us with a case of authorship without an author. Who is the real author of a text, an image, a video, created in collaboration with a generative AI application? The AI, the human, neither, both? And how do you redefine the concept of author and authorial inscription? Barilli (1979; p. 103) already suggested several years ago, thinking of the art of those years, to consider the artist as «an animator, a trainer of the aesthetic surface of the community», or, recalling the last McLuhan, to imagine that he could be thought as «a masseur of the common sensorium». Taking his cue, one could say that today a creative person can be considered as a coach of AI, an animator of human thought and expression.
The second hypothesis is that we are faced with a case of creativity without manual skills. The result of human-machine cooperation are

"synchronic works" (Dorfles, 1979), soft works made of bits which are the result of the creative work carried out thanks to new tools (the applications of generative AI) without technical skills other than those related to mastery of languages: more than knowing how to do something, it is important to know how to tell the machine what to do.

CREDITS

The Authors share the idea of the article, the research path, the structure and settings of the single paragraphs. Chiara Panciroli wrote paragraphs *Creativity and digital technology: a three stages history* and *Thinking about Human-AI cooperation: products and processes*, Pier Cesare Rivoltella paragraphs *A definition of creativity?* and *Human-AI co-creation: new challenges for Creativity Education*. The two Authors wrote together the paragraph *Conclusions: rethinking authorship and creative activity*. Each part of the article was reviewed by the two authors.

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Cover figure - Creating artificial worlds. DALL-E generated image.