Chapter 7
Artificial Intelligence and Creativity

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Abstract Collaboration can increase creativity when the interactions are supportive and facilitative. In the real world this could be a group discussion or a collaboration on a particular artwork or project. The computer is increasingly in the loop on these collaborations because it can bring together both local and distant collaborators. In addition, the artwork or project can be displayed on computer screens and the partners can discuss it and work together in real-time. The computer program may also be able to make suggestions to the partners about design options, just as spell-checkers can make suggestions to authors about the grammar and spelling in an article or paper they are writing. The software works in the background and can add value to the overall process of creation, whether this is for a document or an artwork. In this case, the software is working according to pre-determined rules. If the program is allowed to modify itself by taking in input from its own processes, then the rules may change as the program is running. This may be useful in some situations but not in others. The increasing use of artificial intelligence techniques in science, technology, and the arts is reviewed and assessed, and the implications for creativity are presented.

Keywords Artificial intelligence and creativity · Computational creativity

7.1 Enhancing Creativity

An art exhibition is a place where audiences meet works of art that are themselves a form of exposition. In the past, such exhibitions have been static and for a particular time-period and therefore had to be viewed by visitors within that time frame. They have also been mainly works of art such as pictures and drawings, sculptures, or installation art which contained various object components. For groups of people who have common interests, but no opportunity to meet due to geographical separation, online collaboration can provide new opportunities and new environments for sharing and creating. Art galleries are able to move from static displays fixed in time and space to more flexible virtual environments capable of attracting visitors on a global basis. They can also receive input from visitors from their interaction with the displays. This can provide feedback to the artists which could be useful in the creation of future

S. Liggett et al., *Creativity in Art, Design and Technology*, Springer Series on Cultural Computing, https://doi.org/10.1007/978-3-031-24869-6_7

works. In addition, online interaction can provide the context for the development of collaborative art works and interactive exhibits.

Liggett et al. [1] and Earnshaw et al. [2] detail projects which bring together artists, scientists, and social media in collaborative processes. It has been demonstrated that these collaborations deliver added value to all participants and enable research and development to proceed at a faster pace.

Enhancing creativity may be accomplished by

- Increasing the diversity of the participants
- Providing anonymity
- Providing creativity triggers through illustrations of tangible products:
  - Prototype
  - Simulation
  - Storyboards
  - Mockups
  - Graphical presentations

Carroll [3] explores whether and how creativity and rationale can have mutually facilitative interactions. Designs usually serve a particular purpose and conform to certain expectations and norms. Designs often open up new issues, raise new questions, and produce new understandings of esthetics. However, this can also create tension in contexts where creativity produces a significant departure from the status quo, and where the effect on those who observe the design may be unpredictable.

7.2 Case Study—Ars Electronica

Ars Electronica is an Austrian cultural, educational and scientific institute active in the field of new media and has a focus on the relationship between art, technology and society. It runs an annual festival, and manages a multidisciplinary media arts R&D facility known as the Futurelab that is guided by the question of what new technologies mean for our lives. Together with artists, scientists, developers, designers, entrepreneurs and activists, explore current developments in the digital society and speculate about their manifestations in the future. The key question is "not what technology can or will be able to do, but always what it should do for us" [4]. Ars Elecronica has a focus of our artistic research and its European ARTificial Intelligence Lab (AI Lab) has Residency program with #Residency 7 awarded to Anna Ridler (GB) and Caroline Sinders (US) for their project 'AI isn't Artificial but Human' in partnership with the Edinburgh International Festival.

Anna Ridler is a UK based artist and researcher who was listed in 2018 by Artnet as one of nine "pioneering artists" exploring AI's creative potential. She is interested in working with collections of information, particularly self-generated data sets, to create new and unusual narratives in a variety of mediums, and what happens when things cannot fit into discrete categories. She is currently interested in the intersection

of machine learning and nature and what we can learn from history. Her artwork "Mosaic Virus" is a video work produced by an artificial intelligence and shows a flowering tulip whose appearance is controlled by the price of a Bitcoin. In this piece, the stripes and colors depend on the value of the Bitcoin and change over time to show how the market fluctuates, and also draw historical parallels from the "tulip mania" that swept across the Netherlands in the 1630s to the current speculation on crypto-currencies. A major part of the project was to create a dataset of 10,000 tulips, all categorized by hand to reveal the human aspect behind machine learning [5].

Caroline Sinders is a US machine learning artist and researcher whose work explores the intersections between natural language processing, artificial intelligence, abuse, online harassment, and politics in digital, conversational spaces. Caroline Sinders's artwork. "Feminist Data Set" (Fig. 7.1) investigates what it means to think through machine learning, to examine every step of the process through a feminist lens, carefully considering every aspect of production, iteration and design. The project carried out data collection in educational and community-based workshops which was then developed to create a feminist data labeling and training system and a data labeling product [6].

"The Feminist Data Set" is an artistic and critical design multi-year project that queries each step of the AI process. It includes

Fig. 7.1 Caroline Sinders, *Feminist Data Set*, collected at SOHO20. Copyright © Caroline Sinders, photographer: Rachel Steinberg (2018) reproduced with permissions

> data collection, data labeling, data training, selection of an algorithm to be used, the algorithmic model, and then the design of how the model is placed in a chat bot (and what the chat bot looks like). Each step exists to challenge and analyse the pipeline of machine learning – is each step feminist, is it intersectional, does each step have a bias and how can this bias be removed? [7].

Sinders found that it evident that the required tool, namely a feminist intervention, does not yet exist and therefore needs to be created and the final result of the project once complete will be a feminist chat bot [5].

"*There is so much that we do not yet see, so much that is still hidden; no one really knows where the digital revolution will take us*" Hannes Leopoldseder (1940–2021), co-founder of Ars Electronica [8].

7.3 Computational Creativity

Defining the process of analysis to enable it to be done automatically by a computer requires the definition of the key parameters. The use of Artificial Intelligence (AI) techniques may provide a degree of augmentation of human capability and present new options and possibilities not conceived of initially by the human mind. This raises the question of in what sense could a machine be described as having creativity? In what sense would this relate to human creativity? If one of the objectives of Google's acquisition of DeepMind in 2014 was to improve the capability of machines to be able to think more like humans, then it will be interesting to see how far computers are able to produce creative solutions to current challenges and problems in order to go beyond what humans are currently able to do [9]. Clearly one of the advantages is direct access to the world's information in Google's databases in forms other than searching for a match to a query. Knowing the right question to ask is often a large part of the problem space. If the question is not known in advance, can new applications of Google's databases provide new and innovative ideas derived from the current information that has been collected and stored? The issue of whether machines could surpass the capabilities of humans is an ongoing debate [10].

Boden proposes [11] that AI techniques can be used to create new ideas in three ways as follows:

1. By producing novel combinations of familiar ideas
2. By exploring the potential of conceptual spaces
3. By making transformations that enable the generation of previously impossible ideas.

In addition, models of AI and creativity and their applications, can offer insights into creativity itself. This is similar to the ways in which computer-assisted learning has provided new insights into human learning by acting as a reflector back to the human. It may be regarded as a by-product of the fundamental aim of a computer-directed process, which could be seen as a way to perform a process faster, more economically, or with greater efficiency and effectiveness. In addition, this learning

process can also be more personalized and adapted to the particular needs and requirements of the individual. By analogy, a computer-directed creative process can be tuned to a particular individual circumstance. From this comparison it can be seen that there is significant potential in exploring how AI can assist the creative process, and in some cases modify it to produce a new and unexpected outcome, or set of outcomes (the third in Boden's three ways listed above).

Computer-assisted creativity usually involves implementing a set of rules or procedures which a human would follow if the process were to be done manually. This offers the advantage of speed and efficiency in generating outcomes. However, it also offers the possibility of amending the rules and observing what changes in the outcome(s) are produced. This can be extended further to the interactive modification of the rules in real-time in order to generate a series of possible outcomes, from which an optimum outcome may be selected. However, the real gains can come when the rules are much more flexible, and the computer is allowed to modify the rules internally. In this case, the user may define a possible starting point and the computer is then free to generate further points, and also new rules which the user may not have thought of beforehand.

Bostrom [12] raises concerns about the prospect of 'superintelligence' and what its implications might be for human society as a whole if there are insufficient controls on initial conditions and potential outcomes.

7.4 Case Study—Deep Mind Technologies Developments

Deep Mind's objective is to produce general-purpose learning algorithms using machine learning and systems neuroscience. Such algorithms can be utilized in a wide variety of applications unlike earlier chess playing programs (such as IBM's Deep Blue) which were tailored to a particular environment and to achieving a predefined goal. These new algorithms were tested in a variety of applications involving games, where clearly human creativity plays a role. Game play is a complex test-bed which is able to evaluate the power of the algorithms. This is because one move at a particular point on the game can have far-reaching implications subsequently. This raises the issue of the optimum move now for the best of a set of possible outcomes in the future. How can a new move be arrived at that has not been played before? This kind of "out-of-the-box" thinking could characterize a human making this move. Can the algorithm improve on this for a wide range of possible moves? The game may have well-defined rules but if the player is in a new situation they have not seen before, what move do they make when they do not intuitively know the outcome? An algorithm that can learn how to play the game faster and better than a human will be likely to make better decisions when in a new situation.

Deep Mind's AlphaGo program was better than the world champion human professional Go player in 2016 [13]. Another program, AlphaZero, was superior to the best programs playing go, chess, and shogi after a short period of learning the games [14]. In science, Deep Mind has made considerable progress in addressing the difficult problem of protein folding [15].

7.5 Conclusions

Factors affecting the digital future include the increasing use of artificial intelligence techniques to handle routine transactions or information requests, as well as new applications and objects; immersive and augmented reality interfaces, and advanced analytic techniques. All these are likely to generate further developments and applications in the digital world and offer opportunity for participation and change.

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